Capital Markets Impact on Commercial Real Estate Cap Rates: *A Practitioner's View*

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The historical behavior of commercial real estate market participants might seem to suggest that they pay little attention to the larger capital markets and the interconnection between the larger capital markets and commercial real estate. This blind eye was especially evident in 2007 when the subprime residential mortgage mess exploded into generalized capital markets turmoil. As credit spreads widened across every type of debt instrument, commercial real estate professionals continued to buy and sell properties at values that showed little to no adjustment. It was not until the second quarter of 2008, almost a year after the mid-2007 jump in debt spreads, that the capitalization rates associated with NCREIF NPI property sales showed material widening.

Through those months, investors fixated on transactions cap rates as a first signal that change was under way. The first hint of change was the steep decline in the number of property transactions in mid-2007, which testified to rising uncertainty. But, with few sales, the quality of information contained in transactions cap rates was diminished. In this atmosphere, commercial real estate research practitioners were asked repeatedly for insights into when and how much real cap-rate adjustment was in the offing. This article is the result of the work done to answer those questions.

The article begins with a description of cap rates and the arithmetic behind them. The next section presents an overview of previous research on commercial real estate cap rates and analogous research into corporate bond pricing. The following section introduces our model and describes it as directed toward identifying *signal variables* that point to impending changes in commercial real estate risk pricing as embodied in transactions cap rates. The examined signal variables include a variety of indicators covering macroeconomic, financial, credit, and commercial real estate factors. The model is estimated both in a long-term variant and in a short-term first-differences form that addresses nonstationarity in the long-term model. Results demonstrate that high frequency corporate bond spread data are an effective signal of impending transactions cap rate changes. The mid-2007 shift in corporate bond spreads did foreshadow the subsequent widening of cap rates.

BACKGROUND

Cap rates were originally conceived as a shorthand expression of real estate value in the primitive times before desktop computers were equipped with discounted cash flow software.[1] Arithmetically, the cap rate for property i at time t is the result of simple valuation arithmetic such that the property's net operating income (NOI) at time t is divided by its value,

$$C_{it} = \mathrm{NOI}_{it}/P_{it} \quad (1)$$

It is analogous to a pricing multiple expressed as

$$P_{it} = \mathrm{NOI}_{it}/C_{it} \quad (2)$$

More correctly, the price that an investor is willing to pay for the property depends on the present value of the stream of cash flows expected from the investment, discounted by a constant rate, r, and the expected growth in that cash flow, g. If we assume that the property is held indefinitely and that cash flow grows at a constant rate, the cap rate will approximate the difference between the discount rate and the cash flow growth rate,

$$C_{it} = r_t - g_t \quad (3)$$

Hypothetically, commercial real estate's link to the larger capital markets should be directly related to the discount rate, r, shown in Equation (3). The discount rate should reflect the opportunity cost of capital, usually portrayed as a Treasury rate, while the expected cash flow growth rate should reflect commercial real estate and macroeconomic fundamentals. A risk premia is also embedded in the discount rate that should reflect "real estate risk pricing," which should be related to the pricing of risk in the larger capital markets. The model presented here explores these hypothetical linkages.

We use macroeconomic and interest rate fundamentals, credit risk pricing, and investor risk aversion to portray capital market developments. These factors are similar to those used in models of corporate bond credit spreads. The results support the conclusion that commercial real estate pricing is integrated into global capital markets and also support the use of these factors to signal the potential for upcoming adjustments in commercial real estate pricing.

PREVIOUS RESEARCH

The determinants of commercial real estate cap rates have been found to respond to both capital market forces and commercial real estate fundamentals in a series of work published around the time of the value decline that began in 2001 (Sivitanidou and Sivitanides [1999], Sivitanides et al. [2001], and Sivitanides, Torto, and Wheaton [2003]). In the most recent of those works, Sivitanides, Torto, and Wheaton [2003] used the cap rates implied in NCREIF valuations for office properties only to test the variety of model specifications, such as metro-area-specific data for rent and rent growth, as well as capital market factors, including the real 10-year Treasury rate and inflation. Their results show that both metro-specific rent and rent-growth factors as well as the capital market factors significantly influence office cap rates. The significance of local market factors confirms similar findings in Sivitanides et al. [2001] and in Sivitanidou and Sivitanides [1999].

Beyond this work, Liow [2004] used office and retail property price indices for Singapore to show the influence of macroeconomic variables on pricing. The variables include GDP growth, growth in industrial production, unexpected inflation, short-term interest rates, and performance of a stock market portfolio. This work uses GARCH models to demonstrate that the influence of the macroeconomic measures on property pricing is time varying across the different states of the business cycle. Ling and Naranjo [1997] similarly linked U.S. real estate returns, rather than prices, to macroeconomic forces, specifically, growth in real per capita consumption, the real Treasury bill rate, the term structure of interest rates, and unexpected inflation. Their work also identifies a time variation in results.

Industry researchers have contributed to previous research as well. Conner and Liang [2004] investigated the impact of NOI changes on cap rates and calculated a "modified" duration that measures the sensitivity of cap rates to interest rate changes. Both calculations are focused on untangling the arithmetic associated with property valuation in a ceteris paribus context.

This research also draws for inspiration from corporate bond pricing research. If commercial real estate is indeed integrated into global capital markets, it competes for investor dollars with all other available investments including stocks, bonds, and other asset types. Institutional-quality commercial real estate, such as that contained in the NCREIF index portfolio, is similar to corporate bonds in that total return is largely related to cash flow on leases, which are debt instruments. Finance research offers a wealth of precedent dealing with corporate bond pricing. Here, we draw particularly from several conclusions supported by research showing corporate bond spreads to be influenced by the following:

1. Treasury rates
2. Other macroeconomic factors

3. Equity market volatility and jumps in that volatility
4. A *jump* factor that has been called liquidity shift, event risk, and/or regime shift
5. Various measures of credit risk
6. Proxies for systemic liquidity

A small sampling of contributors includes Merton [1974], Alessandrini [1999], Bevan and Garzarelli [2000], Collin-Dufresne, Goldstein, and Martin [2001], Campbell and Taksler [2002], Davies [2004], Longstaff, Mithal, and Neis [2004], DeJong and Driessen [2005], Chacko [2006], Krishnamurthy and Vissing-Jorgensen [2007], and Lin and Curtillet [2007]. Industry publications incorporating these approaches are typified by Naik, Devarajan, and Bhattacharya [2007] and have been helpful as well.

The relationship of corporate credit spreads to Treasury rates and to other macroeconomic factors essentially points to the influence of the business cycle, which will affect both systematic credit risk and its borrower-specific idiosyncratic component. Lin and Curtillet [2007] went further in this direction and established relationships between Treasury rates and various components of credit spreads.

The influence of equity market volatility points to the valuation of the default option embedded in debt instruments, drawing from Merton [1974]; it too is likely to have both systematic and idiosyncratic components. Similarly, a jump component has been assessed in idiosyncratic terms as related to the event risk associated with a particular borrower and in systemic terms where it represents a regime shift in risk pricing.

