Condos and Co-ops

Abstract. **Prices and characteristics were collected for two similar, adjacent buildings. One building, a co-op, has a master mortgage with a prepayment lock-out, while the other building, a condo, has no master mortgage. They provide a natural experiment to isolate the capitalization of financing terms. The research provides the clearest demonstration to date of the impact of financing terms on sales price. The value of the prepayment lock-out is estimated, using a stochastic simulation, as a function of the level of interest rates, rate volatility and time remaining on the lock-out provision. Prices for co-op units are found to fluctuate with the value of the prepayment lock-out. The value of the lock-out is overcapitalized in the price of co-op units. Co-op status reduces the value of apartments by about 9%.**

Introduction

In 1967 a complex of three buildings, in the same architectural style, was built in northwest Washington DC. In 1980–81 two of the buildings were converted from rental property to owner-occupancy. One became a co-op, the other a condo. The co-op obtained a 30-year master mortgage, at a then attractive 10% interest rate, with a 15-year prepayment lock-out, followed by a declining prepayment penalty. The condo had no master mortgage.

Since purchasing a unit in the co-op requires assuming a share of the master mortgage's payments, economically rational, fully informed buyers and sellers will capitalize the value of any unusual financing provisions in the sale price of the units. Previous researchers, examining below-market rate mortgage terms, calculated the value of the financing under the assumption that interest rates were not stochastic. This line of research usually found incomplete capitalization–sales prices were increased by the financing, but by less than 100% of the financing's value. This article suggests an alternative method for calculating the value of unusual financing arrangements attached to the purchase of owner-occupied housing. A dynamic stochastic simulation of the time path of interest rates is used to calculate an expected value of the difference in payment streams between the co-op's mortgage and a standard condo mortgage. This estimated value is then used in a hedonic regression to predict the selling price of units in the co-op. By adding data from the adjacent, virtually identical condo building, a sharper estimate of the value of the financing

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terms can be obtained, as well as an estimate of the effect of co-op status vs. condo status.

The remainder of the article is laid out as follows. The first section reviews the literature on pricing mortgage features. This is followed by a discussion of the model used to value the terms of the co-op's mortgage. Then the hedonic model used to test for capitalization effects is presented. The next section discusses the characteristics of the two VanNess buildings and describes the multiple listing service data used to test the market's value of the blanket mortgage. Finally, an empirical section tests the market's pricing of the co-op's financing.

Previous Research

A series of papers written in the mid–1980s, many collected in a 1984 special issue of Housing Finance Review, found incomplete capitalization effects for below-market assumable mortgages. Most researchers calculated the value of the below-market financing using the Cash Equivalence method, which assumes that the current difference between the mortgage rate and the market rate will continue for the remaining term of the mortgage. Smith, Sirmans and Sirmans (1984) and Strathman, DeLacy and Dueker (1984) made some adjustments to the cash equivalence measure, assuming that the below market mortgage would refinance in five years, and include an estimate of the tax consequences of the financing.

Cash Equivalence (or some variant) is then included in a hedonic regression with property characteristics, and the coefficient on the value of the financing terms is interpreted as a measure of capitalization. By and large, these articles find incomplete capitalization; the value of the property increases by some percentage of the cash equivalence value of the financing, with ''adjusted'' values coming closer to 100% capitalization. An interesting alternative method is that of Schwartz and Kapplin (1984), who match sales of Florida condominiums with concessionary mortgage terms to similar units with market rate mortgages, in place of using a hedonic regression to standardize the sales prices. In some ways this method yields a more precise estimate of capitalization than does the approach presented here, as the functional form of the hedonic regression is no longer an issue. However, their method breaks down if there is any unobserved systematic difference between units offered with and without concessionary financing.

Options models of mortgage prepayment suggest an alternative to Cash Equivalence for calculating the value of the financing in the face of volatile interest rates. The contractual provisions in the co-op's mortgage, which preclude refinancing for fifteen years (a prepayment lock-out), and assess a prepayment penalty afterwards, can be thought of as an option whose value is driven by a stochastic variable, the current rate of interest. Given the complexity of the declining prepayment penalty in the contract, a simulation strategy can be employed to ''price the option.'' Similar techniques have been used by Berry and Gehr (1985), Hall (1985) and Leung and Sirmans (1990) to value simpler mortgage terms.

