Estimating the Value of Apartment Buildings

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Abstract
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This article applies hedonic modeling techniques to estimate the value of a sample of apartment properties sold in the greater Portland, Oregon area. An equation for value as a function of location, amenities and capitalization rate is derived. This model explains about 95% of the variation in apartment property prices. Property values decline with increasing distance from the city center. Moreover, values are shown to rise less than proportionally to increases in project size and numbers of units and decline with project age, but the marginal effect of project aging is small.

Introduction
Valuation of apartment projects is important to appraisers, investors, tax assessors and other real estate market participants. This study applies hedonic modeling techniques to estimate the value of a sample of apartment properties sold during 1996–99 in the greater Portland, Oregon area. The results provide a model of the application of hedonic modeling to apartment valuation.

Literature Review
A number of studies have sought to explain the rent paid in the market for rental units using hedonic price theory. This hedonic approach is developed in the work of Lancaster (1971), Rosen (1974) and others. This literature has been reviewed by Jud, Benjamin and Sirmans (1996). A recent study of the relationship between rents and distance is available in Soderberg and Janssen (2001). In addition, Frew and Wilson (2000) examine the rent-distance relationship in the Portland area.

Property rents and values are related through the capitalization (cap) rate. The cap rate as used in the real estate literature refers to the ratio of net operating income (NOI) to property value. This rate has a particularly important role in property
valuation, because the income capitalization method converts the expected NOI stream from commercial property into an estimate of asset value by dividing the net NOI stream by the capitalization rate (Brueggeman and Fisher, 1993: 438). Because NOI is the difference between effective rents and operating expenses, property value is fundamentally related to rents and the cap rate, if expenses are a constant fraction of rents.

The cap rate bears a close relation to the weighted average cost of capital (WACC) as defined in the corporate finance literature (Copeland and Weston, 1988). The WACC is the rate of discount that reflects the average costs of debt and equity capital employed by a firm. Discounting the cash flows from corporate assets at the WACC reveals the value of the firm. The relation between the WACC and firm valuation has extensive theoretical underpinnings extending from the firm valuation work of Modigliani and Miller (1958). Sharpe’s (1964) development of the capital asset pricing model (CAPM) revolutionized stock portfolio theory and provided a widely accepted method to empirically estimate the cost of equity, which as this paper shows, is an embedded component in the cap rate.

Empirical work in the real estate literature seeks to explain the cap rate relative to other rates and macroeconomic factors (Froland, 1987; and Evans, 1990). Ambrose and Nourse (1993) develop an investment approach based on the WACC; however, they do not incorporate the CAPM in their model. Instead, they rely on the intuitive argument that debt rates on mortgages should be related to government debt rates and that the cap rate should be related to the earnings-price ratio.

Jud and Winkler (1995) draw on the theoretical underpinnings of the WACC and the CAPM models in the corporate finance and investment literature to develop a theoretic model of the capitalization rate for real estate properties. Recognizing the imperfect market conditions inherent with real estate transactions, they use a lag component process for market variables as suggested by Evans (1990). The resulting empirical model explains a substantial portion of the variation in cap rates.

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**Empirical Model**

Most studies of apartment rents employ some variation of the following model:

$$R_i = \Phi(D_i, L_i, A_i, u_i),$$  \hspace{1cm} (1)

where, $R_i$ = rent of the $i$th rental unit, $D_i$ = distance, $L_i$ = a vector of variables describing the location of the $i$th unit, $A_i$ = a vector of variables describing the amenities of the $i$th unit, and $u_i$ = a stochastic term. This hedonic approach looks
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at rent as being determined by the location and other attributes (or amenities) of the property.

In the appraisal literature, the income approach to value traditionally has estimated the value of income-producing properties (such as apartments) using the income-capitalization model:

\[
Value_i = \Theta(R_i - E_i, C_i, u_i)
\]  

where, \(Value_i\) = the value of the \(i\)th rental unit, \(E_i\) = operating expense of the \(i\)th rental unit and \(C_i\) = the applicable capitalization rate.

Assuming that operating expenses are a constant fraction of rents and the capitalization rate is constant, Equation (1) can be substituted into Equation (2), yielding:

\[
Value_i = \Psi(D_i, L_i, A_i, u_i)
\]

The Sample City: Portland, Oregon

The data for this study are drawn from a sample of apartment buildings in Portland, Oregon, which is located just south of the Columbia River (the river forms the boundary with the state of Washington, see Exhibit 1). The City of Portland itself has a population of just over half a million residents and posts $6 billion of retail sales per year. The greater Portland/Vancouver (Washington) metropolitan statistical area (MSA) includes six counties and has about 1.75 million residents. The MSA records annual sales of over $18 billion, which makes it the 27th largest commercial area in the country. Retail trade is spread among the area’s seven regional shopping malls and 327 community shopping centers. This MSA is the largest commercial center between Seattle, Washington and San Francisco, California (Oregon, 2001).