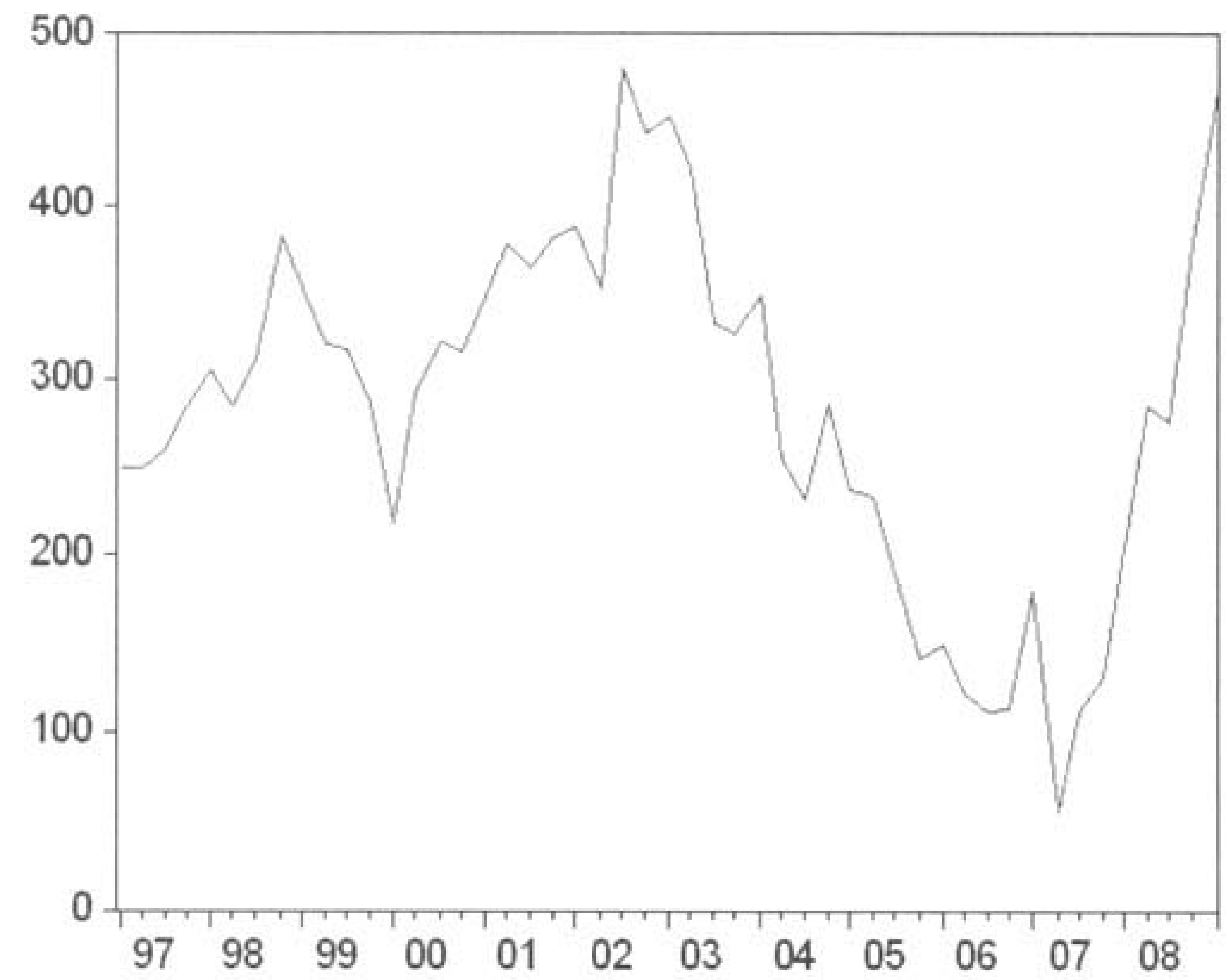
Finally, the impact of liquidity on credit risk has gotten quite a bit of attention in recent years prompted by the temporary standstill in liquidity after the 1998 financial crisis and again in 2008 ignited by Lehman's collapse. Corporate bond researchers draw from both micro-market bid–ask spreads as well as macro level measures, such as the supply of Treasuries to evaluate the relationship between liquidity and corporate bond pricing. Their work offers insight into the difficulty of defining and measuring the notion of liquidity.

EXTENSION TO COMMERCIAL REAL ESTATE CAP RATES: MODEL SPECIFICATION

The portion of the research previously described that links corporate bond pricing with the behavior of the stock market and with individual stocks points to the integration of the bond and stock segments of the capital markets. We hypothesize here that commercial real estate is integrated with them as well. If correct, that integration would suggest that the mark-to-market daily pricing produced by the bond and stock markets should provide useful signals of pricing changes that will appear later in less-frequently traded commercial real estate.

The focus of this article is on the cap-rate spread versus Treasuries (Exhibit 1) as the appropriate measure of commercial real estate pricing. Historically, commercial real estate investors have confined their attention to overall cap rates that were commonly viewed as lagging behind movements in Treasury rates and also relatively sticky. In more recent times, anecdotal evidence suggests that at least some commercial real estate investors are beginning to view the riskless Treasury rate as representing an opportunity cost. Viewed in that way, the commercial real estate investor is interested in the contemporaneous premium above the Treasury rate and the compensation it provides compared with attendant risks. This is analogous to the analysis that a corporate bond investor undertakes in order to assess the attractiveness of a bond investment. A schematic breakdown of the risk premium associated with commercial real estate investment is shown in Exhibit 2.

EXHIBIT 1
CAPSPREAD



NCREIF Transactions Cap Rate minus 10 yr Treasury rate

Exhibit 2
Risk Premia for Commercial Real Estate

	Risk Item	*What Is It?*
OTHER RISKS	**Country risk**	Related to economic, political, and currency stability, legal framework, property rights, transparency, and corruption
	Ownership structure risk	Related to JV structures and partners, specialized property types, environmental problems, and so on
	Illiquidity	Related to the transactions costs, time delay, and varying availability of buyers
REAL ESTATE RISKS	**Value-added and opportunistic risk**	Related to construction, repositioning, lease-up, and cycle timing
	Core real estate-equity	Related to rent growth, expenses, rollover, down time, cap rate uncertainties, and event risk related to ownership
	Core real estate–tenant credit risk	Credit risk including bond-like risk of credit tenants and higher risk of no credit rating
CAPITAL MARKET RISKS	**Availability and pricing of capital for risk taking**	Risk to real estate cap rates from generalized risk-pricing environment
	Inflation	Expected inflation affects slope of Treasury curve and indirectly affects real estate cap rates
	Real rate	Riskless rate varies over the business cycle and affects real estate cap rates

Our model investigates the relationship between four sets of factors and the cap-rate spread pricing of commercial real estate. The sets consist of the following:

- *Macroeconomic and interest rate fundamentals*:
  - corporate profits growth after taxes
  - core CPI and CPI
  - 10-year Treasury rate levels
  - term spread between 2- and 10-year Treasury rates
  - debt flows/GDP ratios
- *Credit risk pricing*:
  - BBB corporate spreads
  - B corporate spreads
- *Investor risk aversion*:
  - S&P volatility option, VIX, as traded on the Chicago Board Options Exchange
- *Commercial real estate performance*:
  - NCREIF NPI total return and its components
  - vacancy rates by property type

We summarize the model as

$$\text{Capratespread}_t = A_0 + \Sigma B_{0\ldots n} \text{ (macro factors, credit pricing factors, equity volatility factors, CRE performance factors)} + e$$

When viewed against the conceptual premia associated with commercial real estate investment shown in Exhibit 2, these sets of factors appear to be appropriate for testing.