Mortgage Valuation

The master mortgage that was signed in April 1980, when the VanNess North was converted to a co-op, carries a fixed interest rate of 10%, and a 30-year amortization schedule. There is a prepayment lock-out for fifteen years. In April 1995, the mortgage could be prepaid with a 5% penalty. The penalty declines by one percentage point annually until April 2000 when the mortgage can be prepaid without penalty. At the time of conversion, new purchasers could chose their LTV, up to 90%. Most buyers chose the maximum, but some did not. By 1994, amortization and property appreciation had lowered the master mortgage obligation to about 45% of value for units whose first purchaser chose the maximum mortgage balance. However, a few units that had been encumbered with little or no mortgage obligation at the time of conversion had much smaller master mortgage obligations, and two units sold with no master mortgage balance at all.

A simple method was needed to value this rather complex option. The valuation was done with a spreadsheet simulation. Quarterly mortgage interest rates from 1984–94 were obtained in order to measure volatility. Volatility was defined as the root mean square of the first differences of the log of the quarterly rates for the previous five years. Interest rates had a pronounced downward drift for most of this period; this specification assumes that the true process is a driftless random walk.[1] The measured volatility, σ, ranged from 0.04 to 0.13.

$$\sigma = SQUARE\ ROOT(\Sigma(\ln(r)_t - \ln(r)_{t-1})^2/n). \tag{1}$$

A spreadsheet model was built that started with the log of the mortgage rate prevailing in the quarter of purchase. The next quarter added to the log of the previous quarter's rate a draw from a normal distribution with mean 0, and σ as calculated in Equation (1) with data from the preceding twenty quarters.

$$r_{t+1} = \exp(\ln(r_t) + N(0,\ \sigma)). \tag{2}$$

If the prevailing mortgage rate was sufficiently below the contract rate on the co-op mortgage, and the prepayment lock-out had expired, the prevailing mortgage rate for the quarter was assigned (a refinancing) and the refinancing costs (including prepayment penalties, if any) were included in the balance. Otherwise, the contract rate was kept. A series of candidate decision rules for the threshold refinancing difference was tested, and the series of decision rules that minimized the expected present value of the after-tax cash flows was chosen. This was done for each quarter remaining in the mortgage's term. The after-tax present value of each stream was calculated, assuming a marginal tax rate of 34.9% (the combination of 28% federal and 9.5% DC.). This process was repeated 1000 times and the value of the mortgage was taken to be the mean of the present values of the streams of after-tax mortgage interest payments.

The same procedure was followed to value a condo mortgage. In order to model the value of the master mortgage's terms, several assumptions were needed. First, it was

necessary to assume a counterfactual financing method. The model assumes that the alternative for a co-op buyer was a condo purchased with a standard, 30-year fixed-rate mortgage, non-assumable, with a 6% termination probability in each year, which reflects the annual rate of sales in the two buildings. If the mortgage terminated, the buyer obtained a new mortgage at the new prevailing rate. If rates in a future year were low enough, relative to the condo buyers' mortgage rate, the mortgage was assumed to refinance at the new rate with the payment of two points.

Second, the noninterest terms of the mortgage that the co-op would get if it refinanced had to be specified. The model assumes that the co-op will refinance into a fixed-rate mortgage, with a 10-year lock-out, for the remaining term of the mortgage. The Freddie Mac 30-year fixed-rate commitment rate was used. When/if the mortgage refinances, it will probably be into a 15-year commercial mortgage. Ten-year commercial mortgages have averaged fifty basis points above 30-year single-family mortgages during the early 1990s (Nothaft, 1994), but the class of commercial mortgages includes industrial properties, new rental projects with 70% LTVs, etc., all of which would have substantially higher default premia than would a 45% LTV co-op mortgage. In 1994/1995, 10-year lock-outs were typical for 15-year co-op mortgages, and contract rates were about the same as those on 30-year fixed-rate single-family mortgages.

The key explanatory variable in the hedonic regressions that follow is the difference between the value of the co-op master mortgage payments and the value of a condo mortgage's payments. The primary determinants of the net value of the co-op mortgage are, of course, the spread between the current mortgage rate and the co-op's 10% rate, and the length of time remaining on the prepayment lock-out or the level of the prepayment penalty.

