Real Estate Bubbles:
Evidence in the Lender-Borrower Relationship

BY ROGER J. BROWN, PH.D., AND BEATE KLINGENBERG, PH.D.

IN THE TYPICAL REAL ESTATE ACQUISITION, the lender often has more money in the property than the borrower; hence, lenders influence transactions through the loan terms they offer. Indeed, buyer interest in a property at any given price is dependent on certain loan terms. When the loan terms change, the buyer's interest in purchasing the property changes, which can lead to a price change. This paper develops a bubble theory based on the connection among the loan-to-value ratio, or LTV; debt coverage ratio, or DCR; interest; and capitalization rate. It explores how data on capitalization rate trends can guide lenders and borrowers to better decisions.

Several definitions of bubbles[1] exist. This paper builds on the position that the market exhibits rational behavior; however, underlying market factors change over time, making it difficult for market participants to correctly interpret the information—in this case information garnered through loan underwriting.

Loan underwriting employs one of two risk management tools: LTV or DCR.[2] Understanding how they relate to each other and what happens in the market as the lender moves from one rule to the other is an important part of conducting business effectively despite ever-changing variables.

Borrowing money to purchase investment realty has the potential to confer two benefits on the buyer. First, if the interest rate on the loan is less than the capitalization rate, the borrower enjoys positive financial leverage in the form of cash flow that is higher than debt service. Second, if the

About the Authors

Roger J. Brown, Ph.D., *a private consultant with 35 years of experience, specializes in solving complex real estate problems. He holds a doctorate degree in finance with a concentration in real estate from Pennsylvania State University and a master's in business administration from San Diego State University.*

Beate Klingenberg, Ph.D., *is assistant professor of management at Marist College, where she is also the director of the Master of Science in Technology Management program. The authors also have published articles in the field of property management.*

borrower experiences a period of inflation that the lender hasn't anticipated—especially if the loan is granted at a fixed rate of interest—leveraged equity growth follows because the appreciation of the entire property value is credited to the borrower's equity.

The choice of how much debt to use can vary with the difference of opinion between borrowers and lenders about inflation expectations. This introduces the issues of risk and return and opportunity costs for both parties. This situation, given fixed net operating income, leads to borrower capitalization rates that differ from lender capitalization rates.[3] The connection between LTV and DCR reveals that market value may be represented as either of the two identities in Equation 1 where "constant" is the ratio of monthly installment payments required on the loan to the loan balance.[4]

$$\frac{noi}{cr} = \text{market value} = \frac{noi}{12 \times constant \times dcr \times ltv}$$

Equation 1

Setting the two expressions for market value equal to each other and solving for the capitalization rate produces Equation 2.[5]

$$cr = 12 \times constant \times dcr \times ltv$$

Equation 2

Lenders have some influence on interest rates, but because of competition and the influence of the U.S. Federal Reserve System, the lender's discretion is across such a narrow range that it is inconsequential for this article. Thus, assuming an amortization period of 360 months and exogenously determined interest rates, the choice of constant is essentially out of the control of the parties to the loan contract.[6]

A central value of discounted cash flow analysis and its appraisal analog, called the mortgage-equity method, is that these procedures provide the benefit of varying future cash flows as part of arriving at value—an advantage lacking in the older capitalization rate approach. The lender who fixes the loan to value ratio and the debt coverage ratio is, in effect, dictating the capitalization rate to the buyer. An important secondary consequence is to require the buyer to use capitalization rate as the valuation tool and to implicitly force the buyer to accept the lender's inflation expectations.

Toward the end of markets where prices rise much faster than income, the cautious lender begins to view investor bids as over-valuing the property. The lender intent on imposing both LTV and DCR requirements faces a fatal choice: Decline the loan or relax one of the underwriting standards to acquire the loan. In the former case, if other, less restrictive lenders in the market can attract this loan, the borrower is likely to go elsewhere. If the lender considers it a desirable loan to a qualified borrower, the second alternative is preferable because over time the quality of borrowers influences the quality of the lender's portfolio. Highly qualified borrowers use modern valuation techniques that attempt to forecast changing income over time. The converse, if one believes that low-quality borrowers use outmoded valuation techniques, is that the lender who fixes LTV and DCR will suffer from adverse selection because overly restrictive loan underwriting standards will attract weaker borrowers.