MACROECONOMIC AND INTEREST RATE FACTORS

Macroeconomic and interest rate fundamentals are expected to provide an important underpinning for cap-rate spreads and thereby offer potential as a signal for cap-rate spread changes ahead. Together, they influence the real rate and the inflation premium shown in Exhibit 2. In an integrated capital market, all investments must compete for funds by first covering the generic real rate of return plus the expected inflation premium. Treasury rates are combinations of the real rate and expected inflation over the term-to-maturity of various Treasury bonds.

The real rate and expected inflation are related to the phase of the business cycle. Near the peak of the cycle, the real rate will be relatively high as monetary policy tightens to dampen brewing inflation. At such times, the inflation premium will also be relatively high. As the cycle shifts, economic growth will weaken, the real rate will ease, and inflation expectations will shrink. These forces interact through the slope of the Treasury yield curve. At the peak of the cycle, the curve will be relatively flat as short-term rates rise via tightening monetary policy and push down expectations for future growth and inflation. The curve sometimes inverts when prospects for the future weaken ahead of monetary policy loosening.

Although the Treasury rate is part of cap-rate arithmetic, it also holds potential as a signal, which justifies its inclusion in our model. Investors interpret the level of Treasury rates as indicative of the current phase of the cycle as well as a signal of where the cycle is headed. This judgment should influence the sizing of risk premia and evidence exists of this influence in the corporate bond literature.[2] On the production side of the economy, corporate profits demonstrate their own cycle separate from the interest rate cycle. Corporate profits growth typically leads the GDP cycle and sets the stage for the corporate credit default cycle.

The relative strength of debt flows is part and parcel of the business cycle. Monetary authorities flood the market with liquidity that promotes debt creation when the economy is weak in order to stimulate borrowing and investment. At the top of the cycle, liquidity is tightened with the intent of shrinking credit availability in order to slow activity and stem inflation. And debt flows are not uniform across sectors of the economy, which suggests that a variety of measures should be tested to capture the richness of the varying ebbs and flows that describe debt cycles. In the most recent cyclical run-up, debt mushroomed in the household residential mortgage sector and also in the disguise of a variety of derivative instruments that are not captured in reported debt data.

Macroeconomic and interest rate fundamentals directly affect commercial real estate. Employment growth influences the demand for space, interest rates influence the financing cycle that impacts new construction, and expected inflation, in turn, influences interest rates and, indirectly, space construction. Expected and unexpected inflation together influence commercial real estate valuation, reflecting the degree to which commercial real estate can be an effective inflation hedge.

CREDIT PRICING FACTORS

Credit pricing is also expected to affect the cap-rate spread and offers potential as a forward signal. In Exhibit 2, credit pricing is referred to as the premium related to the "availability and price of capital for risk taking." This is a generic premium over and above the real rate and inflation that comprises the riskless opportunity cost. In an integrated capital market, all investments compete for funds based on the relationship between the expected return to the perceived risk, over and above the riskless opportunity cost. The market's challenge is to ration funds among competing uses by weighing systematic risks across various asset types and then weighing idiosyncratic risks within asset types. For commercial real estate, risk pricing should reflect property investment style (core versus value-add versus opportunistic), market liquidity and attractiveness (primary versus secondary versus tertiary), and property quality (institutional versus noninstitutional). For modeling purposes, a proxy for generic risk pricing that reflects day-to-day active trading is required. The most accessible proxies are stock and bond measures, such as price/earnings ratios and corporate credit spreads.

Equity volatility is expected to affect the cap-rate spread because it is a signal of investors' risk perceptions. Rising volatility indicates rising uncertainty in the equity markets and in the investment environment as a whole.

Finally, commercial real estate performance, incorporating underlying space market fundamentals, is expected to affect the cap-rate spread. The appraisals that determine NCREIF values and that contribute to property transactions analysis procedurally incorporate a great deal of backward-looking data, which contributes to the well-known stickiness in real estate values and performance. Net operating income and market vacancy rates are among the indicators incorporated into appraisals.

DATA SPECIFICATIONS

The dataset is composed of quarterly data covering the period 1997 Q1 through 2009 Q1. The time period is constrained by the limited history of option-adjusted spread data on corporate bonds, which is drawn from the Merrill Lynch Bond Index.[3] When viewed in the context of the commercial real estate cycle, the time period starts during the upswing in the value cycle that followed the early 1990s real estate recession and ends shortly after the value peak in 2008. Cap-rate spreads widened in the financial crisis in late 1998 and remained wide through the 2001 recession and its aftermath, declining thereafter until mid-2007.

Exhibit 3 shows the means and standard deviations for the dataset as well as *t*-statistics and adjusted R-squares for each regressed against cap spread.

EMPIRICAL RESULTS: LONG-TERM MODELS

The results of simple linear regressions are shown in Exhibit 4 in addition to coefficients, *t*-statistics, and lags for all the variables. Models 1 through 5 add in the proposed signal factors in a sequential fashion and seek those that are most effective. Model 6 shortens the range and offers an out-of-sample forecast. Borrowing from Clayton, Ling, and Naranjo [2008], these estimations use the level of CAPSPREAD as the dependent variable and are deemed "long-term" models in that they ignore the nonstationarity of the data. In the next section, a "short-term" model (Model 7) that uses first differences and the Clayton–Ling–Naranjo error correction method is presented.

In Model 1, CAPSPREAD is predicted by only macroeconomic and interest rate variables. The best-fit version is shown in Exhibit 4 and includes ATPROFITS, which serves as a proxy for the phase and strength of the economy; both CORECPI and CPI as inflation measures; T10 and TSLOPE as measures of interest rates; and TSLOPE as a measure of uncertainty. The fit is improved by using a one-quarter lag on CORECPI and TSLOPE and a two-quarter lag on T10 and ATPROFITS.