A Model of Unit Pricing

In order to test for capitalization effects, a hedonic model was estimated to predict the sale price of units in the co-op and condo. The dependent variable is sales price per square foot, measured in nominal dollars. Independent variables are entered in levels. The choice of functional form was dictated by the fact that most hedonic studies (for instance, Blomquist and Worley, 1981) find that a log transformation fits best, but some of the independent variables in this study are clearly not multiplicative. A parking space, for instance, cannot have a proportionate effect on price, or arbitrage would result in all parking spaces being sold to the most expensive units. Coulson (1989) finds that ''those markets in which the attribute is divisible and recombinable are more arbitrageable and hence more linear than those attributes which are not.'' By focusing on price per square foot and appropriately transforming some independent variables, characteristics such as quality of view or number of bedrooms can have a roughly proportionate effect on price (as a log transform provides) while others, such as a parking space or mortgage value, have an additive effect.

The following variables are assumed to influence price per square foot of a condo or co-op unit. Square footage, *FEET*, is entered on the right hand side, allowing price

to vary with unit size. Two dummy variables, *EFFICIENCY* and *1-BEDROOM*, also allow variability by size, allowing efficiencies and one-bedrooms to have different prices. The omitted category is two or more bedrooms. Number of baths is not used as all one-bedrooms had one bath; all two-bedrooms had two baths. Another variable, *PARKVIEW*, equaled one if the unit had a view of Rock Creek Park. $FLOOR^2$ is an integer variable measuring number of floors above ground. Seasonality is captured with a dummy variable, *SUMMER*, which equals one for contracts signed from April to September. Annual time splines are entered to capture general trends in the housing market.

The variable *CO-OP* equals one for the VN North and zero for the VN East to absorb any inherent differences in the buildings beyond the effects of the blanket mortgage valuation, such as co-op vs. condo status. A negative price differential can be expected for co-ops based on DC's favorable tax treatment of co-op conversions. Rental housing converted to condominium status pays a 4.7% condo conversion fee, a 1.1% real estate transfer tax and a 1.1% mortgage recordation fee,[3] but conversions to co-op status are exempt. A developer converting a rental building to owner-occupancy is presumably indifferent between co-op conversions and condo conversions, at the same after-tax price, so the relative supply of co-ops to condos should be infinitely elastic at a price difference of about 6.9%. On the demand side, the relatively unfavorable terms for secondary financing of the 'gap' between the blanket mortgage and unit value would reduce willingness to pay for this co-op by 1%–3%.[4] Additionally, the need to accept the master mortgage's fixed-rate payment on a 15- to 20-year amortization (depending on year of purchase), and the more restrictive rules imposed by the co-op board, would reduce demand further, relative to condo status. This would also result in co-ops and condos being treated as imperfect substitutes on the demand side, as preferences for rules and mortgage terms would vary among potential demanders.

Other variables should have an additive effect on the price of the unit, instead of influencing price per foot. There are resale markets for parking spaces, and an active rental market in which occupants of one building sometimes rent spaces in the other building. Thus, the variable *PARKING* is the number of parking spaces (usually one), divided by the square footage of the unit. In this way, the coefficient on *PARKING* measures the price of a parking space. The net relative value of the portion of the co-op mortgage assigned to each co-op unit, divided by square feet, is the key independent variable. The present value of the expected difference in mortgage payments should act as a lump-sum tax, so that a $1 increase in net expected value of co-op mortgage payments (holding condo payments fixed) should translate into a $1 decrease in unit value. The coefficient on this variable measures the capitalization of the mortgage terms into the price of the co-op unit. A coefficient of one would imply that unit prices change dollar-for-dollar with changes in the value of the co-op mortgage.

$$\begin{aligned}\$/FEET = {} & \alpha + \beta_1\, FEET + \beta_2\, FLOOR + \beta_3\, (PARKING/FEET) + \beta_4\, PARKVIEW \\ & + \beta_5\, EFFIC + \beta_6\, 1BR + \beta_7 (NETVAL/FEET) + \beta_8\, CO\text{-}OP + \beta_9\, SUMMER \\ & + \beta_{i,j}\, TIME_j + \varepsilon. \end{aligned} \tag{3}$$

Data

The primary data source is Washington DC's Multiple Listing Service (MLS).[5] List price, sales price, fees, contract date, square footage, number of bedrooms, whether zero, one or two parking spaces were sold with the unit, dollar value of the master mortgage allocated to a co-op unit, and unit number were taken from the MLS sheets for units sold from January, 1989 to July, 1995. Sales with contract dates between January, 1989 and March, 1995 were kept. Sales that were clearly identified as foreclosure were eliminated. This provided 310 sales, 152 observations in the co-op and 158 in the condo. The MLS data were supplemented with interest rates from Freddie Mac.