To use the mortgage-equity appraisal method for lending decisions that align with the borrower's use of discounted cash flow analysis for purchasing decisions, either LTV or DCR must vary. One question remains: Is the borrower better qualified to make a forecast, or simply a better forecaster than the lender?

LITERATURE REVIEW: EXAMINING NUMEROUS ASPECTS OF BUBBLES

A substantial body of literature discusses the topic of residential housing bubbles, but fewer publications cover commercial property bubbles.[7] Researchers concur that the existence of real estate cycles is accepted fact, with peaks sometimes exhibiting speculative behavior.

Using option pricing, author Steve Grenadier attempts to answer why some property types are more susceptible to bubbles than others in the article "The Persistence of Real Estate Cycles." Researchers also have considered the theoretical framework of bubbles and empirical observation of bubbles. For the latter, see "Bubbles in Metropolitan Housing Markets," by Jesse M. Abraham and Patric H.

Hendershott. In addition, "House Price Dynamics: An International Empirical Perspective," by Peter Englund and Yannis M. Ioannides, covers bubbles in several countries outside the U.S.; and "How Long Can Real Estate Investments Defy Weak Supply/Demand Conditions?," by Hessam Nadji, discusses the sustainability of current market conditions in commercial real estate.

Kyung-Hwan Kim and Seoung Hwan Shu present an empirical analysis of bubbles in Korea and Japan in the article "Speculation and Price Bubbles in the Korean and Japanese Real Estate Markets." They find that the level of interest rates have a significant impact on the existence of a bubble. In "Forecasting Prices and Excess Returns in the Housing Market," authors Karl E. Case and Robert J. Shiller develop a forecasting model based on empirical data for single-family homes. They conclude that price changes continue in the same direction for several years and are positively related to real per capita income growth, increase in adult population and the ratio of construction costs to prices. Through the article "Speculative Prices and Popular Models," Shiller also explains the results of an empirical study on the applicability of popular models to the understanding of speculative bubbles in residential housing and other markets.

Literature to date does not agree about the exact definition of a real estate bubble or how to determine if a specific market is in a bubble. Jonathan McCarthy and Richard W. Peach argue in "Are Home Prices the Next 'Bubble'?" that increases in the U.S. housing market price are attributable to strong market fundamentals—not irrational exuberance expected from a bubble market. Damir Tokic concludes in "Is There A Real Estate Bubble?" that housing bubbles are a result of a speculator-driven, demand-supply imbalance that is corrected only when interest rates rise, a potential trigger for housing bubbles to burst.

"Bubble, Bubble, Where Is the Housing Bubble?" explains a recent study conducted by Margaret Hwang Smith and Gary Smith that indicates most U.S. housing markets are not actually in a bubble, and movements of housing price indexes are inappropriately interpreted. The authors suggest a different housing-valuation model that shows many bubbles in this market are perceived, not real. In "Corporate Equity and Commercial Property Market 'Bubbles,' " Patric H. Hendershott, Robert J. Hendershott and Charles R.W. Ward discuss alternative definitions of an asset bubble and identify two main positions: that irrational market behavior cause bubbles; and that underlying factors in a rational market change over time, making it difficult for market participants to correctly interpret the information.

The authors express views that are closer to the second group, but advance a new hypothesis based on the idea that lenders and borrowers have a difference of opinion about the future of the three-way relationship among capitalization rates, interest rates and inflation.[8] The role of lenders is essential in this analysis, at the outset providing inexpensive financing to inflate the bubble and, later, withdrawing that financing and causing the bubble to deflate.

Papers that try to explain how market prices adjust to an equilibrium level need to provide a logical explanation about why market prices adjust. Property appreciation is insufficient; rather, underlying fundamentals are key. Abraham and Hendershott argue that forecasts of real house price appreciation depend on two factors: forecasts of changes in fundamentals such as real income and real after-tax interest rates, and forecasts of initial gaps between actual and equilibrium prices. And in "Further Evidence on the Existence of Housing Market Bubbles," Steven Bourassa, Patric H. Hendershott and James Murphy introduce changes in real construction costs, employment and population owing to external migration, finding that real, after-tax interest rates matter. Finally, a number of papers including one by Stephen Malpezzi titled "A Simple Error-Correction Model of Housing Prices" look at the role of the regulatory environment and local market constraints.

