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Funding Constraints and Commercial Real Estate Pricing Spirals

by

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Abstract:

This paper examines the relation between the availability of credit (funding liquidity), market liquidity and asset price movements in both private and public commercial real estate markets. Given the relative illiquidity and significant use of leverage in acquisitions within commercial real estate markets, theory predicts that funding constraints are likely to play a significant role in asset price determination. Using vector autoregressive models to capture the short-run dynamics between fluctuations in credit availability and price changes, we find that a tightening in credit availability is negatively related to subsequent price movements in both the private property and public REIT markets, consistent with significant leverage effects. Consistent with the theoretical predictions of Brunnermeier and Pedersen (2009) and Geanakoplos (2003), we also find that assets trading in illiquid segments of the commercial real estate market are highly susceptible to a spiral effect, in which changes in asset prices lead to further changes in the availability of credit. In particular, we document a feedback effect of lagged price changes on subsequent capital availability in the private commercial real estate market, the lowest liquidity quartiles of the public commercial real estate market, and the relatively illiquid market for REIT preferred shares. These results suggest that while leverage is a key factor in determining credit market availability pricing effects, the underlying liquidity with which these assets trade is a key factor in determining the likelihood of an asset pricing spiral -- with lower liquidity creating the market setting for a spiral effect.

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I. Introduction

In response to the latest credit crunch, a branch of theoretical literature focusing on the relation between asset prices, market liquidity, and the availability of debt financing has garnered increased attention (e.g., Geanakoplos, 2003; Garleanu and Pedersen, 2007; Longstaff and Wang, 2008; Brunnermeier and Pedersen 2009). Moreover, a number of recent empirical papers testing these theories have emerged, including studies examining how changes in capital availability impact bank balance sheets (Adrian and Shin, 2010), hedge fund performance (Dudley and Nimalendran, 2010; Boyson, Stahel, and Stulz, 2010), and market liquidity in the general stock market (Hameed, Wang, and Viswanathan, 2010). Overall, these studies find that funding constraints significantly affect asset values at times when public markets are relatively illiquid or when assets are highly leveraged.

These recent empirical papers focus on brief periods of illiquidity and credit tightening in relatively liquid markets. However, no prior literature has tested the dynamic relation between the availability of debt financing on asset prices in markets that are illiquid and composed of highly leveraged assets, such as the private commercial real estate market. The relative illiquidity and significant use of leverage in this market setting allows one to better isolate and measure the impact of credit market availability on asset prices in both periods of credit easing and tightening. Furthermore, no prior research has tested the relative impact of changes in capital availability on assets with claims on similar cash flows that are traded in markets with different liquidity. However, tests using a parallel market with varying degrees of liquidity create a clearer picture of the interaction between credit availability, liquidity, and asset price movements.

In this paper we test the relation between changes in the availability of credit (funding liquidity), market liquidity, and asset prices in both private and public commercial real estate markets. We first examine the time-varying relation between changes in credit availability and market liquidity. We simultaneously test the conditional short-run impact of changes in credit availability on asset prices in both private and public markets. We then test whether changes in asset prices reinforce changes in the availability of credit, creating a spiral.

The commercial real estate market provides an appealing testing ground for examining the dynamic relation between credit availability, market liquidity, and changes in asset prices. First, the private commercial real estate market is a relatively illiquid

market consisting of highly leveraged assets.[1] Therefore, we would expect asset prices in this market to be relatively sensitive to changes in credit availability not only when credit conditions are tightened, but also when lending standards are eased. Second, unlike other private markets, several representative price return indices for private commercial real estate are available, permitting us to calculate time-weighted price returns that can be compared directly to corresponding price changes in public real estate markets. Third, the underlying properties held by the publicly traded real estate firms we analyze are similar to the property holdings of the institutional real estate investors whose private market returns we also track. Controlling for the equity characteristic embedded in public real estate market returns, disparities in the impact of funding liquidity on price changes in private and public real estate markets can be ascribed to differences in the liquidity characteristics of these two markets.

Using vector autoregressive (VAR) models, we address two questions. First, do changes in credit availability affect asset price returns over and above the impact of other fundamental control variables? When investors find it difficult to obtain credit for acquisitions or refinancing, market liquidity decreases, which, in turn, puts downward pressure on prices. Similarly, when access to credit is eased, an increase in the use of leverage for acquisitions will put upward pressure on asset prices. Therefore, we test whether changes in credit availability, after controlling for the impact of market liquidity, impact asset prices. Second, do price changes affect changes in future credit availability over and above the impact of other fundamental control variables? As prices fall in an illiquid market, for instance, the risk of financing an additional transaction rises and credit markets tighten further. Likewise, as asset prices increase, lenders may further ease credit standards to take advantage of this timely profit opportunity. Therefore, we also test the hypothesis that subsequent price changes will lead to further changes in credit availability for assets that are traded in relatively illiquid markets.

We find that credit availability is a significant determinant of subsequent price movements in both private and public commercial real estate markets, consistent with significant leverage effects in these markets. In particular, a tightening (easing) in bank lending standards is negatively (positively) related to subsequent price movements in both

[1] As a conservative estimate of leverage, the American Council of Life Insurers reports that the average loan-to-value ratio on commercial real estate properties was approximately 68% over the period 1992Q2-2008Q4.

the private property and public REIT markets, even after controlling for the impact of market liquidity and other fundamentals. These results suggest that leverage is a key factor in determining credit market effects on pricing. We also find evidence of a spiral effect, in which changes in price movements reinforce future changes in capital availability, concentrated within relatively illiquid segments of the commercial real estate market. This result is consistent with the theoretical predictions of Brunnermeier and Pedersen (2009) and Geanakoplos (2003). In particular, we document a feedback effect of lagged price changes on subsequent capital availability in the private commercial real estate market, the lowest liquidity quartiles of the public commercial real estate market, and the relatively illiquid market for REIT preferred shares. These results suggest that while leverage is a key factor in determining credit market availability pricing effects, the underlying liquidity with which these assets trade is a key factor in determining the likelihood of an asset pricing spiral -- with lower liquidity creating the market setting for a spiral effect.

Anecdotal evidence and recent theoretical work by Shleifer and Vishny (2010) also suggest that investor sentiment plays a role in credit market effects. With this anecdotal evidence and theoretical motivation in mind, as an additional robustness check we also include a proxy for investor sentiment as a fourth endogenous variable in our specifications. While all of our previous results remain robust, we also find that changes in investor sentiment affect future credit availability, consistent with Shleifer and Vishny (2010). We further find some weak evidence of a feedback effect between changes in credit availability and future changes in investor sentiment. Our results suggest banks respond to increasing investor sentiment by easing their credit standards, thereby making credit more readily available to potential investors when they are most optimistic. However, during a market downturn in which investors are becoming increasingly pessimistic, banks tend to tighten their lending standards, which can have a destabilizing effect on asset prices. This raises an interesting policy implication pertaining to the extent to which lenders have the ability to reduce the probability that an asset pricing bubble emerges by restricting the amount of credit they provide during boom periods or ease the severity of a downturn by making credit available when distressed assets are undervalued.

The remainder of the article proceeds as follows. The next section discusses background literature examining the roles of credit availability and market liquidity in asset pricing as motivation for the tests performed in this paper. Section III describes our VAR methodology. We discuss our data and descriptive statistics in Section IV. Section V

reports our main empirical results for our short-run VARs. Our conclusions are presented in the final section.

II. Background Literature and Research Test Development

Recent theoretical work in the asset pricing literature makes an important distinction between two types of liquidity: market liquidity and funding liquidity (Brunnermeier and Pedersen, 2009; Brunnermeier, 2009). Market liquidity refers to the ease with which an investor can find another party to take the opposite side of a transaction. Funding liquidity refers to the ease with which an investor can obtain capital from a financier. In an efficient market, asset price movements should be invariant to changes in credit availability when markets are relatively liquid. Any deviations in price that result from a temporary capital availability shock should be quickly arbitraged away (Fama, 1970). However, arbitrageurs may at times face funding constraints and be unable to provide market liquidity when it is needed the most (Shleifer and Vishny, 1997). When funding constraints are so severe that investors can no longer maintain their existing positions, asset values drop significantly and markets become illiquid, as was evident in the Long Term Capital Management (LTCM) crisis of 1998. Recent developments in financial markets further suggest that shocks to market conditions can be severe enough to cause market liquidity to fluctuate significantly over time.

Brunnermeier and Pedersen (2009) establish a theoretical basis for the endogenous variation of market conditions and funding requirements. In particular, they focus on the relation between funding constraints and asset pricing, the amplifying effects of their interaction, and differences in these impacts across high- and low-leverage securities during periods of market illiquidity. When credit availability is tight, traders become reluctant to take on positions, especially 'capital intensive' positions in highly leveraged assets. This lack of credit availability lowers market liquidity. Under certain conditions, decreased market liquidity increases the risk of financing an acquisition, thus further tightening the availability of funds for investment. When financing constraints are tightened in periods of market illiquidity, the effect may be destabilizing and lead to a liquidity spiral. If financing constraints continue to be tightened as asset prices fall, investors may be forced to de-lever their position by selling assets into an illiquid market. In short, declining asset prices and tighter funding constraints may reinforce one another causing a spiral to ensue. Therefore, when asset markets are illiquid, prices may be driven

more by changes in the availability of capital than by movements in fundamentals in the short-run.

Geanakoplos (2003) presents a similar collateral based theory of pricing spirals. When investors can readily obtain capital to purchase or refinance an asset, optimistic investors are able to hold a larger fraction of the capital stock than they otherwise would be able to. Geanakoplos (2003) calls these optimistic investors "natural buyers." Using large amounts of leverage, these optimistic buyers tend to push up prices to levels that exceed fundamental values. These price increases, in turn, increase the confidence and risk tolerance of lenders, thereby fueling a relaxation of underwriting standards. This increased availability of capital may put additional upward pressure on asset prices, further increasing the confidence of lenders. Said differently, access to leverage is pro-cyclical. However, if a negative credit shock occurs that increases lender uncertainty (for example, the bankruptcy of Lehman Brothers in 2008), lenders may tighten underwriting standards in response. This tightening in credit markets may, in turn, force highly leveraged optimists to de-lever their current positions and use less leverage on new acquisitions, thereby putting downward pressure on prices. Since it is now harder to borrow money, optimistic buyers are less able to obtain financing for investment. This, in turn, causes asset markets to become less liquid and the proportion of "natural buyers" in the market to decrease. This decrease in market liquidity puts downward pressure on prices and further increases the risk of providing financing. Therefore, asset prices will be sensitive to changes in the availability of credit in markets in which transactions are highly leveraged.

Previous empirical research has examined the role of market liquidity in asset pricing. Amihud (2002) finds that aggregate market illiquidity is an important factor in determining a firm's expected returns. Furthermore, Pastor and Stambaugh (2003) provide evidence that a firm's sensitivity to fluctuations in market liquidity (i.e., its liquidity beta) is a significant state variable in asset pricing. However, few empirical analyses have tested the interaction between market liquidity, lending constraints, and asset prices. Hameed, Kang, and Viswanathan (2010) find that periods of significant negative stock market returns cause market liquidity to decrease, particularly during times in which funding constraints are tight. Dudley and Nimalendran (2010) provide evidence that returns on leveraged hedge funds are highly sensitive to changes in funding risk, especially during periods of market illiquidity. Finally, Adrian and Shin (2010) find that the amount of

leverage carried on bank balance sheets is sensitive to asset price movements of the underlying collateral, especially during a financial market downturn.