The signs are largely expected. ATPROFITS and the inflation variables are negatively related to CAPSPREAD. In the rising phase of the business cycle, profits growth and inflation are both relatively high. Both variables contribute to the increasing attractiveness of commercial real estate and suggest that cap-rate tightening is in the offing. Of the

EXHIBIT 3
Data Set Statistics

	Mean	Std. Dev.	T-Stat	Adj. R-sq
APTVAC	6.53	2.25	**3.46**	**0.19**
ATPROFITS	0.87	7.95	0.62	−0.01
B35	636.51	391.08	5.56	0.38
BBB35	191.69	145.54	3.41	0.18
CAPRET	0.69	2.40	−4.92	0.33
CAPSPREAD	284.41	101.66	–	–
CORECPI	0.54	0.14	−2.44	0.09
CPI	0.60	0.68	−1.84	0.05
DRATFED	1.61	3.51	0.32	−0.02
DRATFIN	9.33	2.39	−1.28	0.01
DRATHH	6.44	2.75	−0.52	−0.02
DRATNF	2.95	1.75	−4.97	0.33
INCRET	1.84	0.32	4.04	0.24
INDVAC	6.08	1.73	−0.20	−0.02
NOIGR4	0.03	0.05	−3.20	0.16
OFFVAC	12.67	2.78	0.99	0.00
RETVAC	8.78	0.77	7.73	0.56
SPXTR	0.99	9.11	−1.14	0.01
T10	4.84	0.90	−1.25	0.01
TSLOPE	85.33	90.83	4.45	0.29
VIX	22.35	9.22	5.17	0.35

Notes: CAPSPREAD: NCREIF NPI quarterly transactions cap rate minus the 10-year Treasury rate average for the quarter; CPI: Consumer price index, changes in quarterly averages of monthly seasonally adjusted data; CORECPI: Consumer price index less food and energy, changes in quarterly averages of monthly seasonally adjusted data; ATPROFITS: After tax corporate profits with CCA & IVA, quarter-to-quarter changes; T10: 10-year benchmark Treasury rate, quarterly average of daily data; TSLOPE: 2-year Treasury rate minus 10-year Treasury rate, quarterly average; DRATFED: Ratio of Federal government debt to GDP, quarterly, Flow of Funds; DRATFIN: Ratio of financial sector debt to GDP, quarterly, Flow of Funds; DRATHH: Ratio of household sector debt to GDP, quarterly, Flow of Funds; DRAFNF: Ratio of nonfinancial sector debt to GDP, quarterly, Flow of Funds; BBB35: Option-adjusted spread, corporate BBB quality, 3–5 year duration, Merrill Lynch index, quarterly average of daily data; B35: Option-adjusted spread, corporate B quality, 3–5 year duration, Merrill Lynch index, quarterly average of daily data; VIX: Volatility of S&P futures, quarterly average of daily data; INCRET: NCREIF NPI income return, quarterly; CAPRET: NCREIF NPI capital return, quarterly; TR: NCREIF NPI total return, quarterly; NOIGR4: NCREIF NPI net operating income growth rate, four-quarter roll; APTVAC: Vacancy rate on professionally managed apartment properties, quarterly, sum of markets, Torto–Wheaton Research; INDVAC: Vacancy rate on industrial properties, quarterly, sum of markets, Torto–Wheaton Research; OFFVAC: Vacancy rate on office properties, quarterly, sum of markets, Torto–Wheaton Research; RETVAC: Vacancy rate on retail properties, quarterly, sum of markets, Torto–Wheaton Research.

EXHIBIT 4

Results of Models 1 through 7

	Model 1			Model 2			Model 3			Model 4			Model 5			Model 6			Model 7		
	Coef	T-Stat	lag	Coef	T-Stat	lag	Coef	T-Stat	lag	Coef	T-Stat	lag	Coef	T-Stat	lag	Coef	T-Stat	lag	Coef	T-Stat	lag
APTVAC													9.15	2.63	−1	6.34	1.76	−1	7.72	3	−1
ATPROFITS	−0.55	−0.38	−2																		
B35				0.18	7.13	−1	0.14	4.17	−1	0.10	4.61	−1	0.10	4.70	−1	0.11	5.27	−1	0.12	5.41	−1
BBB35																					
CAPRET																					
CORECPI	−152.76	−1.82	−1	−224.87	−3.94	−1	−193.43	−3.34	−1												
CPI	−34.17	−2.27	0	−22.47	−2.21	0															
DRATHH										−16.08	−5.80	−4	−15.48	−4.83	−4	−17.05	−5.41	−4	−16.66	−3.92	−4
DRATNF										−12.12	−2.66	−2	−20.23	−7.35	−2	−17.73	−5.57	−2	−15.89	−4.12	−2
INCRET																					
RETVAC													38.07	6.30	−2	39.99	6.79	−2			
T10	65.81	6.71	−2	55.70	8.30	−2	39.38	4.77	−2	63.59	10.40	−2									
TSLOPE	0.77	6.98	−1	0.45	5.42	−1	0.41	4.90	−1	0.66	6.73	−1									
VIX							3.73	2.38	−1												
Error Correction																			1.15	7.09	0
Adj. R-squared	0.52			0.78			0.79			0.85			0.91			0.91			0.70		
Durbin-Watson	0.58			1.13			1.27			1.30			2.33			2.21			1.91		

Notes: Model 1: Includes macroeconomic and interest rate variables; Model 2: Adds credit risk pricing variables to Model 1; Model 3: Adds equity market variables to Model 2; Model 4: Adds debt flow variables to Model 3; Model 5: Adds commercial real estate variables to Model 4; Model 6: Shorten period to end 2006 Q4; Model 7: Due to nonstationarity uses first differences and residuals from Model 5.