"Property Asset Bubbles: Evidence from the Sydney Office Market," also by Patric H. Hendershott, considers commercial real estate and includes the investors' expectations about future cash flows, comparing them with equilibrium rental income to discuss the existence of a bubble. This paper, though also interested in expected cash flows, focuses on how lenders adjust the provision of capital to borrowers by using either LTV or DCR as the risk-management tool in loan underwriting to influence price dynamics. The following model extends the work

that Patric H. Hendershott presented by including additional variables.

DEVELOPMENT OF THE MODEL—POSITIVE LEVERAGE AND GROWTH EXPECTATION

Lenders operate as a sort of governor at the market's party, monitoring the punchbowl and adding just enough juice in the form of easy credit to keep the market well lubricated, but not enough to allow the situation to get out of hand. Operationally, this restrictive behavior manifests itself as loan underwriting that moves between the two risk management tools, LTV and DCR.

Simplifying the discussion requires participants to make two assumptions. First, they should ignore tax consequences, which is justified for a variety of reasons. Investors purchasing even moderately sized real estate usually must have substantial financial resources that place them in the higher—and flat—income tax brackets. Investors presumably have similar after-tax motives. Also, because tax returns are confidential, tax benefits are not observable so empirical verification of after-tax results is essentially unavailable. The second assumption is that interest rates, at least for the first year, are fixed.

Equation 3 expresses cash-on-cash return, or cc, for an investment using 30-year amortizing debt in terms of capitalization rate, denoted as cr, interest rate, shown as i, and loan-to-value ratio, or ltv.

$$cc = \frac{cr\left[1 - \dfrac{12 \times i \times ltv}{cr\left[1 - \dfrac{1}{(1+i)^{360}}\right]}\right]}{1 - ltv}$$

Equation 3

DCR measures whether and by how much the property income exceeds the loan payments. The dollar amount of DCR in excess of unity is the same as the borrower's before-tax cash-on-cash return.

Previous empirical studies such as the analysis by Bourassa, Hendershott and Murphy indicate that changes in the real after-tax interest rate have an impact on the development of a bubble. However, those studies did not consider the role of the lender and the response to changes in the capitalization rate.

Assume that lenders' opinions of value lag behind borrowers' opinions.[9] As the difference widens, borrowers find that they apply for a loan that is 75 percent of the purchase price and get a loan that is 75 percent of the lenders' appraised value, a loan amount that is perhaps only 70 percent of the purchase price.[10] If buyers still want to buy and sellers remain inflexible on price, demanding cash, buyers must increase down payments to make up the difference. Lagging appraised values indicate a de facto change in the lenders' risk management strategy from LTV to DCR.

Why does the buyer make the concession of placing more money in the deal despite the absence of a current-year reward in the form of positive cash flow? What is it that the buyer is willing to pay for that the lender is unwilling to finance? Why does a buyer accept breakeven leverage? Buyers give up the current-year override in the expectation of future growth, shown as g, in rent and value. Introducing monotonic growth to the multiperiod discounted cash flow method of valuation converges in the limit to Equation 4.[11]

$$v = \frac{noi}{d - g}$$

Equation 4

In Equation 4, capitalization rate becomes the difference between the discount rate, or d, the investor demands and the growth rate the investor expects will produce part of the return that the discount rate represents.[12]

The expectation of future growth explains why investors increase down payments as cash-on-cash returns fall. The introduction of future growth into the capitalization rate equation essentially impounds those out-year rewards into the computation of first year return. One

might argue that making return dependent on higher cash flows to be received in the future looks more like speculation than investing. Lenders agree with this assessment and begin refusing to finance buyers' speculative behavior. Their reaction, as governors of the market, is to constrain loan amounts—the loan-to-sale price ratio—to those values supported by actual past sales, not sales that may happen based on projected higher income that may be collected. Imperfect a restraint that it might be, this behavior represents the lenders' refusal to fully participate in a bubble economy.

The term "fully participate" is chosen carefully. It may be that the immediate previous sales that the lender can observe, and does base the present loan on, were part of the bubble. Also, the pressure of deposit cost and the competition for loans carries some portion of the lender's portfolio into at least the early stages of price euphoria. However, if sanity is to prevail, lenders can lower LTVs to avoid participating in the last expansion of the bubble. Equation 5 shows the cash-on-cash with growth assumption, or ccg, which after rearrangement and simplification bears considerable similarity to Equation 3.

$$ccg = \frac{(d-g)\left[1 - \frac{12 \times i \times ltv}{(d-g)\left(1 - \frac{1}{(1+i)^{360}}\right)}\right]}{1 - ltv}$$

Equation 5

Declining LTVs continue, adjusting DCRs upward as disagreement about what the future holds widens between lenders and borrowers. The lender's shift from LTV to DCR as an underwriting tool affects how risk is distributed between the lenders' senior claim and the borrowers' subordinate claim. The borrower is in the first loss position and if the bubble deflates, the lender wants the borrower to take the loss.