Overall, the extant theoretical literature predicts that the sensitivity of market liquidity and asset prices to the availability of funds for investment is most pronounced for assets that are illiquid and highly leveraged. However, no research to date has tested the dynamic relation between the availability of credit and asset pricing for highly leveraged assets that trade consistently in relatively illiquid markets. By testing the impact of changes in funding constraints on asset prices within the relatively illiquid and highly leveraged private commercial real estate market, our study provides an experimental setting that allows one to better isolate and measure the potential impact of credit market availability on asset prices in both periods of credit easing and tightening – providing a unique contribution to the literature.

We further extend our contribution by measuring the relative impact of credit availability on prices of similar assets traded in markets with different liquidity. Tests using a parallel market with varying degrees of liquidity create a clearer picture of the interaction between credit availability, liquidity, and asset price movements. Prior empirical research has shown that differences in market liquidity can lead to discrepancies in prices of economically equivalent assets traded in different markets. For example, Froot and Dabora (1999) find that pairs of large companies ("Siamese twins") that trade around the world are priced differently because of differences in trading environments. Similarly, Chan, Hong, and Subrahmanyam (2008) show that market liquidity is an important determinant of the price difference between ADRs (American Depository Receipts) and their underlying shares. However, no prior research has examined the role of funding liquidity within this context. Using relatively liquid REIT common shares, liquidity and leverage sorted REIT portfolios, and the relatively illiquid market for REIT preferred shares, we examine the relative effects of changes in funding constraints on the prices of similar assets traded in markets with varying liquidity. This framework also allows us to test whether the relative likelihood of a spiral effect is dependent on the underlying market liquidity with which these assets trade.

Anecdotal evidence also suggests the expansion of credit availability during the real estate boom of the early-to-mid 2000s was in part driven by the response of creditors to increasing investor optimism and speculative demand for these assets. More formally, Shleifer and Vishny (2010) develop a theoretical model in which banks cater their financing

decisions to shifts in investor sentiment. If banks cater their lending decisions to shifts in investor sentiment, a feedback loop may be created between changes in credit availability and changes in investor sentiment. With the anecdotal evidence and theoretical motivation in mind, we further extend our tests of credit market effects by including a proxy for investor sentiment as a fourth endogenous variable in our specifications.

III. Empirical Methodology

Vector Autoregressive Models

Brunnermeier and Pedersen (2009) suggest that liquidity-based price impacts can be tested empirically by examining short-run price changes, whereas the impact of fundamental volatility is more likely to be evident in long-run price movements. To capture the short-term dynamics between credit availability, market liquidity, and asset price changes, we employ vector autoregressive (VAR) models. In its simplest form, a VAR model is composed of a system of regressions where two or more dependent variables are expressed as linear functions of their own and each other's lagged values, as well as other exogenous control variables. In more technical terms, a vector autoregression model is the unconstrained reduced form of a dynamic simultaneous equations model. An unrestricted p^{th}-order Gaussian VAR model can be represented as:

$$Y_t = \mu + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \ldots + \Phi_k Y_{t-p} + e_t, \quad (1)$$

where Y_t is a vector of variables, μ is a p x 1 vector of intercepts, Φ_1, Φ_2, …, Φ_k are p x p matrices of parameters with all eigenvalues of Φ having moduli less than one so that the VAR is stationary, and e_t is a vector of uncorrelated structural shocks [~ $NID(0,\Omega)$]. We obtain maximum likelihood estimates of Φ and Ω using iterated least squares. The number of quarterly lags is chosen based on examination of the AIC, SBIC, and the likelihood ratio selection criteria for various choices of p.

We use an unconstrained VAR system to examine the dynamic relation between credit availability, market liquidity, and asset prices in private and public commercial real estate markets over our 1992:Q2-2009:Q4 sample period. We utilize data from the Federal Reserve Board's Senior Loan Officer Survey, which captures changes in lending standards for commercial real estate loans, as our measure of credit availability. Our proxy for market liquidity in the private commercial real estate market is the percentage of properties sold from the National Council of Real Estate Investment Fiduciaries (NCREIF) Property Index each quarter. We utilize share turnover as our measure of market liquidity for publicly

traded REITs.[2] To capture price changes in private and public commercial real estate, we utilize the percentage price change in the quarterly MIT/NCREIF Transaction Based Index (TBI) and the appreciation component of the FTSE NAREIT U.S. equity REIT index, respectively. We include lagged values of several control variables that have been shown to matter in the asset pricing literature to control for other potential sources of variation in liquidity and returns over time (see data section below for more details).

V. Data and Descriptive Statistics

Liquidity Data Sources and Definitions

In a relatively illiquid market, such as private commercial real estate, transaction frequency is a key indicator of market liquidity (Fisher et al., 2004). When there are more potential buyers in the market, property owners can sell more assets, or sell any given asset more quickly, with less of an impact on competitively determined market values. Conversely, when market liquidity is low, asset turnover will be lower and the price impact of a transaction will be relatively high.

Our measure of aggregate market liquidity in the private commercial real estate market is the percentage of properties sold (*PROPSOLD*) from the NCREIF NPI index. Established in 1982, NCREIF is a not-for-profit institutional real estate industry association that collects, processes, validates, and disseminates information on the risk/return characteristics of commercial real estate assets owned by institutional (primarily pension fund) investors (see www.ncreif.com). NCREIF's flagship index, the NCREIF Property Index (NPI), tracks property-level returns on a large pool of commercial real estate assets acquired in the private market for investment purposes only. The property composition of the NPI changes quarterly as data contributing NCREIF members buy and sell properties. However, all historical property-level data remain in the database and index. An increase in *PROPSOLD* suggests that market liquidity in the private commercial real estate market is increasing.

In a relatively liquid market, such as the market for publicly traded shares of REIT common equity, market liquidity measures are directly observable. Using daily trading volume and shares outstanding data from the University of Chicago's Center for Research in Security Prices (CRSP), we construct our primary measure of market liquidity, share

[2] Results from Augmented Dickey Fuller Tests suggest the use of first differences of our measures of credit availability and market liquidity in our VAR specifications.

turnover, for publicly traded common shares of equity REITs. We define *REIT_TURN* as total trading volume in a quarter divided by total shares outstanding as of the end of the quarter. As a robustness check, we also construct two additional measures of REIT market liquidity -- dollar volume and a market *illiquidity* measure based on the methodology of Amihud (2002).

Funding liquidity (credit availability) is defined as the ease with which an investor can obtain capital for acquisitions and the refinancing of existing assets. Because bank lending standards are the criteria by which banks evaluate the risk of providing credit to potential borrowers, changes in these standards reflect the relative ease with which investors may obtain funds. All else equal, a tightening in lending standards would reduce the supply of funds available to investors and therefore decrease funding liquidity.

Our measure of funding liquidity is obtained from the Federal Reserve Board's *Senior Loan Officer Opinion Survey on Bank Lending Practices*, a quarterly survey of approximately sixty large domestic banks and twenty-four U.S. branches or agencies of foreign banks. The purpose of the survey is to collect information on credit availability, with a focus on changes in lending practices within domestic loan markets. The sample of respondents is geographically diverse as participating banks come from all 12 Federal Reserve Districts. The banks must also have more than $3 billion in assets and more than 5 percent of their loan portfolio comprised of commercial and industrial (C&I) loans. While the survey was originally created in 1967, there have been several breaks in the time series and some variation in the wording of its questions. Since the second quarter of 1990, however, the survey has maintained consistency in its core set of questions.

TIGHTEN, our measure of changes in credit availability, focuses on responses to the following survey question: "Over the past three months, how have your bank's credit standards for approving applications for commercial real estate loans changed?" Respondents must select one of the following options: tightened considerably, tightened somewhat, remained essentially unchanged, eased somewhat, or eased considerably.[3] The net percentage of loan officers reporting a tightening of credit conditions is calculated as the sum of the number of respondents who selected "tightened considerably" and "tightened somewhat" minus the sum of the number of respondents who selected "eased somewhat" or "eased considerably" divided by the total number of respondents. An increase in *TIGHTEN*

[3] Further information on the Senior Loan Officer Survey is located at: www.federalreserve.gov/boarddocs/SnLoanSurvey

indicates that the availability of funds for commercial real estate investment is declining. Lown, Morgan, and Rohatgi (2000) show that lending by U.S. banks slows substantially following a report of tightened lending standards in the Senior Loan Officer Survey and that reported changes in lending standards are highly correlated with other measures of credit availability.

An additional measure of capital availability within commercial real estate markets, *RERC_CAPITAL*, is constructed from survey data published by the Real Estate Research Corporation (RERC) in its quarterly *Real Estate Report* (see www.rerc.com). RERC surveys institutional real estate investors, appraisers, lenders, and managers throughout the United States to gather information on current investment criteria, such as required rates of return on equity, expected rental growth rates, and current investment conditions, including the availability of capital. RERC survey respondents are asked to rank the current availability of capital for investment on a scale of 1 to 10, with 1 indicating "poor" capital availability and 10 indicating "excellent" access to capital. An increase in *RERC_CAPITAL* indicates that respondents believe capital availability has increased over the prior quarter.

Asset Pricing Data Sources and Definitions

Our pricing data for private commercial real estate is the TBI (Transactions–Based Index of Industrial Commercial Property Investment Performance). The TBI is a hedonic price index based on a "representative property" that mirrors the average characteristics of the NCREIF properties. The TBI price index estimates quarterly market price changes based on the verifiable sales prices of properties sold from the NCREIF database each quarter.[4] We utilize the natural log of the quarterly percentage change in the aggregate price index (*TBIRET*) as our measure of asset price movements in the private commercial real estate market. For robustness, we also utilize the natural log of the quarterly capital return component of the leveraged NCREIF index (*NCREIF_LEV*) as an additional measure of asset price movements in the private commercial real estate market. The correlation between the capital return component of the leveraged NCREIF and the change in the TBI price index is 0.62.

[4] Details of the index methodology are described in Fisher, Geltner, and Pollakowski (2007). Further information on the MIT/NCREIF price indices is located at http://mit.edu/cre/research/credl/

Pricing data for common shares of publicly traded commercial real estate is obtained from the National Association of Real Estate Investment Trusts (NAREIT). Members of NAREIT include REITs that own, operate and finance income-producing real estate. NAREIT publishes the FTSE NAREIT Equity Index, a market capitalization weighted index measuring returns on REITs that meet minimum size and liquidity criteria and are listed on the NYSE/Amex or Nasdaq. We utilize the natural log of the quarterly appreciation component of the return on the FTSE NAREIT Equity Index (*REITRET*) as our measure of asset price movements in the public commercial real estate market.

Control Variables

We include the following set of control variables to capture other potential sources of variation in prices, credit availability, and market liquidity in our VAR regression specifications: the yield on three-month U.S. Treasury securities (*TBILL*), the slope of the Treasury term structure of interest rates (*TERMSPREAD*), the spread between yields on BAA rated and AAA rated corporate bonds (*DEFSPREAD*), the rate of inflation (*INFLA*), and the excess return on the public stock market (*MKT*) (e.g., Chen, Roll, and Ross, 1986; Ferson and Harvey, 1991; Fama and French, 1993; Fama and Schwert, 1977; Sharpe, 2002). In addition, we include the remaining Fama-French risk factors, *SMB* and *HML*, augmented by the return momentum factor, *UMD* (e.g., Fama and French 1996; Liew and Vassalou, 2000; Lettau and Ludvigson, 2001; Jegadeesh and Titman, 1993; and Carhart, 1997). These factors also control for the public equity characteristics of our public market real estate returns.

Prior research has shown that dividend (current) yields are also a significant predictor of subsequent asset price changes (Ghysels, Plazzi and Valkanov, 2007; Fama and French, 1988). Therefore, we include the dividend yield on equity REITs (*DIVYLD*) as an additional control variable in our REIT pricing equations. In our private market specifications, we use the aggregate capitalization rate (*CAPRT*) for commercial properties (i.e., the ratio between a property's annual net rent and its price) as our proxy for current yield. Dividend yields and capitalization rates are from NAREIT and the American Council of Life Insurers (ACLI), respectively.

