The use of hedonic prices for the estimate of the capitalization rate

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Abstract
In this paper we develop a model of income capitalization where the hedonic prices play a key role in estimating the going-in capitalization rate. Precisely, we introduce the hedonic functions for rental and selling prices into the basic model of income capitalization. From the modified model it is possible to derive a direct relationship between hedonic prices and capitalization rate. An advantage of the proposed procedure is that the estimation of the capitalization rate can be made without considering rental income data. We provide empirical evidence for the theoretical result.

Keywords:
Income capitalization approach, Hedonic models, Hedonic prices, Capitalization rate
1. Introduction

Income capitalization approach and hedonic models are the methods usually used for estimating the selling or the rental price. In the income capitalization approach, the capitalization rate is used to calculate a rent-to-value ratio to transform the value of an owned home into a market rent or vice versa; while another way of directly calculating the rental income (or house price) is by estimating rent (or price) with a hedonic regression model and then estimating imputed rents for owners (or home value for renters) by applying the renter (owner) coefficients to owner (renter) characteristics (Garner and Short, 2009). Furthermore, the two methods can be combined (see e.g. Phillips, 1988; Linneman e Voith, 1991). A ‘double’ hedonic function, namely the “hedonic rental price function” and “the hedonic home value price function” (Linneman e Voith, 1991), can be used to correct the direct estimate of the capitalization rate. The ratio between rental income and house price (the capitalization rate), in fact, should compare the rent and value of identical homes; ideally, it is possible to do this by applying the estimated coefficients of hedonic models to a vector of characteristics that defines a standard home of constant quality (Hamilton and Schwab, 1985).

In this paper we develop a model of income capitalization where the hedonic prices play a key role in estimating the capitalization rate. Precisely, we introduce the hedonic price functions into the standard equation of income capitalization, thus deriving a direct relationship between hedonic price and capitalization rate. This relationship allows us to neglect data on rental income. Indeed, in this work we only exploit the information regarding selling prices. As far as we are aware, no existing works of related literature have considered how to estimate the capitalization rate without using data on rental income. Selling prices and their implicit (hedonic) prices incorporate all of the information required to correctly estimate the capitalization rate. The selling price, in fact, takes into account factors that are different from the housing characteristics (such as the bargaining power of the parties, insufficient or incomplete information, etc.), while the implicit prices allow us to adjust the capitalization rate to the intrinsic characteristics of housing. Finally, the obtained capitalization rate can be used both for building the discount rate and for estimating the going-out capitalization rate.

Obviously, it is always preferable to estimate the capitalization rate just using comparable transactional data. Nevertheless, the model developed in this paper has two main advantages. From

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1 However, in order to avoid inefficient estimates it is necessary to control for selectivity bias in the hedonic models using the Heckman two-step approach (Linneman e Voith, 1991; Garner and Short, 2009). Owners and renters, in fact, have systematically different endowments and preferences. In particular, the intrinsic preference for homeownership is very important, since an individual may be willing to pay more to own a particular trait bundle than to rent it (Linneman e Voith, 1991). Heston and Nakamura (2009) find that for similar housing features owner occupied housing would rent for about 14 percent above market rents. This premium may be attributed to a mix of “owner pride” and unobserved quality differences.
an empirical point of view, the method developed in this paper is especially useful when: 1) the rental income data are missing and/or not entirely reliable (due to the phenomenon of shadow economy, for example); 2) the data on rental income and house price are related to different homes (the capitalization rate, in fact, should compare the rent and value of identical homes); 3) there are many binary variables, included the submarket dummy variables. In all these cases, therefore, the method can be a valuable alternative to direct estimation. From a theoretical point of view, instead, the model is able to highlight in a straightforward manner the close relationship between hedonic prices and capitalization rate. Indeed, as far as we are aware, this important link has been overlooked by housing market studies which deal with real estate appraisals.

Also, in order to provide empirical evidence for the theoretical model, we develop an empirical analysis. Using data from the Canadian housing market, we find that the theoretical results appear to be consistent with the observed capitalization rate.

The remainder of the paper is organised as follows. Section 2 briefly presents the income capitalization approach and the two related methods: yield capitalization and direct capitalization. The modified model with hedonic prices is instead presented in section 3; while section 4 contains the data, some descriptive statistics and the results of the empirical analysis. Section 5 concludes the work.