It is not news that borrowers are more optimistic than lenders. Adopting 1.0 as the least stringent DCR—meaning that the property has exactly enough income to make its loan payments—the lender's margin of safety, or the extent to which NOI exceeds loan payments, is defined as excess DCR, or xdcr, in Equation 6.

$$excess\ dcr = xdcr = dcr - 1 = \frac{noi}{ds} - 1 \geq 0$$

Equation 6

When excess DCR is zero, cash-on-cash return is also zero. At this point investors partially concur, though reluctantly, with lenders and accept zero as the minimum cash-on-cash return.[13] Again the words "partially concur" are chosen intentionally. Borrowers express their disagreement with lenders by increasing equity investment. This action is exactly what the lenders had in mind. If borrowers are to reap the benefit of higher future cash flows, borrowers should finance that risk. If the loan is at a fixed rate, the lender receives none of the higher future income and, even with variable interest rates, the lender usually does not capture the full benefit.

When cash-on-cash return and excess DCR reach zero, the buyer must finance 100 percent of any price increase. With prices rising and the acquisition NOI constant, all that keeps excess DCR at zero is the reduction of the percentage of sales price that the loan amount represents. At the top of the bubble lies the question: How much additional buyer equity investment is too much to support the sellers' promise of future growth in income?

At this point, an uptick in interest rates, given the delicate balance of excess DCR and cash-on-cash return at zero, deflates the bubble.[14] At low interest rates, buyers feel that the expected growth portion of the discount rate is sufficient to justify additional investment. If interest rates remain low and buyers actually increase income following their purchase, they may find yet another buyer with even more optimism and cash, given lender constraints on LTV. This continues through the moment that interest rates increase, at which time the bubble deflates.