Descriptive Statistics

Table 1 reports descriptive statistics for our measures of credit availability, market liquidity, price returns, and control variables over the 1992Q2 to 2009Q4 sample period. The starting point of our sample period is dictated by the availability of survey data obtained from the Real Estate Research Corporation (RERC). When responding to the Senior Loan Officer Survey, loan officers are instructed to report changes in lending standards over the previous quarter regardless of how current credit conditions compare to long-term norms. Nevertheless, *TIGHTEN*, displays a high degree of autocorrelation (0.91), indicating persistence in the direction of changes in lending standards over time (Panel A). *RERC_CAPITAL* displays a similar level of autocorrelation (0.95). Though highly autocorrelated, both measures capture significant peaks and troughs in the capital availability cycle. For example, *TIGHTEN* ranges from a minimum of -0.24, indicating that the net percentage of respondents reported an easing in lending standards, to a high of 0.87, denoting a period in which most banks were tightening lending standards. *RERC_CAPITAL* displays similar variation ranging from a low of 1.8 to a high of 9.6, on a scale of 1 to 10. The contemporaneous correlation between *RERC_CAPITAL* and *TIGHTEN* is -0.65 (see Table 2). Recall that an increase in *RERC_CAPITAL* indicates that capital availability is increasing while an increase in *TIGHTEN* suggests that capital availability is declining.

Panel B of Table 1 reports descriptive statistics for our measures of market liquidity in private and public commercial real estate markets. On average, only 2.1 percent of the properties held in the NCREIF database are sold each quarter over our sample period, indicating that private commercial real estate markets are extremely illiquid. *PROPSOLD* also displays a high degree of autocorrelation (0.64), indicating persistence in periods of relative illiquidity. Publicly traded REITs are significantly more liquid than direct private market investments; the average annualized share turnover is approximately 133 percent during our sample period. However, *REIT_TURN* displays significant volatility over our sample period. This result is consistent with even the most relatively liquid markets experiencing significant declines in market liquidity when investors face difficulties obtaining funds for investment.

Panels A and B of Figure 1 display *TIGHTEN* and our aggregate measures of market liquidity in the private commercial real estate market (*PROPSOLD*) and public commercial real estate market (*REIT_TURN*), respectively. Following a period of large

declines in commercial real estate values and a credit crunch in the late 1980's and early 1990's, lending standards for commercial real estate loans were eased slightly in late 1993 and remained relatively loose for several years. At this time, the public REIT market was growing significantly with increased involvement from institutions. Institutional investors, who had difficulty disposing of properties within the private market during the downturn of the late 1980's, were shifting funds into the liquid market for publicly traded REITs. As funds continued to flow into the public commercial real estate sector, market liquidity in the underlying property market also increased significantly over this period. Lending standards for commercial real estate loans began to tighten again in the late 1990's, a period in which many investors rotated out of value-oriented assets, including commercial real estate, and into high growth technology stocks. Not surprisingly, a significant shock to market liquidity in private commercial real estate occurred. Following an easing of lending standards in 2003, commercial real estate began a prolonged bull market in which market liquidity was at its peak. However, as the credit crisis began to unfold in late 2007-2008, lending standards on commercial real estate loans were tightened considerably. Market liquidity significantly decreased in subsequent quarters.

Panel C of Table 1 reports descriptive statistics for our price return series. Consistent with prior literature, the average quarterly return on publicly traded equity REITs (1.5%) is greater than returns on similar institutional quality assets owned and managed in private markets (*TBIRET* = 0.8%). However, price changes in the public REIT market are substantially more volatile than those in the underlying private property market.

Panel D of Table 1 reports descriptive statistics for our control variables. The annual yield on three-month Treasury bills (*TBILL*) averaged 3.60 percent over the sample period, ranging from a low of 0.10 percent to a high of 6.2 percent. The slope of the Treasury term structure averaged 1.7 percent on an annual basis, although *TERMSPREAD* varied significantly over the sample period. The mean default risk premium is 0.90 percent per year, but *DEFSPREAD* ranged from a low of just 0.60 percent to a high of 3.0 percent. Average quarterly inflation (*INFLA*) is 0.60 percent, although inflation also displayed considerable time variation over our sample period. The mean stock market risk premium (*MKT*) is 1.50 percent per quarter, but ranges from a low of -22.3 percent to a high of 20.6 percent. *SMB*, *HML*, and *UMD* averaged 0.90 percent, 0.80 percent, and 1.7 percent per quarter, respectively, and also displayed substantial volatility over the sample period. The

average cap rate (*CAPRT*) for commercial properties over our sample period is 8.60 percent, ranging from a low of 6.50 percent to a high of 10.3 percent. The mean dividend yield (*DIVYLD*) for equity REITs is 6.30 percent and ranges from 3.60 percent to 9.40 percent.

Table 2 reports contemporaneous correlations among our measures of credit availability and price appreciation. Credit availability (*TIGHTEN*) is negatively related to *TBIRET* (ρ = -0.47) and *REITRET* (ρ = -0.28). That is, a tightening of lending standards for commercial real estate loans is correlated with a decline in asset values within both private and public commercial real estate markets. We find similar results using *RERC_CAPITAL*, although the contemporaneous correlation between capital availability and price changes are positive, as expected. An increase in the availability of capital is positively correlated with an increase in asset values.

Panel A of Figure 2 displays *TIGHTEN* in relation to *TBIRET*. Beginning in 2002, when lending standards were eased considerably, prices in private commercial real estate experienced a significant boom. However, as credit availability decreased in 2005, prices began to spiral as returns declined consistently over the next two years. Thus, unconditionally, changes in lending standards and price changes appear to reinforce each other in the private market.

Panel B of Figure 2 plots *TIGHTEN* against REIT returns (*REITRET*). Although REIT returns appear to respond to changes in lending standards, they quickly revert in subsequent periods. For example, while REIT prices experienced a significant decline in the fourth quarter of 2008, returns once again became positive in the first quarter of 2009.

V. Empirical Results

Dynamic Relations in Illiquid Private Markets

Panel A of Table 3 provides estimates of our unconstrained VAR model for the private commercial real estate market in which the percentage change in the TBI price index (*TBIRET*), our measure of credit availability (*TIGHTEN*), and aggregate market liquidity (*PROPSOLD*) are specified as endogenous variables. Although not reported, we also include lagged values of the following exogenous control variables: *TBILL*, *TERMSPREAD*, *DEFSPREAD*, *INFL*, *MKT, SMB, HML, UMD, and CAPRT*. The sample period is 1992:Q2 to 2009:Q4. This specification allows us to test whether changes in credit availability affect subsequent market liquidity and whether a feedback effect occurs in which changes in market liquidity affect the subsequent availability of credit, controlling

for lagged fundamentals and other factors. As previously discussed, when access to credit markets is tightened, investors find it more difficult to finance acquisitions or to refinance previously acquired assets. This is especially true of highly levered assets. The lack of capital availability subsequently lowers market liquidity. Under certain conditions, reduced market liquidity increases the risk of financing a transaction, thus leading to further tightening in the availability of capital to these investors (Brunnermeier and Pedersen, 2009). When credit conditions continue to tighten in illiquidity, they are said to be "destabilizing," and a liquidity spiral ensues.

Focusing first on the $\Delta PROPSOLD$ equation (Column 3), we find that an increase in credit tightening predicts a decrease in market liquidity with either a two-quarter (p-value = 0.079) or three quarter lag (p-value = 0.073). That is, as the percentage of banks tightening commercial real estate lending standards increases, the percentage of properties sold in the private commercial real estate market declines in subsequent quarters. As credit availability continues to be tightened in an illiquid market, a liquidity spiral may ensue.

Though not tabulated, we find a similar relation between changes in the availability of capital and changes in subsequent market liquidity using *ΔRERC_CAPITAL* as our measure of funding liquidity. An increase in lagged *ΔRERC_CAPITAL* predicts an increase in $\Delta PROPSOLD$. That is, as capital is more readily available, the percentage of properties sold in the private commercial real estate market increases in subsequent periods.

If shifts in market liquidity further reduce the availability of credit, a liquidity spiral may arise. In our $\Delta TIGTHEN$ equation (Column 2), the estimated coefficient on the two-quarter lag of $\Delta PROPSOLD$ is negatively related (p-value = 0.045) to $\Delta TIGTHEN$. That is, an increase in market liquidity leads to a loosening of lending standards. Consistent with the theory of Brunnermeier and Pedersen (2009), our preliminary results suggest that a decrease in funding liquidity (tightening in lending standards) can lead to a liquidity spiral in the private commercial real estate market as decreasing market liquidity further reduces the supply of credit.

Our VAR specification also allows us to examine whether changes in credit availability affect subsequent price movements in private real estate markets and whether a feedback effect occurs in which price changes affect the subsequent availability of credit. As documented in our previous results, a reduction in the availability of capital is associated with less market liquidity in subsequent quarters. When such changes in lending standards are "destabilizing," and a liquidity spiral ensues, there is a magnifying

increase in the price impact of subsequent transactions. Both spirals reinforce each other, amplifying the total effect beyond what their individual impacts would be (Brunnermeier and Pedersen, 2009; Brunnermeier, 2009; Geanakoplos, 2003).

Focusing on the *TBIRET* equation (Column1), the estimated coefficients on Δ*TIGHTEN* at the two- and three-quarter lags are negative and highly significant. This strongly suggests that a tightening of lending standards leads to price declines over subsequent periods. This result is consistent with the theoretical predications of Brunnermeier and Pedersen (2009) and Geanakoplos (2003). When assets can be readily acquired using significant leverage, the most optimistic investors are able to own and control a larger percentage of the current stock of assets than they would be able to otherwise. However, as the capital available to these optimistic buyers declines, they are less able to acquire or refinance assets, thereby leaving more pessimistic investors as the marginal buyers. As a result, asset valuations will likely decline.

Although not tabulated, we find a similar relation between *ΔRERC_CAPITAL* and subsequent price returns. The estimated coefficient on the two quarter lag of *ΔRERC_CAPITAL* is both positive (0.022) and highly significant (p-value = 0.016). That is, as capital is more readily available, prices in the private commercial real estate market increase over subsequent quarters.

The estimated coefficient on lagged *TBIRET* in the *TBIRET* equation is negative (-0.235) and significant (p-value = 0.076), indicating that price increases in the prior quarter predict a subsequent reversal in the following quarter. However, if changes in asset values impact the availability of capital to make future transactions, prices may spiral in one direction.

Returning to our Δ*TIGHTEN* equation (Column 2 of Table 3), we find a negative (-1.079) and highly significant (p-value = 0.000) relation between lagged *TBIRET* and current period *ΔTIGHTEN*. That is, declining asset prices in an illiquid market increase the risk of financing another trade, which leads banks to further tighten the supply of available credit for future transactions. Consistent with the theory of Brunnermeier and Pedersen (2009), our results imply that a decrease in funding liquidity (tightening in lending standards) can lead to a liquidity spiral in the private commercial real estate market as a decrease in asset prices affects the supply of credit in the subsequent quarter.

Although not tabulated, we find similar results when using *NCREIF_LEV* as our measure of price changes in the private commercial real estate market. In the

NCREIF_LEV equation, the estimated coefficients on lagged *ΔTIGHTEN* are negative and highly significant. In the *ΔTIGHTEN* equation, we again document a feedback effect in which the estimated coefficient on lagged *NCREIF_LEV* is negative and significantly related to subsequent period *ΔTIGHTEN*.

To examine the cumulative effect of the four lags of our endogenous variables, we sum the estimated lagged coefficients and test whether the four lags are jointly significant. The summed coefficients and p-values associated with tests of joint significance are reported in Panel B of Table 3. Controlling for aggregate market liquidity, a tightening of lending standards over the prior year predicts price declines in the private market. Moreover, declining prices are associated with a subsequent tightening of lending standards. Decreased market liquidity over the prior four quarters is also associated with a tightening of credit standards.