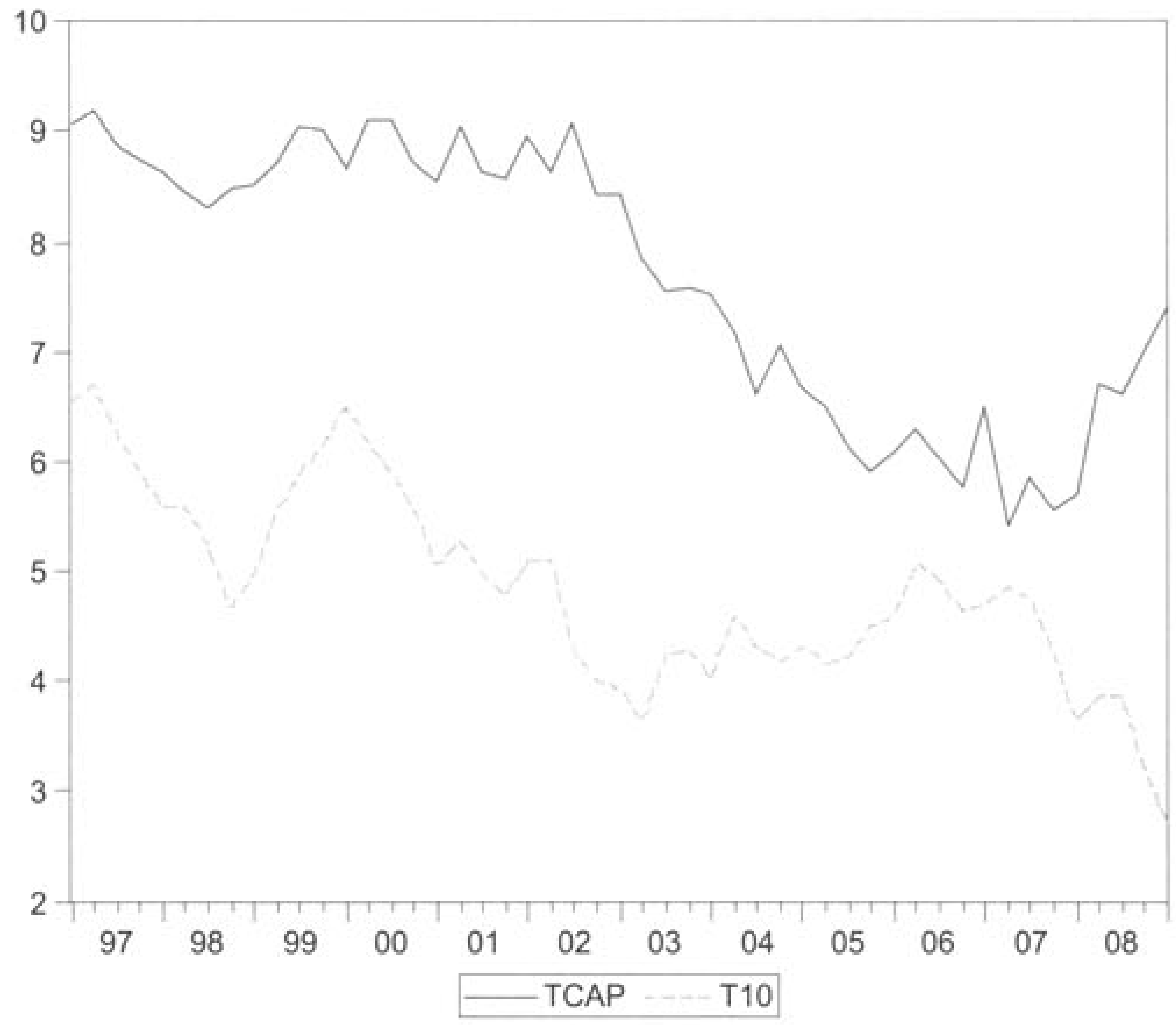
two, only the inflation variables are significant. In addition, both T10 and TSLOPE are significant and have positive signs. For TSLOPE, the positive sign is intuitive; a relatively steeper Treasury curve is a sign of rising economic uncertainty that should warn of wider CAPSPREAD. The positive sign on T10 is not so intuitive.

Arithmetically, higher Treasury rates would seem to warn of a narrowing in CAPSPREAD and credit spreads generally, all else being equal. But as demonstrated by Lin and Curtillet [2007], the relationship between Treasury rates and spreads is more complicated and depends on the story behind the position of the Treasury curve and on the specific time period examined. For the relatively short period covered in this study, the positive sign combined with the two-quarter lag on T10 probably point to the general downward trend in Treasury rates over the period rather than to cyclical swings in the yield curve. As shown in Exhibit 5, the 2001 recession was preceded by a peak T10 of almost 7% in early 2000 compared to a peak of just over 5% in mid-2007 that preceded the 2008 recession. The adjusted R-squared for Model 1 is a respectable 0.52, but the Durbin–Watson, at 0.58, is problematic.

Model 2 adds the consideration of credit risk pricing. Spreads for both B- and BBB-rated corporate bonds with three- to five-year maturities were examined. These quality categories were chosen because they represent material credit risk compared with higher-quality corporate bonds. According to S&P, BBB-rated corporate bonds had a cumulative 6.5% default rate over the 1981–2008 period, while B-rated bonds had a 35% cumulative default rate. For A- and AA-rated bonds, the cumulative default rates were 2.6% and 1.1%, respectively. The best fit was associated with B35, although BBB35 was strongly significant as well.

The sign of B35 is positive, as expected, while the signs of the other variables are also expected and unchanged versus Model 1. The inclusion of credit risk pricing in the model raises the adjusted R-squared from 0.52 to 0.78. This affirms that the credit risk pricing variable is a better signal for CAPSPREAD than

EXHIBIT 5
NCREIF Transactions Cap Rate and 10-Yr. Treasury Rate



ATPROFITS. The remaining variables are significant and with signs and lags unchanged from Model 1.

In Model 3, equity market volatility as measured by VIX is added. VIX with a one-quarter lag is highly significant with a positive sign, as expected. Higher equity market volatility indicates heightened uncertainty that should signal wider CAPSPREAD. Including VIX in the model weakens the significance of CPI to marginal, and therefore it was eliminated. In addition, the inclusion of VIX lowers the coefficient of B35. This validates the relationship between corporate credit risk and equity market volatility per Merton [1974]. Remaining variables are significant and with signs and lags unchanged from prior models. The adjusted R-squared of Model 3 is largely unchanged at 0.79.

In Model 4, measurements of macroeconomic debt flows were tested. Four measures from the U.S. Federal Reserve's Flow of Funds Accounts are included, which show the debt-to-nominal GDP ratios of federal, household, financial, and nonfinancial sectors. The best fits are associated with the household sector-to-GDP ratio and the nonfinancial sector-to-GDP ratio. The former is lagged four quarters and the latter, two quarters. Both show negative signs indicating that higher debt-to-GDP ratios are a signal of a narrower CAPSPREAD. This validates the observation that abundant liquidity is associated with compression in risk pricing. In effect, it shows "too much money chasing too few deals." Inclusion of these debt measures eliminates the significance of VIX and VIX is removed from Model 4. The adjusted R-squared improves to 0.85.

In Model 5, commercial real estate fundamentals are added. Variables for NCREIF NPI total return, capital return, income return, and NOI growth are tested along with vacancy rates for apartment, industrial, office, and retail property types obtained from the Torto–Wheaton database on a sum-of-markets basis. The best fits are associated with apartment and retail property vacancy rates, with the former lagged one quarter and the latter lagged two quarters. Signs are positive for both and validate that higher vacancy rates signal a wider CAPSPREAD. In this version of the model, TSLOPE and T10 are no longer significant and drop out. The lags and signs for B35 and the debt ratios are unchanged. The adjusted R-squared rises to 0.91 and the Durbin–Watson improves to 2.33. Model 5 is the best fit and most parsimonious model derived from the data.

Exhibit 6 shows the fit of Model 5 in Panel A and shows CAPSPREAD and B35 together in Panel B. The model obviously picks up the recent reversal in CAPSPREAD and, as shown in Panel B, validates that the shift in CAPSPREAD was signaled by the "repricing of risk" that first emerged in the corporate bond market.