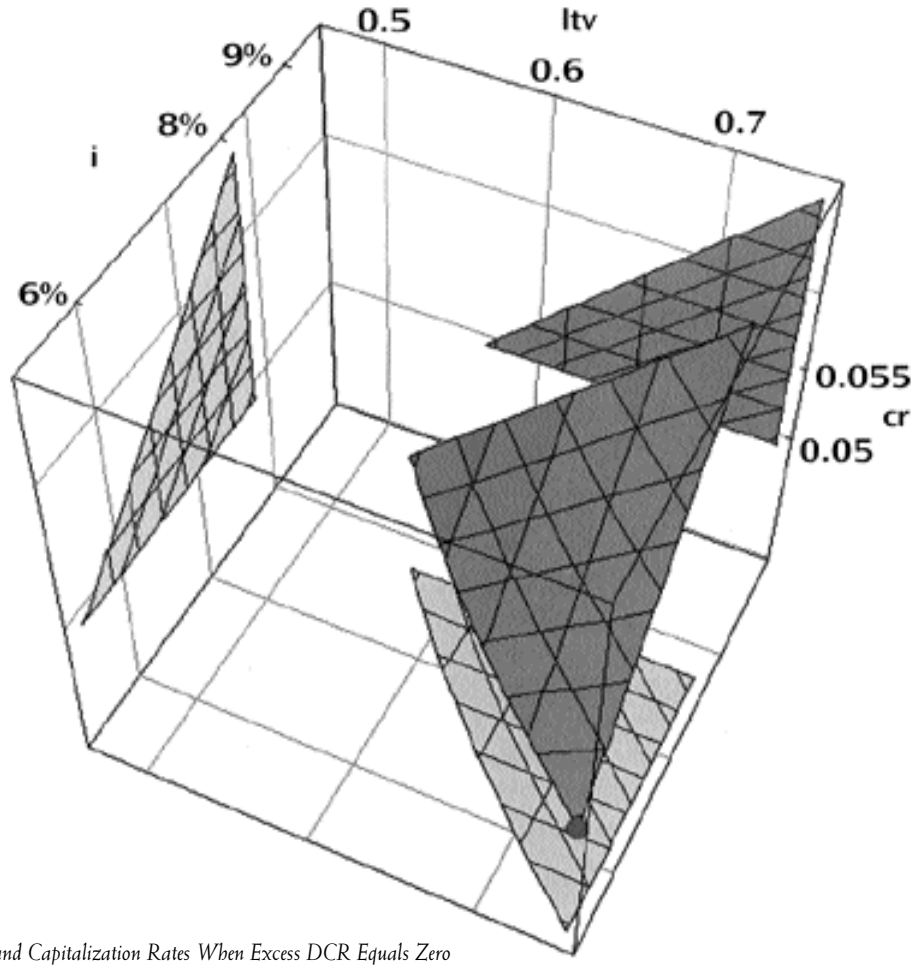


Figure 1: LTV, Interest and Capitalization Rates When Excess DCR Equals Zero

DISCUSSION OF FIGURE 1

The projected shadow on the west wall shows the range of the values of interest and capitalization rates as LTV moves through its specified range, all while excess DCR equals zero. There is one and only one point in the west wall shadow for each possible value of LTV. No transactions are possible in the white areas, given the constraint that excess DCR equals zero and the specified limits of interest, LTV and cap rates. Of course, lenders are always happy to allow transactions to take place when excess DCR is greater than zero, but in a bubble market it is assumed that buyers have pushed prices to the point where those transactions do not occur. To keep down payments to a minimum while paying high prices, borrowers apply for the maximum loan allowed, one with a payment that fully exhausts NOI. The smaller area of the shadow nearer the floor shows lenders phasing themselves out of deals as interest rates increase and capitalization rates fall because fewer values of LTV are possible in those ranges of interest and capitalization rates.

The same applies to the north wall where the shadow plot shows all combinations of LTV and cap rates, as interest moves over its specified range. As the triangle narrows traveling west the number of possible transactions shrink with higher interest rates.

Finally, the floor shows all possible values of interest and LTV as cap rates move through the specified range. Though the same effect is happening in the westward direction, the smaller end of the triangle on the floor takes on additional meaning when one recalls that the cap rate is the difference between the discount rate and growth rate.

ILLUSTRATING AND INTERPRETING THE MODEL

Recall that the difference between the discount rate and growth rate is the capitalization rate. Equation 7 combines two named variables into one.

$$xdcr = \frac{cr\left[1 - \frac{1}{(1+i)^{360}}\right]}{12 \times i \times ltv} - 1$$

Equation 7

Figure 1 depicts a three-dimensional plot of Equation 7, showing reasonable ranges of the variables. The figure depicts the bubble market balanced at a point where the three critical variables cannot move without a price reduction.

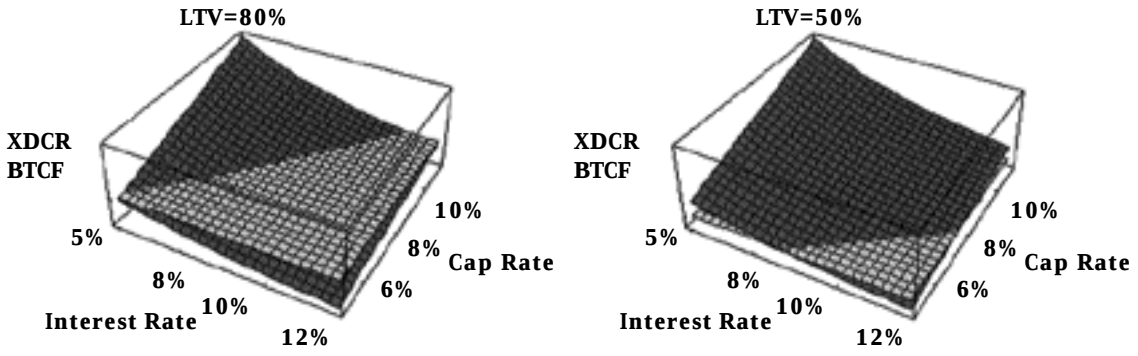
Returning to the earlier question of how much added equity is too much, the companion question is whether the last permissible capitalization rate is weighted too much toward the discount rate or growth. Though analysis cannot precisely determine the answer, common sense suggests that the growth expectations have reached the limit. There is an upper limit to how high buyers believe the market will go, how high they will project future rent increases and how little they will discount those projections. The cost of capital influences those limits. Therefore, during the last expansion of a bubble, buyer expectations are maintained solely by low interest rates.