Portland has grown rapidly during the last decade. The metro area population has increased by over 20% in the last eight years and is expected to grow by another 20% over the next ten years. The city began as a “lumber camp” town on the Willamette River, where it crosses the Columbia River, which provides deep-water access to the Pacific Ocean and makes Portland an inland seaport. Seagoing vessels have always brought supplies to Portland, just as the harvested lumber has been towed by tugboat to other destinations. Today, the port serves growing Pacific Rim shipping traffic and the main economy has been transformed into the “silicon
forest” as hi-tech firms have moved north from California. Today, Intel’s headquarters is in Portland and the firm is the second largest employer in Oregon.

Though still primarily a medium-sized, monocentric city, continued growth will soon transform the area into a multi-centric metropolex, as the city merges with Vancouver, Washington, immediately to the north, and grows south toward Salem, Oregon’s state capital. This area already contains one of the most diversified economies on the West Coast. Together, the financial services, retail sales and manufacturing sectors constitute the majority of the area’s employment. Many office buildings and 147 industrial parks are spread throughout the area (Oregon, 2001).

Many analysts view the Portland experience as a prime example of restrictive urban growth boundaries (UGBs), which many urban areas have recently adopted to avoid the problems of urban sprawl. Portland’s metropolitan UGB boundary was adopted twenty years ago and has not been extended during the recent surge in population growth. The sharply increased population density that has resulted
now makes Portland comparable to European style cities, which have a much steeper rent gradient than do their American counterparts. Urban planners are presently debating the relevant benefits of these two land use patterns. Should the Portland area continue to be the model to emulate or has the boundary now become too restrictive for the American lifestyle?²

With the rapidly increasing property values, many speculators have entered the Portland, Oregon market to buy real estate assets, especially apartment buildings. This has led to a more rapid turnover, as local owners have been induced to sell their properties to distant investors. With a long list of sales per period, a well-organized market for these listings has developed. Financial theory predicts that well-organized markets will have less price variation than markets where sales are sparse and market equilibrium price is harder to determine. Hence, a regression model of apartment sales should explain a high percentage of the variation in prices in the Portland area.

Regression Estimates

Equation (3) is based on a sample 129 apartment properties that sold in the Portland area during 1996–99.

The variables used in the study are:

- Value\_i = Sales price;
- D\_i = Distance to the center of Portland;
- Sq. Ft\_i = Square footage of rental space;
- Land\_i = Land area;
- Age\_i = Age of the project;
- Units\_i = Number of units;
- TPay\_i = Total payroll in the zip code;
- Asal\_i = Average salary in the zip code; and
- Baa\_i = Baa bond rate.

Exhibit 2 presents the means, standard deviations other descriptive statistics for all the variables.

The variables for total payroll (TPay\_i) and average salary (Asal\_i) are used as proxy variables for the level of neighborhood amenities. The total payroll variable measures the level of commercial activity in the neighborhood, while the average salary variable is a measure of the affluence of neighborhood residents. Both of these variables are obtained from the City of Portland Planning Department for the year 1998.

The variable (Baa\_i) is the average Moody’s Baa bond rate. This variable serves as a proxy for the apartment capitalization rate.³

The estimates of Equation (3) are shown in Exhibit 3. All of the variables in the estimated model were included in logarithmic form, so that the estimated variable
### Exhibit 2 | Portland Apartments: Sample Descriptive Statistics

<table>
<thead>
<tr>
<th>Value,</th>
<th>D,</th>
<th>Sq. Ft,</th>
<th>Land,</th>
<th>Age,</th>
<th>Units,</th>
<th>TPay,</th>
<th>Asal,</th>
<th>Baa,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max.</td>
<td>16.731</td>
<td>2.219</td>
<td>12.489</td>
<td>13.390</td>
<td>4.727</td>
<td>5.762</td>
<td>0.897</td>
<td>-3.007</td>
</tr>
<tr>
<td>Min.</td>
<td>11.826</td>
<td>0.000</td>
<td>7.525</td>
<td>8.132</td>
<td>-743.054</td>
<td>1.609</td>
<td>-2.919</td>
<td>-3.975</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>1.032</td>
<td>0.740</td>
<td>1.045</td>
<td>1.254</td>
<td>92.580</td>
<td>1.009</td>
<td>0.996</td>
<td>0.245</td>
</tr>
<tr>
<td>Skewness</td>
<td>1.045</td>
<td>-0.651</td>
<td>0.877</td>
<td>0.546</td>
<td>-7.842</td>
<td>0.890</td>
<td>-0.192</td>
<td>0.340</td>
</tr>
<tr>
<td>Sum</td>
<td>1758.503</td>
<td>163.411</td>
<td>1231.527</td>
<td>1321.771</td>
<td>-1059.585</td>
<td>370.010</td>
<td>-130.942</td>
<td>-460.937</td>
</tr>
<tr>
<td>Sum Sq. Dev.</td>
<td>136.279</td>
<td>70.042</td>
<td>139.711</td>
<td>201.166</td>
<td>1097085.000</td>
<td>130.230</td>
<td>127.078</td>
<td>7.683</td>
</tr>
</tbody>
</table>

Note: In the table, \( n = 129 \).
coefficients may be interpreted as elasticities. The equations are estimated using the White (1982) adjustment for estimating a heteroscedasticity consistent covariance matrix in the presence of heteroscedasticity of unknown form.