Dynamic Relations in Liquid Public Markets

In contrast to their underlying properties, equity REITs trade frequently on a number of major stock exchanges. Although changes in the availability of credit may still impact market liquidity in these markets, it is less likely that subsequent changes in funding liquidity will be "destabilizing" when markets are relatively liquid. Temporary shocks to market liquidity create profit opportunities for speculators who anticipate that prices will return to fundamentals once liquidity has been restored. If lenders expect speculators to enter the market when prices fall as a result of a temporary liquidity shock, they will be less likely to tighten credit. In fact, lenders may decide to increase credit availability as market liquidity decreases in order to facilitate the emergence of these investors. In such a scenario, changes in funding liquidity would be "stabilizing" as lenders make capital available precisely at the time that it would be most advantageous for investors to enter the market. Through our VAR analysis we test whether changes in the availability of credit affect subsequent market liquidity and whether a feedback effect occurs in which changes in market liquidity affect subsequent credit availability in the relatively liquid market for publicly traded equity REITs.

Panel A of Table 4 provides estimates of our unconstrained VAR model for the REIT market in which the appreciation component of our REIT return index (*REITRET*), our measure of credit availability (*TIGHTEN*), and aggregate REIT market liquidity (*REIT_TURN*) are specified as endogenous variables. As in our specifications for the private

market, we include the following set of exogenous control variables: *TBILL*, *TERMSPREAD*, *DEFSPREAD*, *INFL*, *MKT, SMB, HML,* and *UMD*. We also include the dividend yield (*DIVYLD*) on equity REITs, rather than the aggregate cap rate for commercial properties. Benveniste, Capozza, and Seguin (2001) and Clayton and MacKinnon (2002) suggest that liquidity in the underlying property market also play a significant role in determining price changes and liquidity in the public REIT market. Therefore, we include lagged *PROPSOLD* as an additional control in our public market specifications.

Focusing first on the *ΔREIT_TURN* equation (Column 3), lagged *ΔTIGHTEN* is positively related (p-value = 0.000) to changes in REIT market liquidity. Although this result may seem counterintuitive, as a shock to the supply of credit should decrease market liquidity, Clayton and MacKinnon (2002) suggest that real estate investors may value the liquidity of REITs more when private market liquidity is low. If a tightening of credit markets reduces market liquidity in the private commercial real estate market, as suggested by the results reported in Table 3, then investors may prefer to shift their holdings to the public market when the private market is becoming increasingly illiquid. Although not reported, the estimated coefficient on lagged *PROPSOLD* in this specification is both negative and significant, indicating that a decrease in private market liquidity results in an increase in the share turnover of publicly traded REITs. We find similar results using *ΔRERC_CAPITAL* as our measure of capital availability.

Brunnermeier and Pedersen's (2009) theoretical framework suggests that the sensitivity of subsequent changes in funding liquidity to changes in market liquidity is larger for assets that are highly leveraged and illiquid. Because periods of illiquidity are far less common in the market for publicly traded assets, we do not expect to find any form of feedback effect between market liquidity and the availability of credit. In our Δ*TIGHTEN* equation (Column 2), we find that lagged *ΔREIT_TURN* does not predict further tightening in credit conditions.

Focusing on the *REITRET* equation (Column 1), the estimated coefficients on both the three and four-quarter lag of Δ*TIGHTEN* are negative and highly significant. Thus, consistent with our private market results, a tightening in lending standards leads to subsequent declines in REIT prices. Again, we find similar results using *ΔRERC_CAPITAL* as our measure of credit availability. Overall, our results strongly suggest that changes in credit availability are also an important determinant of asset price movements, irrespective

of their influence on market liquidity, for highly leveraged assets that trade in relatively liquid markets

Turning again to our results from the estimation of our $\Delta TIGHTEN$ equation (Column 2 of Table 4), we do not find a significant relation between prior period REIT returns and changes in credit availability. In the absence of a liquidity spiral, the availability of credit is insensitive to asset price movements in a liquid public market. Since investors have the ability to sell other more liquid assets during temporary liquidity shocks in an attempt to raise capital or access other forms of financing for future investment, changes in asset prices may have less of an impact on the availability of credit in more liquid public markets. In fact, during the most recent credit crisis of 2008-2009, many publicly traded REITs had access to bank lines of credit (Hardin and Hill, 2010). This access gave REITs a comparative advantage during a period of reduced credit availability. As a result, REIT prices are likely to bounce back more quickly than would be the case in an illiquid market where liquidity spirals are more likely to occur.

To examine the cumulative effect of the four lags of our endogenous variables, we again sum the estimated lagged coefficients and test whether the four lags are jointly significant. The summed coefficients and p-values associated with tests of joint significance are reported in Panel B of Table 4. Controlling for aggregate market liquidity, a tightening of lending standards over the prior year predicts significant price declines in the REIT market (p-value = 0.001). Moreover, increases in aggregate market liquidity over the prior year are associated with significantly higher REIT prices (p-value = 0.000). However, in contrast to our private market results, declining REIT prices do not predict a subsequent tightening of lending standards (Column 2).

Impulse Response Functions: Credit Availability and Asset Price Movements

Further evidence regarding the impact of changes in credit availability on asset price movements in both private and public commercial real estate markets is provided by the VAR generalized impulse response functions displayed in Figure 3. Panels A and B depict the response of quarterly price changes in *TBIRET* and *REITRET,* respectively, to a one standard deviation change in our primary measure of credit availability (*TIGHTEN*). The solid line in each figure represents the estimated diffusion of quarterly price changes to the shock in credit availability. Panels A and B of Figure 3 reveal an initial decrease in asset prices in both private and public markets in response to a shock to credit availability.

However, there is a significant delay in the time it takes for asset prices to revert following a shock to credit availability within the illiquid private market.

Panels C and D display the response of *TIGHTEN* to a one standard deviation change in private and public market price changes, respectively. In contrast to the REIT results (Panel D), subsequent credit availability is significantly impacted by a shock to asset prices within the private market (Panel C). As asset prices fall, credit conditions tighten, reinforcing the initial impact of a change in credit availability on asset prices within an illiquid market.

Leverage and Liquidity Portfolio Sorts: Public Market

In private markets, we document a spiral effect between changes in credit availability and property prices. In the REIT market, we find that changes in the availability of credit predict changes in REIT prices; however, movements in share prices do not appear to reinforce changes in the availability of credit. However, it is possible for such a feedback relationship to still exist within a particular cross-section of the REIT market. Brunnermeier and Pedersen's (2009) theoretical framework suggests that the dynamic relation between changes in credit availability and asset price movements is stronger for capital intensive assets that are relatively illiquid. Therefore, we might expect to find evidence of a spiral effect among REITs with high leverage and low share turnover.

To test this hypothesis, we obtain leverage and share turnover data for each REIT in our aggregate index using data from SNL and CRSP, respectively. REITs are sorted into quartiles based on both leverage and share turnover. We then construct value-weighted price return portfolios for each subset of the data. For example, to construct our *High Leverage-Low Liquidity* portfolio, we create a value-weighted portfolio of REITs that fall into both the highest leverage quartile and lowest share turnover quartile within each quarter of our sample period. On average, the leverage ratios for the high and low leverage portfolios are approximately 60 percent and 20 percent, respectively. For our liquidity sorts, average quarterly share turnover is 8 percent for the low liquidity quartile and 46 percent for the high liquidity quartile. We follow the empirical methodology detailed previously, utilizing price returns and share turnover for each portfolio, in addition to our aggregate measure of credit availability, in separate VAR specifications. We include the same set of exogenous control variables as specified previously in our earlier REIT market analysis.

Table 5 presents the results of our portfolio analysis. For ease of presentation, we report the sum of our coefficient estimates across the four lags and the p-value pertaining to the joint significance of those four lags. Focusing first on our *REITRET* equations (Columns 1 and 4), we document a negative and statistically significant relation between our measure of credit availability (Δ*TIGHTEN*) and subsequent REIT returns (*REITRET*) in each of our portfolio specifications. Moreover, the estimated coefficients on Δ*TIGHTEN* are increasing in leverage. In other words, prices of more highly leveraged REITs are more sensitive to changes in credit availability than those of REITs with lower leverage ratios. Furthermore, it appears that the share prices of highly leveraged and illiquid REITs are the most sensitive to changes in credit availability. The coefficient estimate on Δ*TIGHTEN* for the *High Leverage-Low Liquidity* portfolio is -1.345 (p-value = 0.000).

Shifting our focus to the Δ*TIGHTEN* equations (Columns 2 and 5 in Table 5), we document a feedback effect between changes in REIT price movements and the subsequent availability of credit only for relatively illiquid REITs. Consistent with our initial hypothesis, the estimated coefficient on *REITRET* is negative (-0.956) and statistically significant (p-value = 0.038) for the *High Leverage-Low Liquidity* portfolio. In addition, we find evidence of a feedback effect between changes in REIT prices and credit availability for the *Low Leverage-Low Liquidity* portfolio. However, we do not find evidence of a feedback effect in the *High Liquidity* portfolios, regardless of leverage ratios. Therefore, the spiral effect is concentrated in the low liquidity REIT portfolios. Consistent with Brunnermeier and Pedersen's liquidity based theory, relative illiquidity is a necessary condition for a spiral effect to occur. This result is also consistent with our previous results from the private market in which similar assets trade in a relatively illiquid environment.

Using Returns on REIT Preferred Stock as a Robustness Check

Within public stock markets we also have the opportunity to examine two types of equity securities issued by the same firm, each with claims on similar cash flow streams, yet which trade at different prices and with different liquidity. By examining the relation between credit availability and the prices of REIT preferred shares, we provide an alternative test of the sensitivity of asset prices to changes in the availability of capital within a relatively illiquid public market. Having documented the existence of pricing spirals in the private market as well as the low liquidity segment of the public REIT

market, we further hypothesize that asset prices of REIT preferred shares may be susceptible to a spiral effect due to the low liquidity environment in which they trade.

We use data from Thomson Reuters DataStream to construct a price index for REIT preferred securities. More specifically, we obtain historical share prices, shares outstanding, trading volume, and market capitalization data for all REIT preferred securities over our sample period. We then construct a quarterly value-weighted index based on the percentage price change of each REIT preferred security (*REITPREF*).[5]

Preferred shares are often considered a hybrid security because they exhibit both bond- and equity-like characteristics. Nevertheless, the price movements of REIT preferred shares are significantly positively correlated with the returns on equity REIT common shares ($\rho = 0.62$). Similarly, the returns on REIT preferred shares are greater, on average, and more volatile than the returns on private commercial real estate. The mean quarterly return on REIT preferred securities is 1.6% over our sample period. Our aggregate measure of share turnover in the REIT preferred market (*REITPR_TURN*), on the other hand, displays liquidity characteristics that more closely resemble the private real estate market. On average, quarterly *REITPR_TURN* is approximately 9 percent during our sample period.

Panel A of Table 6 provides estimates of our unconstrained VAR model for the REIT preferred market in which the percentage price change in Δ*TIGHTEN* and aggregate REIT market liquidity (Δ*REITPR_TURN*) are specified as endogenous variables. We include the same set of controls as in our prior REIT specifications. Focusing on the *REITPREF* equation (Column 1), the estimated coefficient on the three quarter lag of Δ*TIGHTEN* is both negative (-0.191) and highly significant (p-value = 0.006). That is, when access to credit markets is tightened, prices of REIT preferred securities decrease over subsequent quarters. Although not tabulated, we find a similar relation between *ΔRERC_CAPITAL* and subsequent price returns.