Finally, the bubble reaches its maximum expansion when the combination of LTVs, capitalization and interest rates result in the only one permissible point where excess DCR equals zero—the balance point at the lower right corner of the center triangle in Figure 1. An increase in interest rates produces an impermissible drop in excess DCR below zero that can be avoided only by an increase in capitalization rate. If net income does not change, prices must fall.

Smaller LTVs may offset additional negative leverage. The consequence is that buyers put more of their own money into the acquisition, and depend even more on rising values to offset negative leverage and provide a long-term positive overall return. By adding cash, buyers neutralize lender funding restraint. The farthest extension of this practice is that buyers abandon debt financing altogether, purchasing property for all cash at values that do not relate to current income in any way. Before that time comes, buyers refuse to finance higher prices that implicitly require more speculative growth to justify them.

With any increase in capitalization rate, higher LTVs again become permissible at higher interest rates. As prices fall, the lender continues to rely on the DCR as the primary loan underwriting tool. Only when net income actually increases and buyers return to income-based valuation do lenders return to LTV. The rational lender uses LTV when increasing values offer the most protection; and uses DCR when net income offers the most protection. The lender's dilemma is twofold: knowing how the selection of risk management tool affects the portfolio quality, and knowing when to change from one to the other.

Figure 2: Excess DCR Against Interest and Capitalization Rates at Two LTVs



To provide another perspective, plots in Figure 2 illustrate the effect of changing LTV. Each image shows excess DCR against the same range of interest and capitalization rates. Both show a plane where excess DCR is zero; and that higher positive before tax cash flow, or btcf, rises to the rear where the highest capitalization rates and lowest interest rates are combined. Transactions may only occur where the curved plane is above the flat plane where excess DCR equals zero. Those combinations below cannot take place.

Of particular interest is the line at the intersection of the two planes. On the left, when lenders offer relatively high LTVs over a broad range of capitalization rates, the line constituting the intersection of the two planes is fairly long, indicating many transactions may occur.

On the right, because more of the curved plane is above the plane where excess DCR equals zero, it appears that more transactions can take place. However, the combination of lower LTVs and capitalization rates make the intersection line, where bubble market transactions do take place, much shorter. The lower LTV on the right provides a range of transactions at lower interest rates, generally showing up only along the west portion of the front edge of the curved plot.[15]

The investor who buys in a normal market with positive leverage—meaning the cap rate is greater than the loan constant—and positive cash flow is compensated in the acquisition year for committing down payment funds. Increases in prices and speculative fever push cash flows to zero. The only thing justifying investment is future

EMPIRICAL EVIDENCE

Table 1 reflects mean annual observations for capitalization rate and LTV on the leveraged sale of 5,331 U.S. office buildings that took place between January 1997 and February 2003.[16]

YEAR	LTV	CAP RATE
1997	73.47%	10.000%
1998	72.86%	9.325%
1999	72.66%	9.546%
2000	71.83%	9.523%
2001	71.57%	9.278%
2002	71.55%	8.909%
2003	70.20%	8.320%

Table 1: Mean Capitalization Rate and LTV

Figure 3 plots Table 1 to show that lenders do lower LTVs when capitalization rates fall. This time period was one of strong recovery for real estate in general following the recession of the mid-1990s and the stock market decline of the late 1990s.

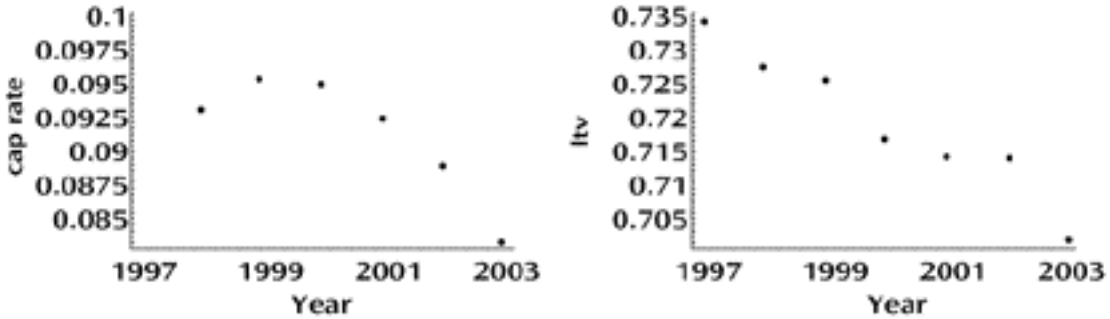


Figure 3: Office Building LTVs and Capitalization Rates

increased income with its associated increase in value. Such compensation is delayed and, therefore, subject to a discount that considers the cost of waiting and the risk. The bubble reaches its maximum size when demand stops. This occurs when there are no more dollars to chase property. The money dries up in two stages. First, lenders refuse to finance the speculative aspect of price. Second, investors refuse to discount future rents further, and will not risk larger down payments.