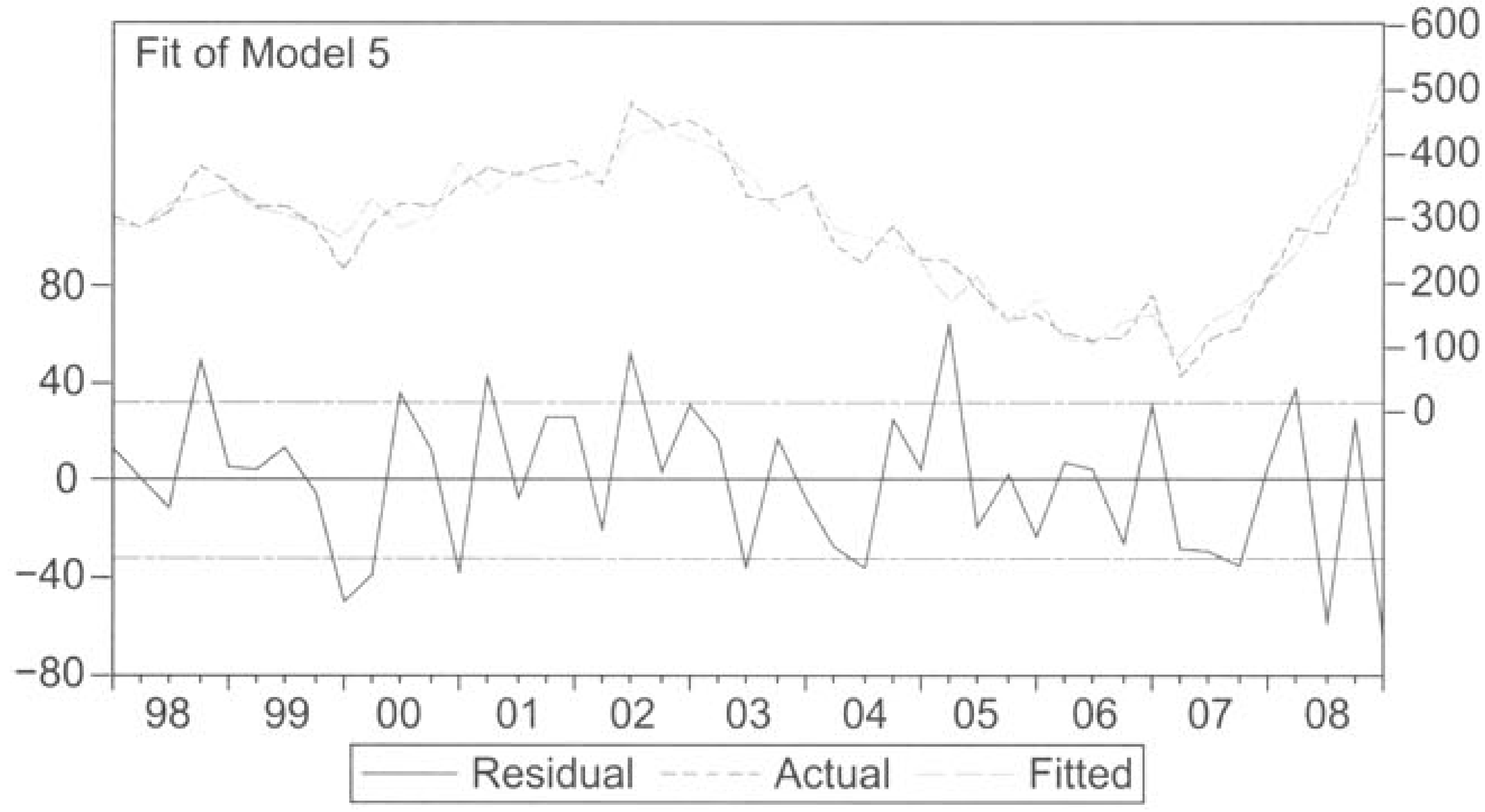
To further affirm the effectiveness of Model 5, we re-estimate using a shorter period ending 2006 Q4. The shorter timeframe deprives the model of the most recent risk repricing period. The results are shown for Model 6 in Exhibit 4. The coefficients, signs, and adjusted R-squared are little changed by shortening the data range. Next, these coefficients are used in an out-of-sample forecast for the remainder of the data range through 2009 Q1; the residuals are shown in Exhibit 7, which also illustrates the effectiveness of the model in picking up the regime shift in risk pricing in 2007. The efficacy of such short-term forecasting is questionable, however. Following Clayton, Ling, and Naranjo [2008], the model variables were found to be nonstationary using augumented Dickey–Fuller unit root tests.

EMPIRICAL RESULTS: SHORT-TERM MODELS

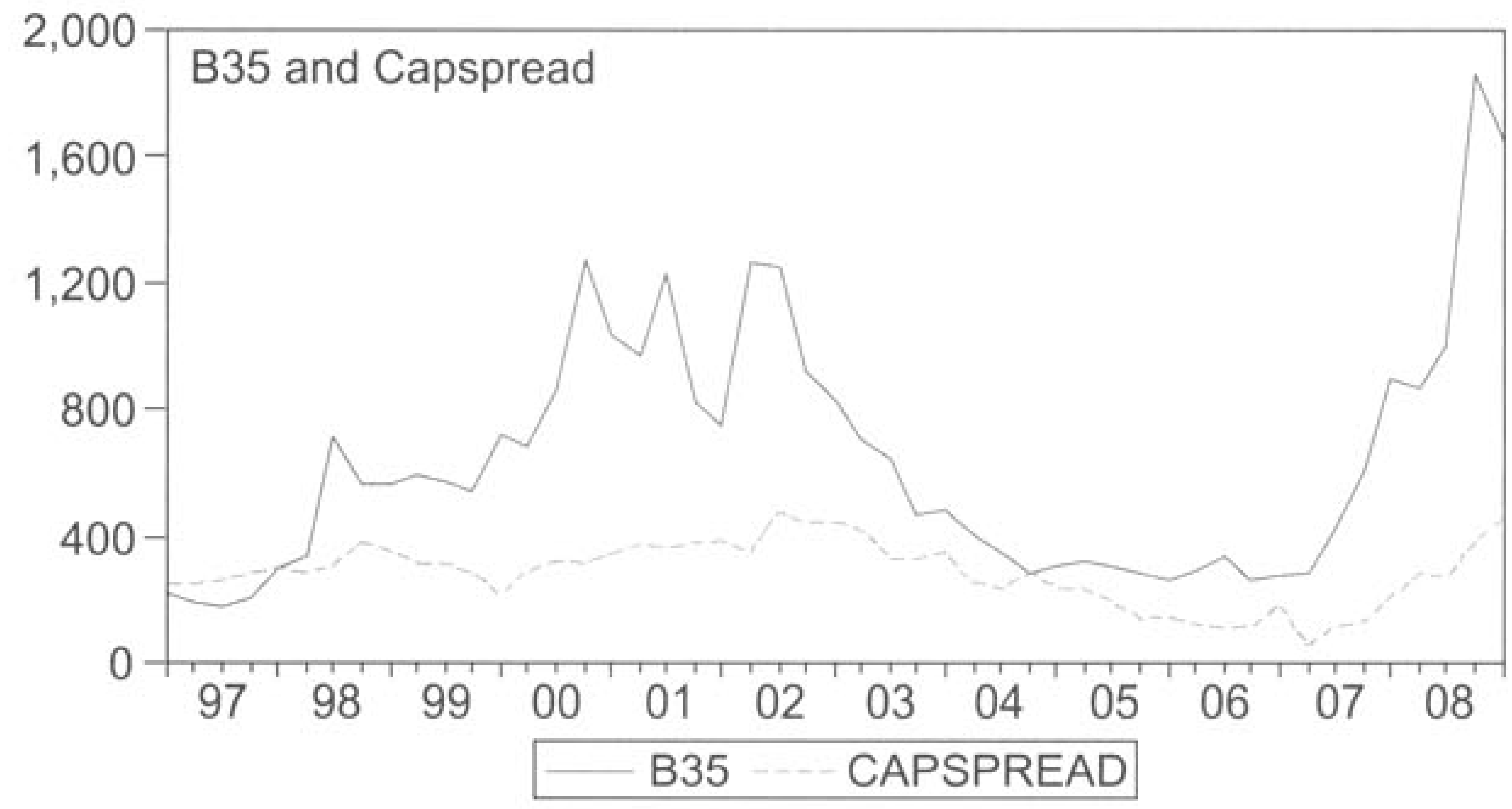
To address the lack of stationarity, we constructed Model 7, borrowing the approach of Clayton, Ling, and Naranjo [2008] and using first differences, inserting the residuals of Model 5 as an error correction term. First differences were tested for unit roots, again using augumented Dickey–Fuller tests, and found to be stationary at the 99%