We also find evidence of a feedback effect between changes in REIT preferred share prices and the subsequent availability of credit. The estimated coefficient on lagged *REITPREF* is negative (-0.311) and significant (p-value = 0.055), suggesting that changes in credit availability are sensitive to asset price movements in these illiquid public markets. When using *ΔRERC_CAPITAL* in place of Δ*TIGHTEN*, evidence of a feedback effect is even

[5] The correlation between our REIT preferred index and the MSCI REIT Preferred Index is 0.98 for the overlapping sample period (2005-2009).

stronger (p-value 0.002). Consistent with Brunnermeier and Pedersen (2009), we find that when funding constraints increase in an illiquid market (i.e., when changes in funding liquidity may be "destabilizing"), subsequent changes in asset prices affect the future availability of capital, thus magnifying the overall price impact of a funding shock.

To examine the cumulative effect of the four lags of our endogenous variables, we again sum the estimated lagged coefficients and test whether the four lags are jointly significant. The summed coefficients and p-values associated with tests of joint significance are reported in Panel B of Table 6. Controlling for aggregate market liquidity, a tightening in credit over the prior year predicts significant price declines in the REIT preferred market (p-value = 0.000). Moreover, declining asset prices are associated with a subsequent decrease in the availability of credit (p-value = 0.024), providing further evidence of a spiral effect within this relatively illiquid public market.

Credit Availability, Asset Prices, and Investor Sentiment

Anecdotal evidence suggests the expansion of credit availability during the real estate boom of the early-to-mid 2000s was in part driven by the response of creditors to increasing investor optimism and speculative demand for these assets. A recent article in the *Economist* (2010) characterizes the emergence of asset pricing bubbles as follows, "Aside from high asset valuations, the two classic symptoms of a bubble are rapid growth in private-sector credit and an outbreak of public enthusiasm for particular assets." Therefore, examining the dynamic relation between changes in the availability of credit and changes in investor sentiment will provide further insight into the underlying factors that fueled the rapid price appreciation and collapse of the commercial real estate market.

More formally, Shleifer and Vishny (2010) develop a theoretical model in which banks cater their financing decisions to shifts in investor sentiment. During periods of high sentiment, banks increase their mortgage originations (traditional lending), particularly when securitization of these underlying loans is profitable. Banks continue to pursue such profits during a boom period in order to take advantage of attractive money making opportunities in the secondary market. When the asset pricing bubble bursts, banks forgo lending opportunities and credit markets will tighten. Banks cease lending until the prices of distressed assets approach their fundamental values. This implies that capital will not be available to optimistic investors willing to purchase these distressed assets when they are undervalued. If investors are unable to access funds precisely at the time it may be most

advantageous to do so, and prices continue to fall, a bank's decision to further tighten their lending standards will have a destabilizing effect on prices, similar to the theoretical predictions of Brunnermeier and Pedersen (2009) and Geanakoplos (2003). If banks cater their lending decisions to shifts in investor sentiment, a feedback loop may be created between changes in credit availability and changes in investor sentiment.

Ling, Naranjo, and Scheick (2010) construct both a direct and indirect investor sentiment measure for the commercial real estate market. For their direct measure of investor sentiment (*DRES*), they employ survey data published by the Real Estate Research Corporation (RERC) in its quarterly *Real Estate Report*. RERC surveys institutional real estate investors, appraisers, lenders, and managers throughout the United States to gather information on current investment criteria, such as required rates of return on equity, expected rental growth rates, and current "investment conditions." RERC survey respondents are asked to rank current "investment conditions" for multiple property types, both nationally and by metropolitan area, on a scale of 1 to 10, with 1 indicating "poor" investment conditions and 10 indicating "excellent" conditions for investing. *DRES* is constructed from the first principal component extracted from quarterly RERC investment condition survey responses pertaining to the eight RERC property types. For our indirect measure of sentiment (*INDRES*), we follow the framework of Baker and Wurgler (2006, 2007) and use principal component analysis to construct an indirect quarterly sentiment index based on the common variation in seven underlying proxies of investor sentiment in commercial real estate markets: (i) the average REIT stock price premium to net asset value (NAV), (ii) the percentage of properties sold each quarter from the National Council of Real Estate Investment Fiduciaries (NCREIF) Property Index (NPI), (iii) the number of REIT IPOs, (iv) the average first-day returns on REIT IPOs, (v) the share of net REIT equity issues relative to total net REIT equity and debt issues, (vi) net commercial mortgage flows as a percentage of GDP, and (vii) net capital flows to dedicated REIT mutual funds. In our empirical analysis, we utilize the first difference of these series.

To examine the dynamic relation between changes in investor sentiment and changes in the availability of credit, we include changes in investor sentiment as a fourth endogenous variable in our specifications. These results are reported in Table 7. For ease of presentation, we again report the sum of our coefficient estimates across the four quarterly lags and the p-value pertaining to the joint significance of those four lags. We report results utilizing our aggregate private market return series (*TBIRET*); however, the results are

robust to the use of aggregate REIT returns. We include the same set of exogenous control variables as specified previously in our earlier private market analysis.

Panel A of Table 7 reports results using our direct measure of investor sentiment (*ΔDRES*). Focusing first on the *TBIRET* specification (Column 1), we find that even after controlling for the influence of investor sentiment on asset prices, the estimated coefficient on credit availability ($\Delta TIGHTEN_{t-1\ to\ t-4}$) remains negative (-0.217) and statistically significant (p-value = 0.037). In addition, lagged changes in sentiment ($\Delta DRES_{t-1\ to\ t-4}$) predict subsequent price changes in the private market, even after controlling for the impact of changes in credit availability and market liquidity. As investors become increasingly optimistic, they bid up prices of these assets in the short-run. We find similar results when using *ΔINDRES*, as reported in Panel B of Table 7.

Turning to our *ΔTIGHTEN* equation (Column 2), we continue to observe a feedback effect between changes in property prices and subsequent credit availability after controlling for the impact of investor sentiment. Moreover, increasing sentiment predicts looser underwriting standards. We find similar results using *ΔINDRES*. Consistent with the hypothesis of Shleifer and Vishny (2010), changes in investor sentiment are a significant determinant of future credit availability. In particular, our results suggest banks respond to increasing investor sentiment by easing their credit standards, thereby making credit more readily available to potential investors when they are most optimistic. However, during a market downturn in which investors are becoming increasingly pessimistic, banks tend to tighten their lending standards, which can have a destabilizing effect on asset prices. This raises an interesting policy implication pertaining to whether lenders have the ability to reduce the probability that an asset pricing bubble emerges by restricting the amount of credit they provide during boom periods or ease the severity of a downturn by making credit available when distressed assets are undervalued.

Finally, looking at the *ΔDRES* equation (Column 4), there is some evidence of a feedback effect between changes in credit availability and future changes in investor sentiment. However, if we utilize *ΔINDRES* (Panel B of Table 7), the coefficient on lagged changes in tightening on sentiment is no longer statistically significant.

VI. Conclusion

Changes in the availability of credit are a significant determinant of asset price movements in both private and public commercial real estate markets. As credit markets tighten, investors are less able to make new acquisitions in highly leveraged assets or refinance and may be forced to de-lever their existing positions by selling assets into an illiquid market, causing prices to decline. When highly leveraged assets trade in relatively illiquid markets, declining asset values may trigger a liquidity spiral, thereby magnifying the overall price impact of a shock to credit availability.

Commercial real estate markets provide an appealing testing ground for examining the dynamic relation between credit availability, market liquidity, and changes in asset prices. The private commercial real estate market is a relatively illiquid market consisting of highly leveraged assets. Unlike assets traded in more liquid public markets, which tend to experience only brief periods of illiquidity, commercial properties trade in relatively illiquid markets. Therefore, we may expect asset prices in this market to be relatively sensitive to changes in credit availability.

An appealing feature of commercial real estate markets is that assets trade in both a relatively illiquid direct private market and in liquid public stock markets, in the form of securitized portfolios of properties (i.e., REITs). Since the underlying properties held by the publicly traded real estate firms we analyze are similar to the property holdings of the institutional real estate investors whose private market returns we also track, disparities in the impact of funding liquidity on price changes in private and public real estate markets can be ascribed to differences in the characteristics of these two markets. Therefore, we examine the dynamic relation between changes in credit availability and changes in asset prices within segments of the REIT market that are also relatively illiquid.

Using vector autoregressive (VAR) models, we find that asset values of highly leveraged assets, such as commercial real estate, are sensitive to the availability of credit, even when controlling for aggregate market liquidity. As banks tighten (ease) their lending standards on commercial real estate loans, asset prices decline (rise) in both private and public commercial real estate markets. These results suggest that leverage is a key factor in determining credit market effects on pricing. We also provide evidence that assets trading in illiquid segments of the commercial real estate market are highly susceptible to a spiral effect, in which changes in asset prices lead to further changes in the availability of credit,

thus magnifying the overall price impact of a funding shock as a spiral potentially ensues. These results suggest that while leverage is a key factor in determining credit market availability pricing effects, the underlying liquidity with which these assets trade is a key factor in determining the likelihood of an asset pricing spiral -- with lower liquidity creating the market setting for a spiral effect.

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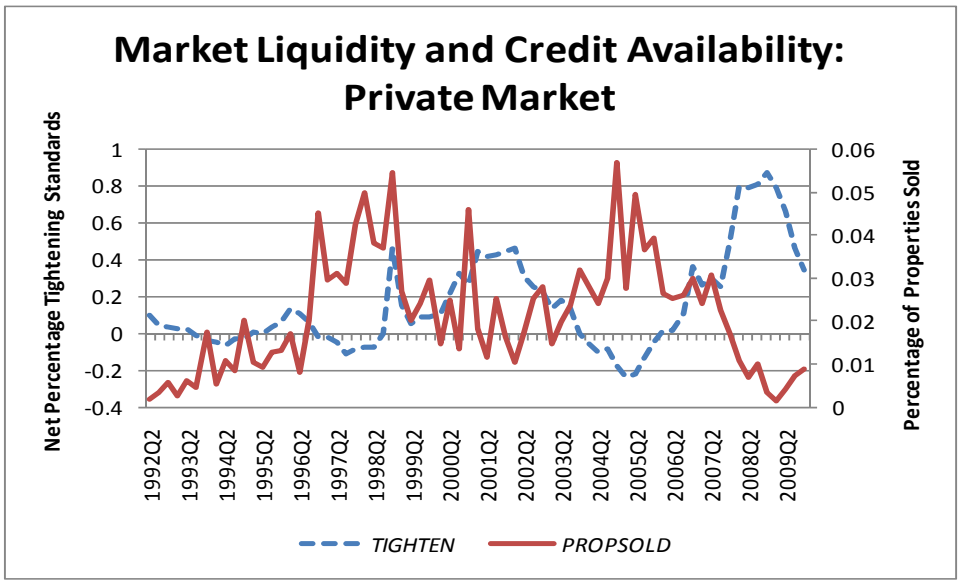
Figure 1: Credit Availability and Market Liquidity

This figure plots our measures of credit availability and levels of aggregate market liquidity in the private and public commercial real estate market over the sample period 1992:Q2-2009:Q4. Our primary measure of credit availability, *TIGHTEN*, is the net percentage of loan officers reporting a tightening of lending standards on commercial real estate loans in the Federal Reserve Board's *Senior Loan Officer Opinion Survey on Bank Lending Practices*. Our measure of aggregate market liquidity in the private commercial real estate market, *PROPSOLD*, is the percentage of properties sold from the NCREIF NPI index. Our measure of aggregate market liquidity in the public commercial real estate market, *REIT_TURN*, is aggregate share turnover for publicly traded REITs.