Both buildings were designed by the same architect in the same style, with the same façade.[6] The co-op (VN North) is the taller of the buildings at sixteen stories, the condo (VN East) building is twelve stories high. VN North is split almost equally between one- and two-bedroom units, with a handful of efficiencies and three-bedrooms, while almost two-thirds of the VN East's units are one-bedrooms. Holding number of bedrooms constant, units in the co-op are slightly larger than units in the condo (see Exhibit 1). The co-op has more restrictive rules than the condo, particularly with regard to owners leasing-out units. Most importantly, the co-op has a master mortgage whose payments a new purchaser must assume.

Prices were kept in nominal dollars, as prices in the VN East, and average selling price (not quality adjusted) for condos in northwest Washington actually fell slightly over the six-year period. Price per square foot rose slightly in VN East and fell slightly in the VN North from the end of 1988 until mid-1992. Prices fell in both buildings from mid-1992 until late 1993, at which point VN East started to rise in price (Exhibits

Exhibit 1
Summary Statistics

Variable	CO-OP Mean	Condo Mean	Both Mean
$/SQ FT	117	121	119
SQUARE FEET	1218	792	1001
FLOOR	7.6	5.5	6.5
PARKING[a] (000's)	0.86	0.86	0.86
PARKVIEW	0.43	0.68	0.56
EFFICIENCY	0.05	0.23	0.15
1-BEDROOM	0.43	0.62	0.53
SUMMER	0.51	0.51	0.51
CO-OP	1	0	0.49
NETVAL[a]	−2.55	0	−1.25
CASHEQ[a]	−1.15	0	0.56

[a]These variables were calculated using square feet. For instance, a 1,200 sq. ft. unit that sold with one parking space had a *PARKING* value of (1000/1,200). A net value of −$10,000 for a 1,200 sq. ft. unit had a *NETVAL* of (−10,000/1,200).

2 and 3). VN North continued to fall into 1994, finally rising in late 1994. Washington experienced a real estate downturn during 1992–94.

The net value of assuming the co-op's mortgage fell dramatically over the period studied. From 1989 to 1991, the value is near zero as the prevailing mortgage rate is about 10%. The value is not precisely zero even when the prevailing rate is 10%, because a single-family mortgage at 10% has a prepayment option that the co-op lacks. The value of the option falls continuously through the third quarter of 1993 as interest rates fall (Exhibit 4). In the last quarter of 1993 the value turns slightly upward as the time to lock-out expiration decreases. Late in 1994, the value turns sharply upward as interest rates rise. The quality-adjusted difference in price between the two buildings generally tracks the change in mortgage value (Exhibit 5).

An after-tax Cash Equivalence value of the difference in mortgage terms was also calculated, assuming no volatility in interest rates. If the prevailing rate was low enough that the present value of refinancing was positive, the co-op mortgage was assumed to refinance, paying a 5% penalty, at the expiration of the lock-out. Under this specification, the co-op mortgage looked very attractive in 1989–90, since the co-op rate was very slightly below the prevailing rate and the co-op mortgage could be assumed without paying points. The Cash Equivalence approach ignores the substantial value of the prepayment option attached to the standard condo mortgage.

Exhibit 2
CO-OP Building
($'s Adjusted for # Bedrooms and Parking)