EXHIBIT 6
Model 5 Fit and Out-of-Sample Forecast

Panel A



Panel B



Panel C

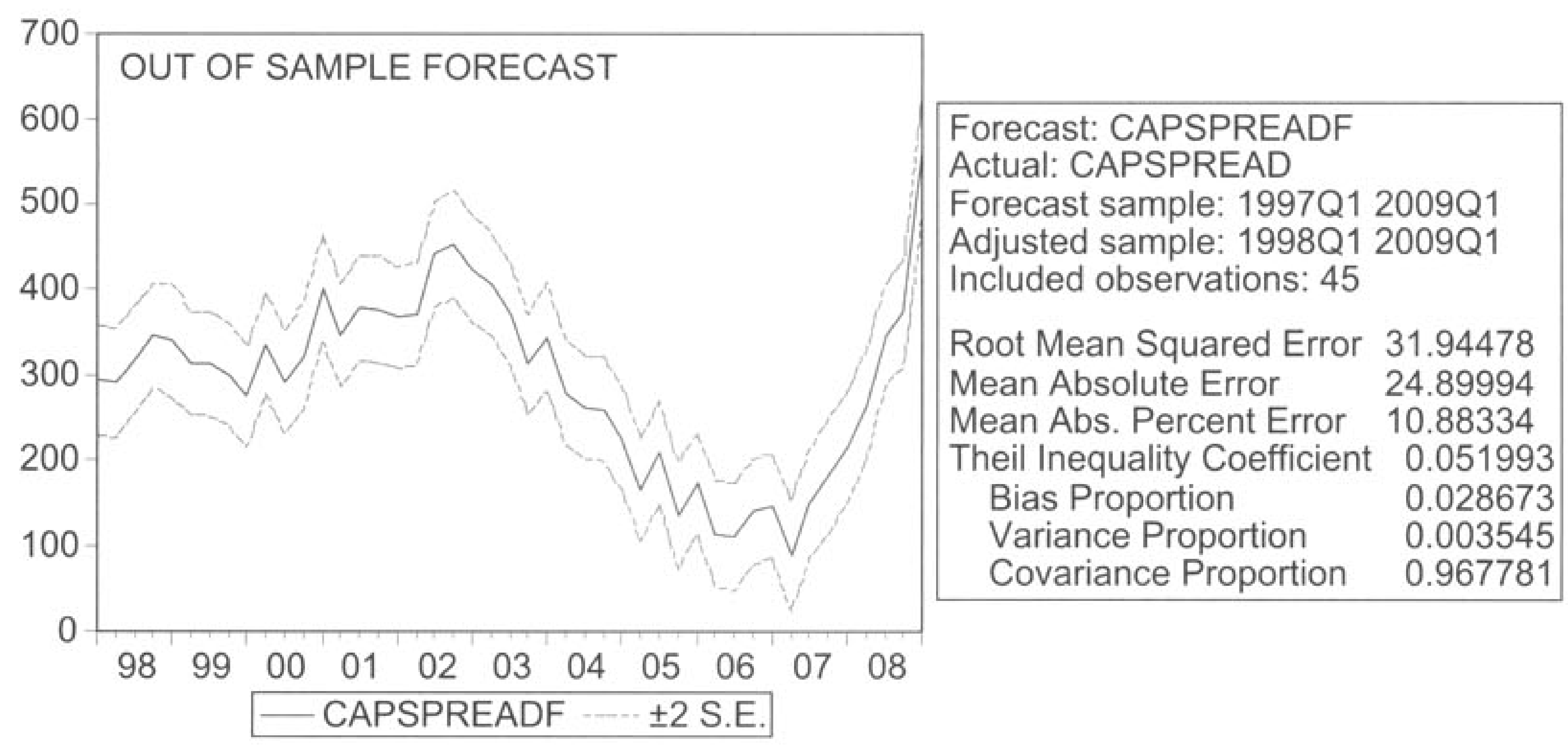
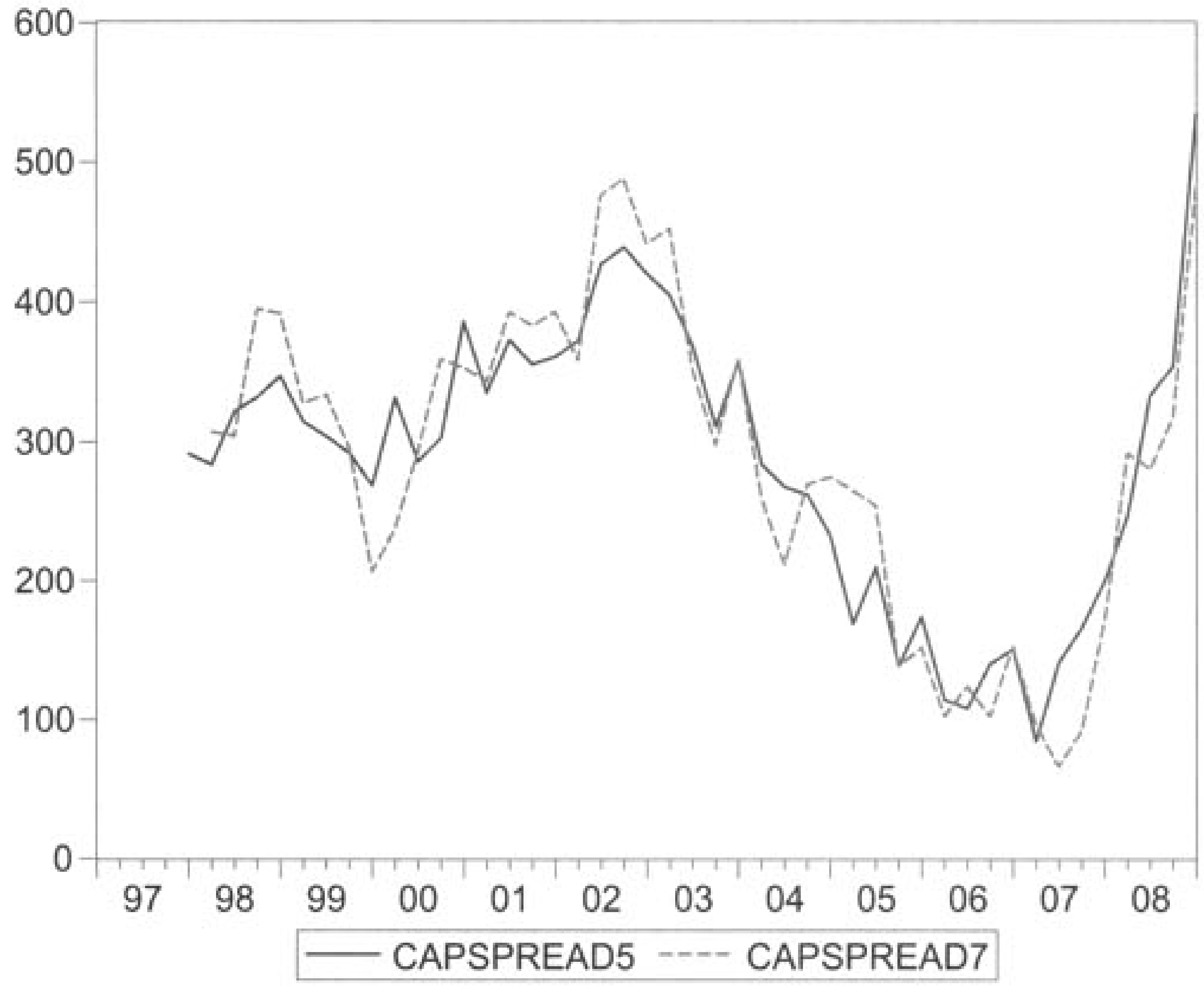