Panel A: Market Liquidity and Credit Availability: Private Commercial Real Estate



Panel B: Market Liquidity and Credit Availability: Public Commercial Real Estate

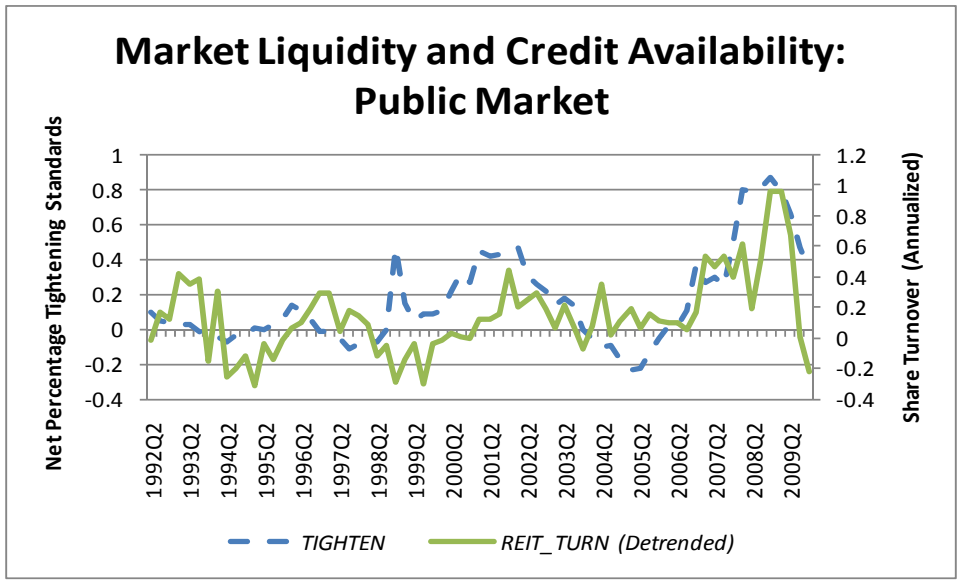
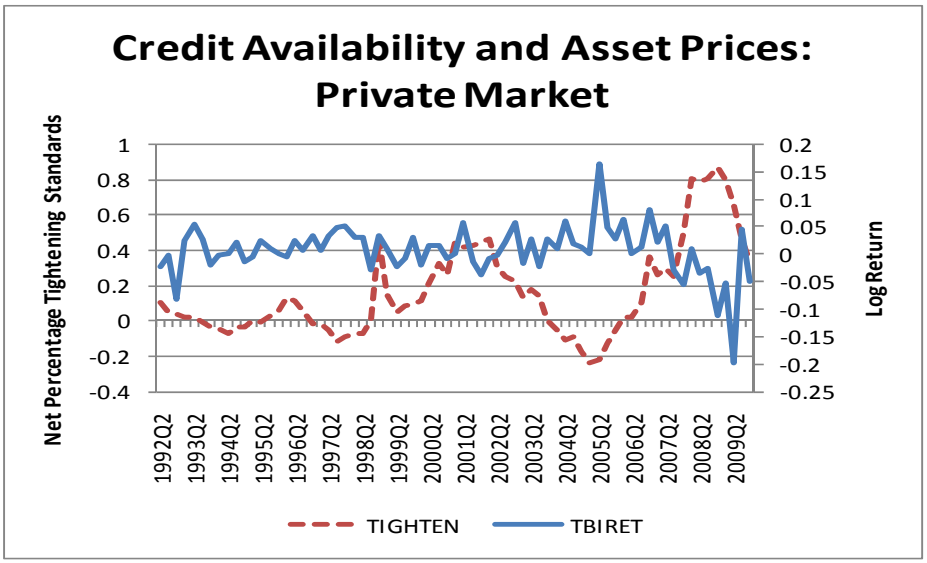


Figure 2: Credit Availability and Asset Prices

This figure plots changes in credit availability and price movements in both private and public commercial real estate markets over the sample period 1992:Q2-2009:Q4. Our measure of credit availability, *TIGHTEN*, is the net percentage of loan officers reporting a tightening of lending standards on commercial real estate loans in the Federal Reserve Board's *Senior Loan Officer Opinion Survey on Bank Lending Practices*. Our measure of price changes in the private commercial real estate market, *TBIRET*, is the natural log of the quarterly percentage change in the aggregate TBI price index. The MIT Center for Real Estate produces the TBI (Transactions–Based Index of Industrial Commercial Property Investment Performance) in association with the National Council of Real Estate Investment Fiduciaries (NCREIF). The TBI is a hedonic price index that estimates quarterly market price changes based on the verifiable sales prices of properties sold from the NCREIF database each quarter. Our measure of price changes in the public commercial real estate market, *REITRET*, is the natural log of the quarterly appreciation component of the return on the FTSE NAREIT Equity Index. Members of NAREIT include REITs and publicly-traded companies that own, operate and finance income-producing real estate.

Panel A: Private Commercial Real Estate



Panel B: Public Commercial Real Estate

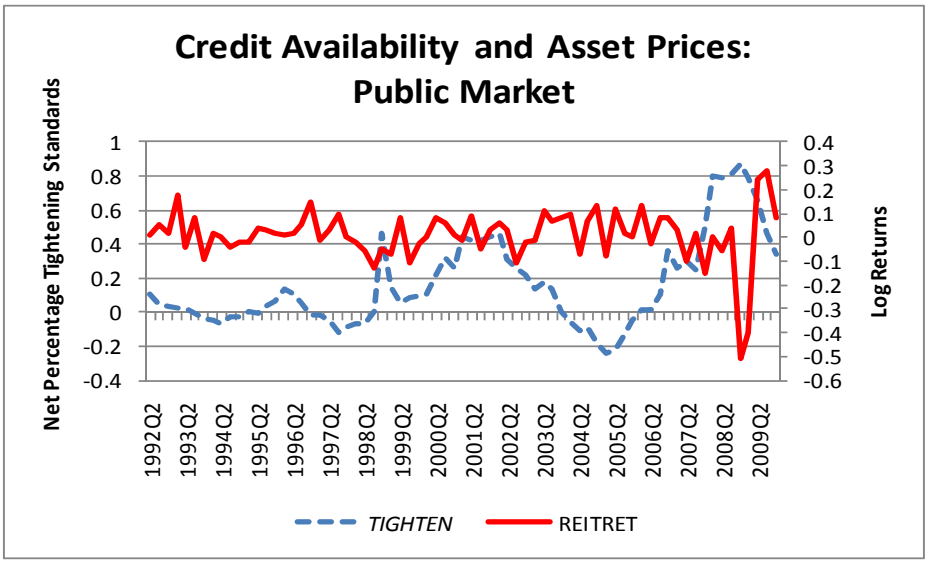
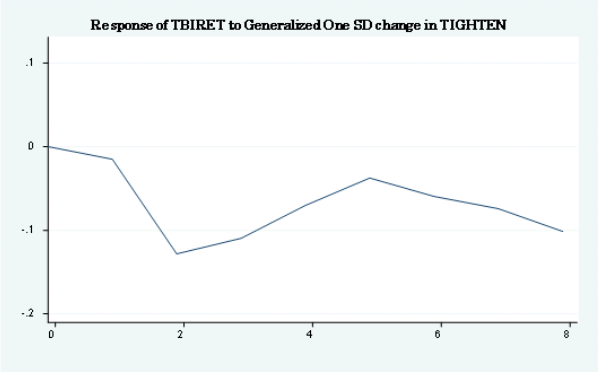


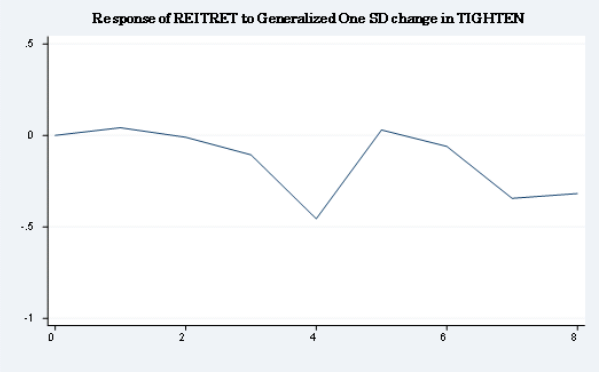
Figure 3: Impulse Response Functions

This figure plots the generalized impulse response functions corresponding to the estimated VAR models in Table 3 and Table 4. Our measure of credit availability, *TIGHTEN*, is the net percentage of loan officers reporting a tightening of lending standards on commercial real estate loans in the Federal Reserve Board's *Senior Loan Officer Opinion Survey on Bank Lending Practices*. Our measure of price changes in the private commercial real estate market, *TBIRET*, is the natural log of the quarterly percentage change in the aggregate TBI price index. The MIT Center for Real Estate produces the TBI (Transactions–Based Index of Industrial Commercial Property Investment Performance) in association with the National Council of Real Estate Investment Fiduciaries (NCREIF). The TBI is a hedonic price index that estimates quarterly market price changes based on the verifiable sales prices of properties sold from the NCREIF database each quarter. Our measure of price changes in the public commercial real estate market, *REITRET*, is the natural log of the quarterly appreciation component of the return on the FTSE NAREIT Equity Index. Members of NAREIT include REITs and publicly-traded companies that own, operate and finance income-producing real estate. The sample period spans 1992:Q2-2009:Q4.

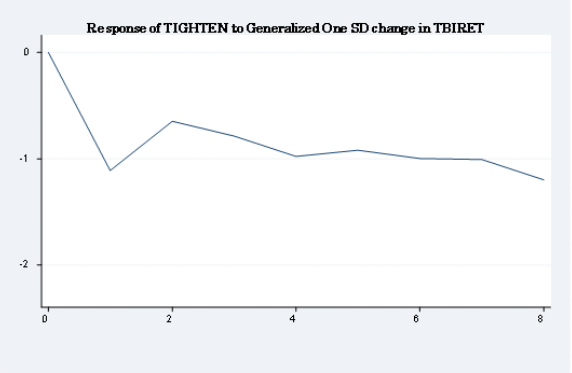
Panel A: Credit Availability and Private Market Prices



Panel B: Credit Availability and Public Market Prices



Panel C: Private Market Prices and Credit Availability



Panel D: Public Market Prices and Credit Availability

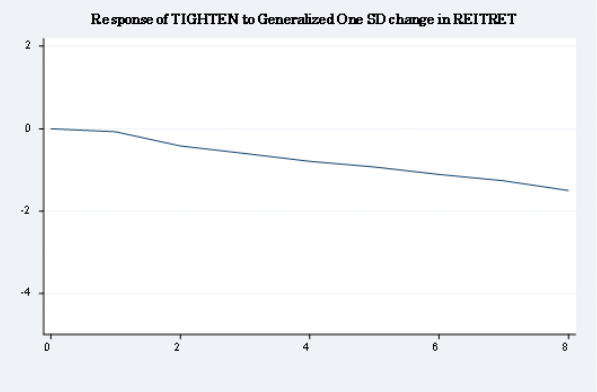


Table 1: Descriptive Statistics

This table reports descriptive statistics for our measures of credit availability, market liquidity (illiquidity), price returns, and control variables. Mean, median, standard deviation, minimum, maximum, and serial correlation are reported. Our measure of credit availability, *TIGHTEN*, is the net percentage of loan officers reporting a tightening of lending standards on commercial real estate loans in the Federal Reserve Board's *Senior Loan Officer Opinion Survey*. *RERC_CAPITAL* is the availability of capital measure published by the Real Estate Research Corporation (RERC) in its quarterly *Real Estate Report*. Our measure of market liquidity in the private commercial real estate market, *PROPSOLD*, is the percentage of properties sold from the NCREIF NPI index. We utilize share turnover as our market liquidity measures for the public REIT market (*REIT_TURN)*. Our measure of price changes in the private commercial real estate market, *TBIRET*, is the natural log of the quarterly percentage change in the aggregate TBI price index. Our measure of price changes in the public commercial real estate market, *REITRET*, is the natural log of the quarterly appreciation component of the return on the FTSE NAREIT Equity Index. Our control variables include the yield on three-month U.S. Treasury securities (*TBILL*), the slope of the Treasury term structure of interest rates (*TERMSPREAD*), the spread between yields on BAA rated and AAA rated corporate bonds (*DEFSPREAD*), inflation (*INFLA*), Fama-French factors, MKT, SMB, HML, augmented by momentum (UMD), the aggregate capitalization rate for commercial properties (*CAPRT*), and the dividend yield on equity REITs (*DIVYLD*). The sample period spans 1992:Q2-2009:Q4. ***, **, and * represent 1%, 5%, and 10% significance levels respectively.