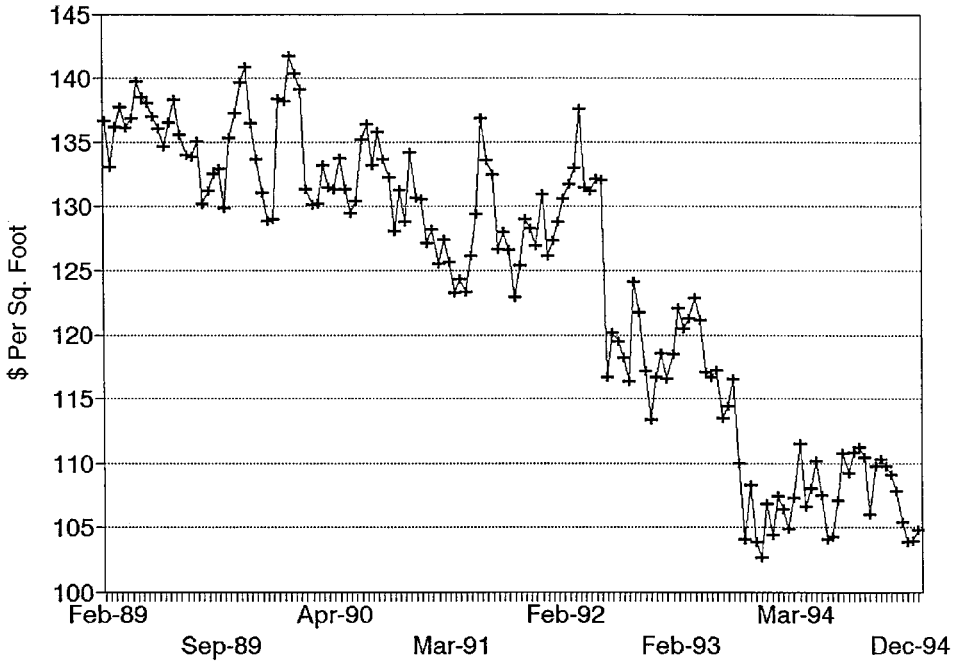
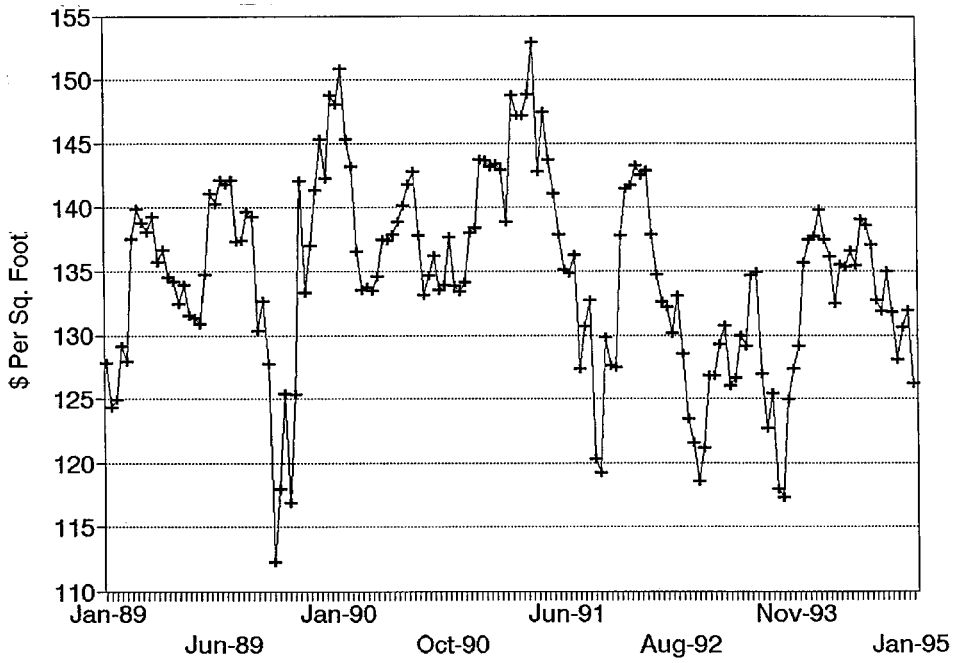


Exhibit 3
Condo Building
($'s Adjusted for # Bedrooms and Parking)