EXHIBIT 7
Fit Comparison: Models 5 and 7



confidence level, as was the error correction term. The best-fit version of Model 7 is shown in Exhibit 4.

Interestingly, the significance of the retail property vacancy rate with its two-quarter lag disappears in the first-differences model, while the significance of the apartment vacancy rate with its one-quarter lag is retained. The remaining variables retain their significance, signs, and lag structures, and are unchanged from Model 5. The adjusted R-squared for Model 7 is 0.70 and the Durbin–Watson is 1.91.

Compared to Model 5, which covers the same time period, Model 7 has a better fit, especially in the most recent quarters, as shown in the residuals in Exhibit 7. At the same time, it affirms the conclusions of the long-term model with regard to the influence of the various signal factors on commercial real estate cap rates.

A PRACTICAL APPLICATION OF THE MODEL

The model developed in this article has a variety of applications. It was originally conceptualized to address a very practical question that arose in mid-2007 as risk pricing in financial markets shifted upward after a long period of very abundant capital flows and compressed pricing. As credit spreads ratcheted upward, commercial real estate investment managers pondered the degree and timing of impact on commercial real estate pricing. Without a concrete understanding of the degree of integration and the lag structure of commercial real estate pricing vis-á-vis the larger capital markets, it was easiest for managers to rely on their "gut." Optimists tended to expect little impact on commercial real estate, while pessimists feared the polar opposite.

In order to address this void, the model's application as a forecasting tool was developed. The long-term model is useful for this purpose because all the signal variables are in lagged form so that the forecast for the period ahead is based only on what is "known" at any point in time. We use the variables in Model 7 and data for the period through 2007 Q2 to formulate Model 8. The results are shown in Exhibit 8 and correspond to the period before any cap-rate response to the regime shift in financial markets. In Model 9, we show adjustments for nonstationarity using the method described earlier and pared to include only significant independent variables.

When we used the coefficients in Model 8 and data through 2007 Q2, we produced the forecast of a 147-basis-point (bp) cap-rate spread for 2007 Q3. The forecast overshot the 111 bps actual by 36 bps. Using Model 9, first-difference data for 2007 Q2 produced a forecast of a 79 bp change in the cap-rate spread for 2007 Q3, which overshot the 55 bps actual by 24 bps, indicating a better fit versus Model 8. In order to apply the models to longer-horizon forecasts requires forecasting the inputs and introducing the attendant forecast risk. In practice, we attempted longer-horizon forecasts using several scenarios for the required inputs.

This exercise is helpful to commercial real estate investment managers in that it offers a dimension to potential

EXHIBIT 8
Results of Forecasting Application

	Model 8			Model 9		
	Coef	T-Stat	Lag	Coef	T-Stat	Lag
APTVAC	6.48	1.79	−1			
B35	0.11	5.11	−1	0.07	2.44	−1
DRATHH	−17.29	−5.68	−4	−17.43	−3.73	−4
DRATNF	−18.86	−6.32	−2	−16.27	−3.89	−2
RETVAC	40.62	6.90	−2			
Error Correction				−1.13	−6.00	−1
Adj. R-squared	0.92			0.64		
Durbin-Watson	2.38			1.74		

Notes: Model 8: Use only lagged independent variables and shorten to end 2007 Q2; Model 9: Due to nonstationarity use first differences and residuals from Model 8.

cap-rate spread widening. Without such dimensioning, managers have nothing more than the dueling judgments of optimists and pessimists. The forecasts provide reassurance that historical relationships support the expectation of a muted and delayed response of commercial real estate pricing relative to the meltdown in the larger financial markets, as shown in high-yield corporate spreads.

CONCLUSION

Our research supports the conclusion that commercial real estate pricing, as reflected in the NCREIF NPI transactions cap-rate spread, is predicted over short periods of time by macroeconomic and financial market conditions and commercial real estate market fundamentals.

The model validates the integration of commercial real estate into the larger capital markets most vividly through the significance of corporate bond spreads. This suggests that commercial real estate investors are not oblivious to risk-adjusted returns available from other asset types. The one-quarter lag attached to the corporate bond variable along with the rather small coefficient is likely a reflection of commercial real estate's pricing protocols.[4] Unlike corporate bonds, commercial real estate trades infrequently and requires a lengthy and costly transaction process; the pricing that emerges from this process is less readily available and less transparent than pricing of publicly traded corporate bonds. At the same time, this process serves to cushion, but not disconnect, commercial real estate pricing from the volatility of publicly traded assets.

ENDNOTES

[1]Capitalization (cap) rates are the ratio of net operating income (NOI) to property value.

[2]Avramov, Jostova, and Philipov [2005] showed that the level of Treasury rates influences changes in corporate bond spreads.

[3]Option-adjusted spreads are desirable because they take into account the value of embedded options and use an effectively duration-matched Treasury rate.

[4]In Model 7, the first-differences model, the coefficient of delb35 is 0.12, which means that for a 100 bp increase in B-rated corporate spreads, cap rates would increase by 12 bps.

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