Panel A: Credit Availability

	Mean	Median	Std Dev	Min	Max	Serial Correlation
TIGHTEN	0.161	0.089	0.263	-0.237	0.870	0.91***
RERC_CAPITAL	7.023	7.600	1.980	1.800	9.600	0.95***

Panel B: Market Liquidity

	Mean	Median	Std Dev	Min	Max	Serial Correlation
PROPSOLD	0.021	0.020	0.013	0.001	0.057	0.64***
REIT_TURN	1.330	0.768	1.308	0.344	6.272	0.94***

Panel C: Price Returns

	Mean	Median	Std Dev	Min	Max	Serial Correlation
TBIRET	0.008	0.010	0.046	-0.179	0.178	0.18
REITRET	0.015	0.020	0.106	-0.400	0.320	0.16

Panel D: Controls

	Mean	Median	Std Dev	Min	Max	Serial Correlation
TBILL	0.036	0.039	0.018	0.001	0.062	0.97***
TERMSPREAD	0.017	0.016	0.012	-0.006	0.036	0.93***
DEFSPREAD	0.009	0.008	0.005	0.006	0.030	0.85***
INFLA	0.006	0.006	0.009	-0.039	0.025	-0.14
MKT	0.015	0.021	0.086	-0.223	0.206	0.08
SMB	0.009	0.004	0.056	-0.108	0.191	0.03
HML	0.008	0.004	0.082	-0.320	0.239	0.16
UMD	0.017	0.019	0.097	-0.398	0.260	0.14
CAPRT	0.086	0.091	0.010	0.065	0.103	0.95***
DIVYLD	0.063	0.065	0.014	0.036	0.094	0.87***

Table 2: Correlations – Credit Availability and Asset Prices

This table reports contemporaneous correlations between our measures of credit availability and our price return indices. Our measure of credit availability, *TIGHTEN*, is the net percentage of loan officers reporting a tightening of lending standards on commercial real estate loans in the Federal Reserve Board's *Senior Loan Officer Opinion Survey on Bank Lending Practices*. *RERC_CAPITAL* is the availability of capital measure published by the Real Estate Research Corporation (RERC) in its quarterly *Real Estate Report*. Our measure of price changes in the private commercial real estate market, *TBIRET*, is the natural log of the quarterly percentage change in the aggregate TBI price index. Our measure of price changes in the public commercial real estate market, *REITRET*, is the natural log of the quarterly appreciation component of the return on the FTSE NAREIT Equity Index. The sample period spans 1992:Q2-2009:Q4. ***, **, and * represent 1%, 5%, and 10% significance levels respectively.

	TIGHTEN	*RERC_CAPITAL*	*TBIRET*	*REITRET*
TIGHTEN	1.000	-0.646***	-0.467***	-0.284**
RERC_CAPITAL		1.000	0.579***	0.228*
TBIRET			1.000	0.261**
REITRET				1.000

Table 3: VAR Results - Credit Availability and Private Commercial Real Estate

This table presents results obtained from estimating our unrestricted VAR model for the private commercial real estate market. An unrestricted p^{th}-order Gaussian VAR model can be represented as:

$$Y_t = \mu + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \ldots + \Phi_k Y_{t-p} + e_t,$$

The lag-length of the VAR is chosen by looking at the AIC, SBIC, and the likelihood ratio for various choices of *p*. We find that four lags provide the best fit. Our measure of credit availability, *TIGHTEN*, is the net percentage of loan officers reporting a tightening of lending standards on commercial real estate loans in the Federal Reserve Board's *Senior Loan Officer Opinion Survey on Bank Lending Practices*. Our measure of market liquidity in the private commercial real estate market, *PROPSOLD*, is the percentage of properties sold from the NCREIF NPI index. Our measure of price changes in the private commercial real estate market, *TBIRET*, is the natural log of the quarterly percentage change in the aggregate TBI price index. Augmented Dickey Fuller tests suggest the use of changes of our liquidity measures within our VAR system. The sample period spans 1992:Q2-2009:Q4. Our control variables include the yield on three-month U.S. Treasury securities (*TBILL*), the slope of the Treasury term structure of interest rates (*TERMSPREAD*), the spread between yields on BAA rated and AAA rated corporate bonds (*DEFSPREAD*), inflation (*INFLA*), the Fama-French factors: *MKT*, *SMB*, *HML*, augmented by momentum (*UMD*), and the aggregate capitalization rate for commercial properties (*CAPRT*). P-values are reported in parentheses. ***, **, and * represent 1%, 5%, and 10% significance levels respectively.

Panel A: Individual Lags

Endog. Variables	*TBIRET*	*ΔTIGHTEN*	*ΔPROPSOLD*
Constant	0.169**	0.852***	-0.009
	(0.015)	(0.000)	(0.591)
$TBIRET_{t-1}$	-0.235*	-1.079***	0.016
	(0.076)	(0.000)	(0.615)
$TBIRET_{t-2}$	0.165	-0.185	0.030
	(0.180)	(0.424)	(0.322)
$TBIRET_{t-3}$	-0.228	-0.118	-0.035
	(0.150)	(0.692)	(0.356)
$TBIRET_{t-4}$	-0.103	-0.622**	-0.013
	(0.466)	(0.019)	(0.714)
$\Delta TIGHTEN_{t-1}$	0.013	-0.195**	-0.015
	(0.779)	(0.021)	(0.179)
$\Delta TIGHTEN_{t-2}$	-0.099**	-0.175*	-0.020*
	(0.038)	(0.051)	(0.079)
$\Delta TIGHTEN_{t-3}$	-0.099**	-0.248***	-0.021*
	(0.043)	(0.007)	(0.073)
$\Delta TIGHTEN_{t-4}$	-0.056	-0.292***	-0.015
	(0.295)	(0.004)	(0.241)
$\Delta PROPSOLD_{t-1}$	0.043	-1.387	-0.850***
	(0.935)	(0.165)	(0.000)
$\Delta PROPSOLD_{t-2}$	0.760	-2.408**	-0.638***
	(0.233)	(0.045)	(0.000)
$\Delta PROPSOLD_{t-3}$	1.073	0.195	-0.408**
	(0.107)	(0.876)	(0.012)
$\Delta PROPSOLD_{t-4}$	0.092	0.863	-0.093
	(0.867)	(0.403)	(0.485)
Adjusted R^2	0.22	0.55	0.30

Panel B: Joint Significance

Endog. Variables	*TBIRET*	*ΔTIGHTEN*	*ΔPROPSOLD*
$TBIRET_{t-1 \text{ to } t-4}$	-0.195*	-2.004***	-0.002
	(0.074)	(0.000)	(0.740)
$\Delta TIGHTEN_{t-1 \text{ to } t-4}$	-0.243*	-0.910***	-0.072
	(0.074)	(0.002)	(0.128)
$\Delta PROPSOLD_{t-1 \text{ to } t-4}$	1.969	-2.737**	-1.989***
	(0.312)	(0.035)	(0.000)
Adjusted R^2	0.22	0.55	0.30

Table 4: VAR Results - Credit Availability and Public Commercial Real Estate

This table presents results obtained from estimating our unrestricted VAR models for the public commercial real estate market (common equity). An unrestricted p^{th}-order Gaussian VAR model can be represented as:

$$Y_t = \mu + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \ldots + \Phi_k Y_{t-p} + e_t,$$

The lag-length of the VAR is chosen by looking at the AIC, SBIC, and the likelihood ratio for various choices of *p*. Our measure of credit availability, *TIGHTEN*, is the net percentage of loan officers reporting a tightening of lending standards on commercial real estate loans in the Federal Reserve Board's *Senior Loan Officer Opinion Survey on Bank Lending Practices*. We utilize share turnover as our measure of market liquidity in the public commercial real estate market (*REIT_TURN*). Our measure of price changes in the public commercial real estate market, *REITRET*, is the natural log of the quarterly appreciation component of the return on the FTSE NAREIT Equity Index. Augmented Dickey Fuller tests suggest the use of changes of our liquidity measures within our VAR system. The sample period spans 1992:Q2-2009:Q4. Our control variables include the yield on three-month U.S. Treasury securities (*TBILL*), the slope of the Treasury term structure of interest rates (*TERMSPREAD*), the spread between yields on BAA rated and AAA rated corporate bonds (*DEFSPREAD*), inflation (*INFLA*), the Fama-French factors: *MKT*, *SMB*, *HML*, augmented by momentum (*UMD*), the dividend yield on equity REITs (*DIVYLD*), and our measure of market liquidity in the private commercial real estate market (*PROPSOLD*). P-values are reported in parentheses. ***, **, and * represent 1%, 5%, and 10% significance levels respectively.

Panel A: Individual Lags

Endog. Variables	*REITRET*	*ΔTIGHTEN*	*ΔREIT_TURN*
Constant	0.003	0.639***	0.807
	(0.977)	(0.000)	(0.167)
$REITRET_{t-1}$	0.257	-0.108	-1.239
	(0.151)	(0.628)	(0.157)
$REITRET_{t-2}$	0.258	-0.337	1.457*
	(0.129)	(0.109)	(0.079)
$REITRET_{t-3}$	0.179	-0.188	-0.281
	(0.236)	(0.316)	(0.703)
$REITRET_{t-4}$	0.044	-0.030	1.440***
	(0.698)	(0.828)	(0.009)
$\Delta TIGHTEN_{t-1}$	0.030	-0.248**	0.394
	(0.728)	(0.018)	(0.342)
$\Delta TIGHTEN_{t-2}$	-0.036	-0.250**	-0.236
	(0.677)	(0.018)	(0.571)
$\Delta TIGHTEN_{t-3}$	-0.213**	-0.103	2.018***
	(0.015)	(0.343)	(0.000)
$\Delta TIGHTEN_{t-4}$	-0.335***	-0.199*	0.844*
	(0.000)	(0.083)	(0.063)
$\Delta REIT\_TURN_{t-1}$	-0.086***	-0.004	-0.600***
	(0.006)	(0.924)	(0.000)
$\Delta REIT\_TURN_{t-2}$	0.157***	-0.039	-0.752***
	(0.000)	(0.478)	(0.001)
$\Delta REIT\_TURN_{t-3}$	0.089**	-0.011	-0.275
	(0.033)	(0.836)	(0.179)
$\Delta REIT\_TURN_{t-4}$	0.012	0.008	-0.759***
	(0.765)	(0.878)	(0.000)
Adjusted R^2	0.59	0.36	0.45

Panel B: Joint Significance

Endog. Variables	*REITRET*	*ΔTIGHTEN*	*ΔREIT_TURN*
$REITRET_{t-1 \text{ to } t-4}$	0.738	-0.663	1.377***
	(0.401)	(0.553)	(0.006)
$\Delta TIGHTEN_{t-1 \text{ to } t-4}$	-0.483***	-0.800**	3.020***
	(0.001)	(0.024)	(0.000)
$\Delta REIT\_TURN_{t-1 \text{ to } t-4}$	0.172***	-0.046	-2.386***
	(0.000)	(0.939)	(0.000)
Adjusted R^2	0.59	0.36	0.45