SUMMARY

Institutional lenders can conclude two things from this paper. One is that they should be alert to changes in the direction of capitalization rates when setting loan underwriting policy. The other is that changes in underwriting standards affect both the quality of the loan portfolio and market transaction prices.

Investors should recognize the best entry and exit points, noting how the direction of capitalization rates affects the final results. Perhaps the most astute investors in any market are those who refuse to be carried along with the crowd, sit out bubble markets and avoid auction environments. Wise real estate entrepreneurs know that they make profits on the purchase of a property; they merely collect these profits at the time of sale.

A more ambitious claim is that real estate bubble activity predicts a wave of inflation. Investors consider real estate—like other hard assets such as gold, rare coins and art—to be safe harbors when financial markets are weak. Evidence shows that hard assets tend to perform well in inflationary environments as well. If real estate investors are particularly sensitive to these potential precursors, they might be the canary in the mine shaft for inflation expectations.[17] ■

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ENDNOTES

1 The authors distinguish, by using the word "bubble," a situation of unsustainable increases in property prices not supported by a commensurate increase in income. A bubble differs in this way from cyclical price movements. (For more information, see Literature Review: Examining Numerous Aspects of Bubbles, page 38).

2 Emphasis on using *either* LTV or DCR arises from the improvidence of fixing both variables. Doing so precludes the use of the mortgage equity technique for valuation.

3 For a further analysis and discussion of capitalization rates and their relation to holding periods, see "Private Investor Holding Period" (details in References).

4 The constant is also the factor from Elwood Table No. 6—the payment to amortize $1.

5 The presence of the constant "12" in Equation 2 indicates that the loan is amortizing monthly and that the constant in use is the monthly constant. The use of the annual constant is not the same as 12 times the monthly constant. Such unfortunate complications arise from the convention of lenders requiring monthly payments while investors use annual capitalization rates.

6 This is not to preclude the borrower from electing a shorter amortization term to retire debt faster, which can occur without agreeing to a shorter loan provided prepayment is permissible.

7 See References for details about all articles mentioned in this paper. Only three papers deal explicitly with commercial real estate: "Property Asset Bubbles: Evidence from the Sydney Office Market," "Corporate Equity and Commercial Property Market 'Bubbles'" and "How Long Can Real Estate Investments Defy Weak Supply/Demand Conditions?"

8 This three-way relationship presents an anomaly. If capitalization rates are partially composed of interest rates and interest rates rise with inflation, capitalization rates should rise with inflation. In bubble markets the opposite occurs: capitalization rates fall as buyers bid up prices in anticipation of higher rents expected with inflation.

9 Some market participants question whether the issue of appraisals typically lagging transaction prices plays a role in this matter. Though this view could be argued, the model is based on a difference in opinion between the lender and borrower regarding value. How they arrived at that value is beyond the scope of the model presented in this paper.

10 This points to another subject, long discussed but never resolved: the price-value dichotomy. It is not the goal of this paper to resolve that question.

11 This is equivalent to the Gordon Growth Model in finance.

12 Clearly, d and g must be different and d must be larger than g.

13 It is possible to accept the negative cash flow that comes with negative leverage but that is beyond the scope of this paper. Borrowers otherwise willing are often restrained from doing so by lenders who prohibit it as a condition of granting the loan.

14 Author Damir Tokic anticipated this outcome, but he did so by analyzing the economic aspects of the demand-supply imbalance.

15 An animated and interactive version of this figure is at www.mathestate.com using Tutorial Tool No. 7, Real Estate Price Bubbles. The direct link is mathestate.com/tutorials/bubble1.html.

16 The authors can provide the complete dataset upon request.

17 At the time of the final draft of this paper, oil prices reached a record-high price and gold prices reached a 20-year high.