In Panel 1 of Exhibit 3, all of the independent variables with the exception of the total payroll variable (TPay<sub>i</sub>) and average salary (Asal<sub>i</sub>) variables are statistically significant at the .05 level or better using a one-tailed test. As expected, the coefficient on the distance variable is negative, indicating that moving away from the center of the urban area reduces the value of the apartment project. A 1% increase in distance is associated with a 0.08% reduction in apartment value.

Increases in rentable square footage and land area are strongly associated with higher values. A 1% rise in square footage raises apartment value by some 0.54%, while a 1% expansion of land area increases value by 0.11%.

Expanding the number of rentable units also raises apartment value, but the increase in value is less than proportional to the increase in units. A 1% rise in the number of units is estimated to be associated with a 0.32% increase in value.

Age reduces value, as expected, but the effect of increasing age is relative modest. The estimated coefficient on the age variable indicates that a 1% increase in age is associated only with a −0.0004% reduction in value.

Neighborhood effects also influence value. An increase in the level of commercial activity in a neighborhood, as measured by TPay<sub>i</sub>, is associated with a reduction in apartment value, although the effect is not statistically significant. On the other
hand, higher neighborhood income, as measured by $Asal$, is associated with higher apartment value, but again the effect is not statistically significant.

In Panel 2 of Exhibit 3, the bond rate variable ($Baa_i$) is included to control for possible changes in the capitalization rate. The variable is not statistically significant and has the wrong sign. Thus, over the period of the sample, changes in capitalization rates were not substantial enough to substantially affect values.

Exhibit 4 plots the actual and projected sales prices (log price) for the 129 properties in the sample, using the estimated equation shown in Exhibit 3, Panel 1. The correspondence is quite close. The absolute mean error of the forecast is 0.161, while the sample mean for all sales is 13.632. The average percentage error of the forecast is 1.18%.

**Conclusion**

This study applies hedonic modeling techniques to estimate the value of a sample of apartment properties sold during 1996–99 in the greater Portland, Oregon area. The results provide a model of the application of hedonic modeling to apartment valuation. The findings show that using hedonic techniques it is possible to effectively value apartment properties.

The results for the Portland area show that apartment values decline with increasing distance from the city center. Values are shown to rise less than
proportionally to increases in project size and numbers of units. Market values decline with project age, but the marginal effect of project aging is small. The effects of neighborhood on value are mixed. Values decline with increasing economic activity in the neighborhood and rise with resident income, but the effects are not statistically significant at reasonable probability levels.

Endnotes

1 The desire to stop this type of urban sprawl has lead to one of the hottest political debates in the recent history of urban affairs. Reporting on the 1998 election results, Egan (1998) concludes: "Nationwide, voters approved nearly 200 state and local ballot initiatives on curbing sprawl." He elaborates: "On election day, voters from Southern California to New Jersey showed that the sprawl issue may have become a political driving force . . . voters across the country and across party lines . . . voted to stop the march of new homes and business parks at the borders of their communities and tax themselves to buy open space as a hedge against future development."

Also addressing this widespread backlash against sprawl, Will (1999) writes: "Liberalism is about to suffer an acute case of Portland Envy . . . the Oregon City is using zoning and other measures to produce high-density living by promoting multifamily housing such as row houses and shrinking the average lot size."

2 Not everyone agrees that Portland is the right model to emulate. Fischel (1997) raises a concern when he writes: "The Portland Oregon area’s urban growth boundary is an idea whose benefits to the region may depend on a willingness to expand the boundary occasionally." He elaborates: "Portland appears to be breaking new ground by not being willing (literally) to break new ground outside its urban growth boundary. It uses a metropolitan-wide body to order the suburbs to rezone land to accommodate higher density development—a situation unparalleled in the United States . . . Because of its current reluctance to extend the urban growth boundary—a reluctance that seems inconsistent with its original rationale of orderly suburban growth—metropolitan Portland has to impose density requirement on new developments that are entirely out of scale with the size of the city . . . The extremely high density that Portland appears to envision is beyond that of all but the largest cities in the United States."

3 For a discussion of the determinants of real estate capitalization rates, see Jud and Winkler (1995).

References


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