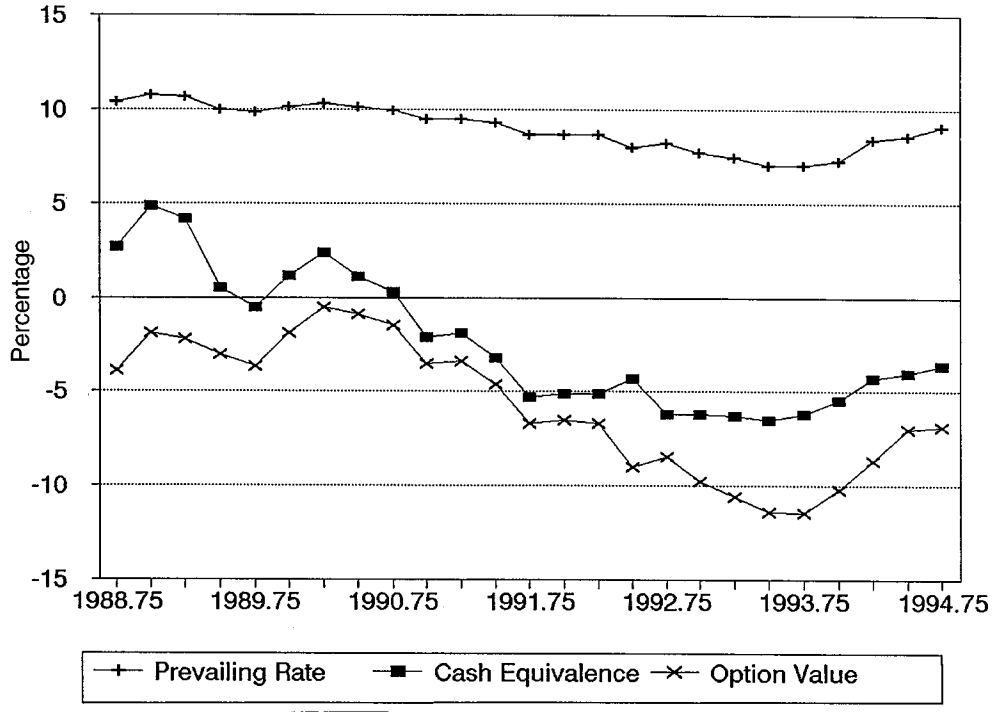
Cash Equivalence also departs from the stochastic simulation estimate in the 1993–94 period, because Cash Equivalence ignores the risk that rates would rise before the expiration of the lock-out, preventing the co-op from locking in the low rates prevailing in 1993 (this actually occurred in 1994).

Regression Results

The value of the co-op mortgage is highly collinear with the fall in neighborhood prices that occurred in 1992–93. However, the use of data from both buildings allows the separation of the mortgage effect from the general trend in prices. Regressions were run by stacking data from both buildings, with a dummy variable, *CO-OP*, absorbing any inherent differences in price between the two buildings. White's (1980) test for heteroskedasticity was applied to each specification. The null hypothesis of homoskedasticity was not rejected at 10% for any specification estimated. Additionally, there was no evidence for autocorrelation in the residuals. Thus, simple ordinary least squares is the appropriate estimation method.

The primary specification fit remarkably well (see Exhibit 6). The *EFFICIENCY*, *1-BEDROOM* and *SQUARE FEET* variables all indicated that price per square foot rises