Table 5: VAR Results - Credit Availability and Public Market Returns (Leverage-Liquidity Sorts)

This table presents results obtained from estimating our unrestricted VAR models on portfolios based on leverage and liquidity characteristics of assets trading in the public commercial real estate market. An unrestricted p^{th}-order Gaussian VAR model can be represented as:

$$Y_t = \mu + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \ldots + \Phi_k Y_{t-p} + e_t,$$

The lag-length of the VAR is chosen by looking at the AIC, SBIC, and the likelihood ratio for various choices of *p*. Our measure of credit availability, *TIGHTEN*, is the net percentage of loan officers reporting a tightening of lending standards on commercial real estate loans in the Federal Reserve Board's *Senior Loan Officer Opinion Survey on Bank Lending Practices*. We utilize share turnover as our measure of market liquidity for REIT shares (*REIT_TURN*). Our measure of price changes in the public commercial real estate market, *REITRET*, is the natural log of the quarterly appreciation component of a value-weighted portfolio of REIT securities. Securities are assigned to portfolios based on quartile sorts on leverage ratios and share turnover. Augmented Dickey Fuller tests suggest the use of changes of our liquidity measures within our VAR system. The sample period spans 1992:Q2-2009:Q4. Our control variables include the yield on three-month U.S. Treasury securities (*TBILL*), the slope of the Treasury term structure of interest rates (*TERMSPREAD*), the spread between yields on BAA rated and AAA rated corporate bonds (*DEFSPREAD*), inflation (*INFLA*), the Fama-French factors, *MKT*, *SMB*, *HML*, augmented by momentum (*UMD*), the dividend yield on equity REITs (*DIVYLD*), and our measure of market liquidity in the private commercial real estate market (*PROPSOLD*). P-values are reported in parentheses. ***, **, and * represent 1%, 5%, and 10% significance levels respectively.

		Low Leverage			*High Leverage*	
	Endog. Variables	*REITRET*	Δ*TIGHTEN*	*ΔREIT_TURN*	*REITRET*	Δ*TIGHTEN*	*ΔREIT_TURN*
Low Liquidity	$REITRET_{t-1 \text{ to } t-4}$	0.089	-0.991**	0.290	0.438	-0.956**	-0.043*
		(0.194)	(0.013)	(0.400)	(0.146)	(0.038)	(0.057)
	$\Delta TIGHTEN_{t-1 \text{ to } t-4}$	-0.379**	-0.875***	0.164***	-1.345***	-0.487*	0.213***
		(0.047)	(0.002)	(0.001)	(0.000)	(0.082)	(0.006)
	$\Delta REIT\_TURN_{t-1 \text{ to } t-4}$	0.645	1.001	-1.975***	1.074**	0.856	-1.292***
		(0.169)	(0.717)	(0.000)	(0.035)	(0.768)	(0.000)
	Adjusted R^2	0.09	0.44	0.37	0.40	0.42	0.43
	Endog. Variables	*REITRET*	Δ*TIGHTEN*	*ΔREIT_TURN*	*REITRET*	Δ*TIGHTEN*	*ΔREIT_TURN*
High Liquidity	$REITRET_{t-1 \text{ to } t-4}$	0.258	-0.553	0.329	0.500	-0.396	-0.635
		(0.428)	(0.344)	(0.517)	(0.716)	(0.530)	(0.456)
	$\Delta TIGHTEN_{t-1 \text{ to } t-4}$	-0.652***	-0.979***	1.346**	-0.853**	-0.789**	2.016***
		(0.001)	(0.010)	(0.025)	(0.026)	(0.036)	(0.008)
	$\Delta REIT\_TURN_{t-1 \text{ to } t-4}$	0.436***	-0.081	-1.907**	0.810***	-0.086	-1.683***
		(0.000)	(0.554)	(0.026)	(0.000)	(0.589)	(0.000)
	Adjusted R^2	0.34	0.36	0.32	0.51	0.38	0.44

Table 6: VAR Results - Credit Availability and Public Market Returns (Preferred Equity)

This table presents results obtained from estimating our two unrestricted VAR models for the public commercial real estate market (preferred equity). An unrestricted p^{th}-order Gaussian VAR model can be represented as:

$$Y_t = \mu + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \ldots + \Phi_k Y_{t-p} + e_t,$$

The lag-length of the VAR is chosen by looking at the AIC, SBIC, and the likelihood ratio for various choices of *p*. Our measure of credit availability, *TIGHTEN*, is the net percentage of loan officers reporting a tightening of lending standards on commercial real estate loans in the Federal Reserve Board's *Senior Loan Officer Opinion Survey on Bank Lending Practices*. We utilize share turnover as our measure of market liquidity for REIT preferred shares (*REITPR_TURN*). Our measure of price changes in the REIT preferred market, *REITPREF*, is the natural log of a quarterly value-weighted price index for REIT preferred securities constructed with data from Thomson Reuters Datastream. Augmented Dickey Fuller tests suggest the use of changes of our liquidity measures within our VAR system. The sample period spans 1992:Q2-2009:Q4. Our control variables include the yield on three-month U.S. Treasury securities (*TBILL*), the slope of the Treasury term structure of interest rates (*TERMSPREAD*), the spread between yields on BAA rated and AAA rated corporate bonds (*DEFSPREAD*), inflation (*INFLA*), the Fama-French factors, *MKT*, *SMB*, *HML*, augmented by momentum (*UMD*), the dividend yield on equity REITs (*DIVYLD*), and our measure of market liquidity in the private commercial real estate market (*PROPSOLD*). P-values are reported in parentheses. ***, **, and * represent 1%, 5%, and 10% significance levels respectively.

Endog. Variables	*REITPREF*	*ΔTIGHTEN*	*ΔREITPR_TURN*
Constant	-0.125	0.672***	0.047
	(0.161)	(0.000)	(0.715)
$REITPREF_{t-1}$	0.190*	-0.311*	-0.310*
	(0.099)	(0.055)	(0.061)
$REITPREF_{t-2}$	0.069	-0.267*	-0.172
	(0.544)	(0.093)	(0.290)
$REITPREF_{t-3}$	-0.239**	-0.376**	-0.321*
	(0.040)	(0.021)	(0.055)
$REITPREF_{t-4}$	0.007	-0.114	-0.023
	(0.954)	(0.497)	(0.893)
$\Delta TIGHTEN_{t-1}$	-0.057	-0.245***	-0.048
	(0.397)	(0.009)	(0.619)
$\Delta TIGHTEN_{t-2}$	-0.046	-0.272***	0.083
	(0.500)	(0.004)	(0.391)
$\Delta TIGHTEN_{t-3}$	-0.191***	-0.106	0.097
	(0.006)	(0.275)	(0.332)
$\Delta TIGHTEN_{t-4}$	-0.463***	-0.202*	0.249**
	(0.000)	(0.061)	(0.024)
$\Delta REITPR\_TURN_{t-1}$	-0.049	-0.067	-0.444***
	(0.533)	(0.545)	(0.000)
$\Delta REITPR\_TURN_{t-2}$	0.125	-0.247**	-0.214*
	(0.133)	(0.035)	(0.074)
$\Delta REITPR\_TURN_{t-3}$	-0.025	-0.027	0.036
	(0.764)	(0.817)	(0.768)
$\Delta REITPR\_TURN_{t-4}$	-0.132**	0.016	0.094
	(0.022)	(0.844)	(0.256)
Adjusted R^2	0.37	0.42	0.01

Panel B: Joint Significance

Endog. Variables	*REITPREF*	*ΔTIGHTEN*	*ΔREITPR_TURN*
$REITPREF_{t-1 \text{ to } t-4}$	0.027*	-1.067**	-0.826
	(0.087)	(0.024)	(0.101)
$\Delta TIGHTEN_{t-1 \text{ to } t-4}$	-0.756***	-0.825***	0.381
	(0.000)	(0.004)	(0.191)
$\Delta REITPR\_TURN_{t-1 \text{ to } t-4}$	-0.081**	-0.326	-0.529***
	(0.011)	(0.261)	(0.001)
Adjusted R^2	0.37	0.42	0.01

Table 7: VAR Results - Credit Availability, Private Market Returns, and Investor Sentiment

This table presents results obtained from estimating our unrestricted VAR model for the private commercial real estate market, including investor sentiment as an additional endogenous variable. An unrestricted p^{th}-order Gaussian VAR model can be represented as:

$$Y_t = \mu + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \ldots + \Phi_k Y_{t-p} + e_t,$$

The lag-length of the VAR is chosen by looking at the AIC, SBIC, and the likelihood ratio for various choices of *p*. We find that four lags provide the best fit. Our measure of credit availability, *TIGHTEN*, is the net percentage of loan officers reporting a tightening of lending standards on commercial real estate loans in the Federal Reserve Board's *Senior Loan Officer Opinion Survey on Bank Lending Practices*. Our measure of market liquidity in the private commercial real estate market, *PROPSOLD*, is the percentage of properties sold from the NCREIF NPI index. Our measure of price changes in the private commercial real estate market, *TBIRET*, is the natural log of the quarterly percentage change in the aggregate TBI price index. *DRES* and *INDRES* are direct and indirect investor sentiment indices generated for the commercial real estate markets. Augmented Dickey Fuller tests suggest the use of changes of our liquidity measures within our VAR system. The sample period spans 1992:Q2-2009:Q4. Our control variables include the yield on three-month U.S. Treasury securities (*TBILL*), the slope of the Treasury term structure of interest rates (*TERMSPREAD*), the spread between yields on BAA rated and AAA rated corporate bonds (*DEFSPREAD*), inflation (*INFLA*), the Fama-French factors: *MKT*, *SMB*, *HML*, augmented by momentum (*UMD*), and the aggregate capitalization rate for commercial properties (*CAPRT*). P-values are reported in parentheses. ***, **, and * represent 1%, 5%, and 10% significance levels respectively.

Panel A: Joint Significance Using *DRES* (Direct Sentiment Measure)

Endog. Variables	*TBIRET*	*ΔTIGHTEN*	*ΔPROPSOLD*	*ΔDRES*
TBIRET $_{t-1 \text{ to } t-4}$	-0.114**	-1.451**	-0.014	-0.836
	(0.036)	(0.039)	(0.715)	(0.248)
ΔTIGHTEN $_{t-1 \text{ to } t-4}$	-0.217**	-0.953***	-0.066	-1.831*
	(0.037)	(0.000)	(0.136)	(0.053)
ΔPROPSOLD $_{t-1 \text{ to } t-4}$	1.613	-4.577**	-1.789***	-1.558*
	(0.199)	(0.045)	(0.000)	(0.054)
ΔDRES $_{t-1 \text{ to } t-4}$	0.076**	-0.167**	-0.001	-0.347***
	(0.049)	(0.029)	(0.585)	(0.006)
Adjusted R^2	0.14	0.50	0.23	0.07

Panel B: Joint Significance Using *INDRES* (Indirect Sentiment Measure)

Endog. Variables	*TBIRET*	*ΔTIGHTEN*	*ΔPROPSOLD*	*ΔINDRES*
TBIRET $_{t-1 \text{ to } t-4}$	0.122***	-1.538***	-0.011	0.038
	(0.005)	(0.006)	(0.824)	(0.622)
ΔTIGHTEN $_{t-1 \text{ to } t-4}$	-0.249***	-0.902***	-0.076*	-2.698
	(0.010)	(0.001)	(0.064)	(0.376)
ΔPROPSOLD $_{t-1 \text{ to } t-4}$	2.006	0.100	-2.285***	-79.151**
	(0.647)	(0.118)	(0.000)	(0.033)
ΔINDRES $_{t-1 \text{ to } t-4}$	0.020***	-0.085*	0.007	0.159***
	(0.000)	(0.087)	(0.228)	(0.000)
Adjusted R^2	0.35	0.56	0.29	0.06