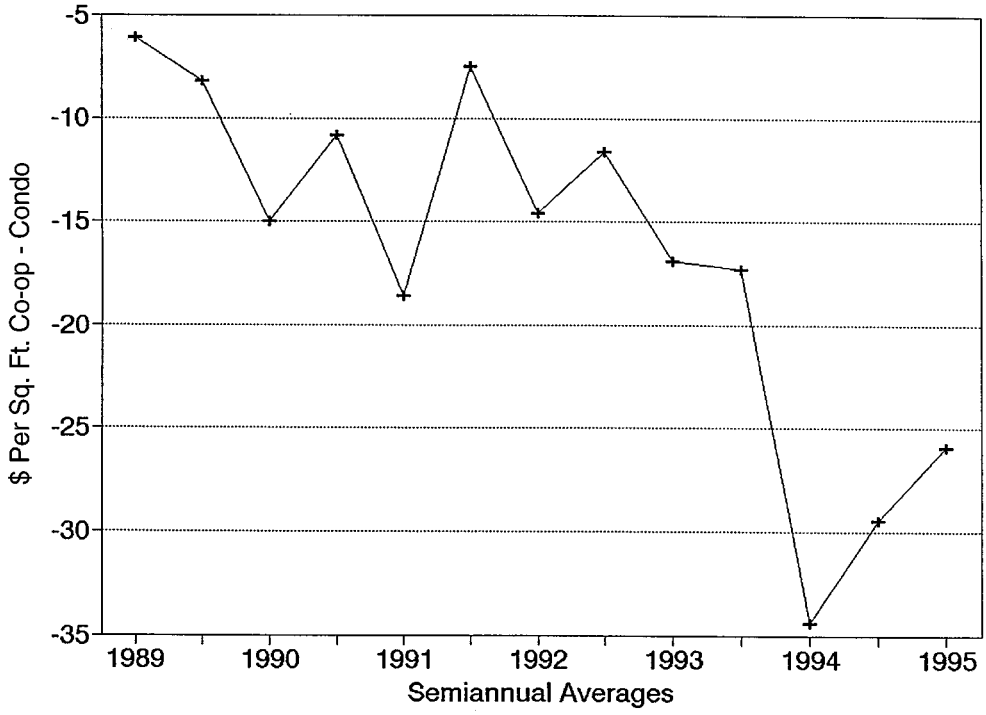
Exhibit 4
Relative Mortgage Value



with size. This is consistent with the opinion of realtors in the area, and with Stigler's survivor principle (Stigler, 1958), as a few small units have been combined over time, but no large units have been split. *PARKVIEW* and *FLOOR* are both positive, consistent with previous work by Pollard (1977) and Blomquist (1988) indicating the value of a good view as an amenity. The effect of increasing height by one floor is only a 0.6% increase in price. When shares were originally allocated at the time of the co-op's conversion, the number of shares increased by 1% per floor. *PARKING* adds almost $8,000 to the price of a unit. That agrees with the handful of parking spaces that sold over the time period for prices between $5,000 and $11,000.

The coefficient of 1.88 on *NETVAL* in the first specification provides evidence for overcapitalization of the above-market terms of the co-op mortgage. Each $1.00 drop in the value of assuming the co-op's blanket mortgage produces a $1.88 decline in the selling price of a co-op unit. This is in contrast to the conclusions of studies of below-market financing where incomplete capitalization is usually found. In the second specification, which uses Cash Equivalence in place of the stochastic simulation, the coefficient is 2.18, even farther from 100% capitalization, and the standard error of the coefficient is larger (although the R^2s are identical). In the third specification, which does not include any measure of financing differences, the R^2 and adjusted R^2 are lower.

Exhibit 5
Price Difference
(Adjusted for Unit Characteristics)



Before offering explanations of overcapitalization, it is important to note that the capitalization coefficient is significantly greater than zero, but only one standard deviation above one. The null hypothesis of 100% capitalization is not rejected, but the magnitude of the coefficient is large enough to warrant a discussion of possible explanations.

There are several plausible explanations for the measured overcapitalization. The first is simple, the 'marginal transactors' in the co-op may have had marginal tax rates lower than that assumed in the model. The median selling price in the co-op is $138,000, slightly higher than the $124,000 median price of owner-occupied housing in DC in 1990 (Census). If the median income of owners is slightly higher than the $49,000 for DC owner-occupants (Census), the median owner would be at the high side of the 28% bracket for single-filers and the low side of 28% for married-filers. But, the building has several occupants and a few potential buyers who may be in lower tax brackets, either because they are foreign nationals working for the World Bank, etc., or because they are retirees living on assets. If they represented marginal buyers in some time periods, the after-tax mortgage differences may overstate the net difference in mortgage terms.[8]

Exhibit 6
Regression Coefficients

	Specification 1		Specification 2		Specification 3	
Variable	BETA	*t*-Stat	BETA	*t*-Stat	BETA	*t*-Stat
INTERCEPT	114.83		112.75		115.55	
SQUARE FEET	0.01	2.3	0.01	2.4	0.01	2.3
FLOOR	0.81	3.8	0.81	3.8	0.85	3.9
PARKING	7.91	5.8	7.93	5.9	8.01	5.9
PARKVIEW	0.70	0.4	0.51	0.3	0.61	0.4
EFFICIENCY	−21.18	−5.0	−20.91	−4.9	−21.27	−4.9
1-BEDROOM	−14.60	−5.2	−14.39	−5.1	−14.95	−5.3
SUMMER	1.73	1.2	2.17	1.5	1.89	1.3
Y1989	0.35	1.0	0.53	1.4	0.37	1.0
Y1990	−0.30	−1.0	−0.35	−1.2	−0.22	−0.8
Y1991	0.07	0.2	0.17	0.5	−0.10	−0.3
Y1992	−0.54	−1.5	−0.63	−1.7	−0.66	−1.8
Y1993	−0.29	−0.8	−0.37	−1.0	−0.42	−1.2
Y1994	−0.23	−0.7	−0.19	−0.6	−0.09	−0.3
CO-OP	−10.53	−3.9	−13.21	−6.2	−15.43	−7.8
NETVAL	1.88	2.7				
CASHEQ			2.18	2.7		
R^2	.554		.554		.530	
Adjusted R^2	.531		.531		.521	
df	294		294		295	

The second explanation is that overcapitalization reflects risk aversion. The purchase of a housing bundle that includes above (or below) market financing is, essentially, the purchase of an interest rate derivative. The value of the financing element of the housing bundle may be much more volatile than other components. This is especially true if, as seems likely, mortgage interest rates are more volatile than house prices. Additionally, typical homebuyers may have little familiarity with the pricing of complex financial instruments, leading them to attach substantial uncertainty to their estimates of the value of unusual financing terms. Under these circumstances, risk-averse homebuyers would offer less than the expected value for favorable, but risky, financing and would accept unfavorable, risky financing only if offered a price reduction in excess of its expected value. The combination of risk-averse buyers and the uncertain value of financing terms could explain both the undercapitalization of favorable financing and the overcapitalization of unfavorable financing.

The estimate of the coefficient on the *CO-OP* variable implies an estimated 9% difference between condo and co-op prices (a $10.53 discount on a $119 mean price per square foot). This is not significantly different from the 6.9% discount expected based on DC's favorable tax treatment for co-op conversions. Goodman and Goodman (1995) find a 7%–30% discount for co-ops in their nationwide sample, depending on the bundle of characteristics priced, with a 12% discount implied by their preferred specification. However, Goodman and Goodman do not include financing terms in their regressions, so their estimate represents the sum of the value of financing and

any inherent difference caused by co-op status. The effect of mortgage terms may have been negative and substantial, as the year they chose for their estimation, 1987, was a ten year low for mortgage rates. Many of the co-ops in their sample may have had above-market contract mortgage rates. In the third specification reported in Exhibit 6, in which financing terms are excluded from the regression, co-op status is estimated to reduce apartment values by 13%, close to the value found by Goodman and Goodman.

Conclusion

The regressions indicate that co-op units are worth about 9% less than comparable condo units, when the attached financing is equivalent to that available in the condo market. It is interesting to note that the board of this co-op considered conversion to condo status until a hired consultant estimated conversion costs at 10% or more of building value, and at least two co-ops in the Virginia suburbs are in the process of converting to condo status. However, to date no co-op in the District of Columbia has ever converted to condo status (Richards, 1994).

Unlike previous research, which indicates incomplete capitalization of unusual financing terms, this article finds more than 100% capitalization of the terms of the co-op mortgage. Risk aversion is consistent with both under-capitalization of below-market terms and over-capitalization of above-market terms. Low tax rates for marginal buyers could also contribute to this result.

The research does indicate that co-op prices are determined by the value of the underlying financing. A straightforward stochastic estimate of the value of complicated financing terms is shown to be systematically related to co-op prices.

Notes

[1]Figlewski (1994) finds that the best prediction of future volatility is given by historical volatility measured over a long time period (five to ten years) and assumes a mean first difference of zero.

[2]The buildings are built into the slope of a hill. The ground floor may be the first through the sixth. It was necessary to consult a floor plan to turn the unit number into *FLOOR*.

[3]The legal status of mortgage recordation fees for these co-ops is unclear.

[4]Secondary financing on individual co-op units, called 'share loans,' is usually available at twenty-five to fifty basis points above the prevailing mortgage rate. An after-tax present value on 100% share loan financing discounted at a 5% after-tax discount rate would imply a 3%–7% disadvantage for co-ops. As this co-op has a master mortgage averaging 45%, share loan financing would be needed for less than half the unit value.

[5]Missing or questionable data were provided by building managers.

[6]The construction and history of the VanNess complex is described in Goode (1988).

[7]Another specification was tried in which the dependent variable was the Box-Cox transform of price per square foot. Estimating λ with a grid search between 0 and 1 yielded a maximum R^2 of $\lambda=1$. Expanding the grid search led to an R^2 maximizing $\lambda=1.7$. However, the improvement in R^2 over the specification reported in the text was only .03. As the improvement in fit is modest, and the coefficient on the variable of interest has a clear interpretation when the dependent variable is not transformed, the Box-Cox results are not used.

[8]A specification that uses the before-tax mortgage differences in place of the after-tax mortgage differences yields a capitalization coefficient of 1.48 in place of the reported 1.88. As few buyers would be in a zero tax bracket, this places an upper bound on the extent to which overcapitalization may be driven by low marginal tax rates.

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