2. The income capitalization approach: the basic model

Two main methods are usually used to convert income flows into an estimation of the house value: Yields capitalization model or Discounted Cash Flows (DCF) analysis and Direct capitalization model. In a Discounted Cash Flows method or Yields capitalization model, the house value (price) \( P \) is the present value of all the expected future cash flows, including the proceeds from the sale at the end of the investment (see, among others, Phillips, 1988; Wang et al., 1990; Appraisal Institute, 2001; Sevelka, 2004; Clayton and Glass, 2009).

\[
P = \sum_{t=1}^{n} \frac{NOI_t}{(1 + r)^t}
\]

(1)

where \( NOI = R - C \) is the net operating income; \( R \) the gross rental income; \( C \) is the financing and operating cost, \( r \) is the discount rate or the opportunity cost of capital or the (risk-adjusted)

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2 Bourassa et al. (2007) show that the gains in accuracy from including submarket variables in a hedonic model are greater than any benefits from using geostatistical or lattice methods. This conclusion is of practical importance, as a hedonic model with submarket dummy variables is substantially easier to implement than spatial statistical methods.

3 Indeed, the reversion value is the larger share of the total return of a property investment.
required total return, and \( n \) is the economic life of the property. Equation (1) is usually broken down into three components (see Phillips, 1988, p. 279):

\[
P = \frac{(R_t - C_t)}{1 + r} + \sum_{t=2}^{n} \frac{(R_t - C_t)}{(1 + r)^t} + \sum_{t=k+1}^{n} \frac{(R_t - C_t)}{(1 + r)^t}
\]  

(2)

where the first term is the net rental income at the end of the first period; the second term is the discounted net rent during the property holding period \( k \); and the third term is the present value of the remaining future cash flows, namely the expected resale price or reversion value at the end of the holding period \( k \).

Instead, in the Direct capitalization model the so-called overall capitalization rate \( c \) plays a key role. The cap rate is defined as the ratio between the net rental income at the end of the first period and the house price (see Phillips, 1988; Wang et al., 1990; Appraisal Institute, 2001; Clayton and Glass, 2009):

\[
c = \frac{(R_t - C_t)}{P} \Rightarrow P = \left( R_t - C_t \right) \cdot \left( \frac{1}{c} \right)
\]  

(3)

where the reciprocal of the cap rate is not the gross rent multiplier (GRM). Precisely, the cap rate is used to convert – in one direct step – a single year’s income expectancy into an estimation of the house value.

To see the close link between yields capitalization and direct capitalization methods, it is sufficient to assume constant net rental income, namely \( (R_t - C_t) = (R - C) \) \( \forall t \). In this case, in fact, equation (2) becomes:

\[
P = \frac{(R - C)}{r} \cdot \frac{1}{(1 + r)^n} - 1
\]  

(4)

In the special case where indefinite holding of the property is expected (i.e. the economic life of the property tends to infinity), we get the following expression from which we obtain an estimation of the capitalization rate:

\[
\frac{\left[ NOI_{t-1} \cdot (1 + g) \right]}{P} = c
\]  

(5)

With a constant growth rate \( g \) of NOI, Equation (5) is nothing but a modified version of the Dividend Discount Model (DDM). Precisely (see Pagliari and Webb, 1992): \( P = \frac{[NOI_t]}{(r - g)} \Rightarrow r = \frac{[NOI_t \cdot (1 + g)]}{P + g} \), where \( \frac{[NOI_{t-1} \cdot (1 + g)]}{P} \) is the cap rate. Since the DDM assumes an infinite holding period or a finite holding period with the
\[
\lim_{n \to \infty} P = \left( \frac{R - C}{r} \right) \Rightarrow c = r
\]  

(5)

Thus, yield capitalization and direct capitalization are interrelated valuation models and applying either methodology to the same income-producing property should generate a similar estimate of market value (Sevelka, 2004). However, the relationship \( c = r \) holds exactly only under the simplifying assumptions of equation (5). Indeed, \( r \) and \( c \) should be equal “in a non-inflationary environment with no expectation of appreciation in income and property value […]” (see Sevelka, p. 138, 2004); otherwise \( c \approx r \).\(^8\)

Also, equation (3) reveals the “going-in capitalization rate”, i.e. the expected first year income on a property investment (Wang et al., 1990; Sevelka, 2004). Thus, it cannot be used to discount the cash flows after the end of the holding period \( k \). The appropriate discount rate to estimate the expected resale price or reversion value, i.e. the “going-out capitalization rate”, can be derived from equation (3) by using the relationship proposed by Wang et al. (1990):\(^9\)

\[
caprate_{out} = caprate_{in} \cdot \delta
\]  

(6)

where \( \delta \) is a (negative) function of both the income-growth rates (before and after the holding period) and the property appreciation rate after the holding period; but it is a (positive) function of the rates of return.\(^10\) As a result, the going-out capitalization rate can be higher (if \( \delta > 1 \)), lower (if \( \delta < 1 \)) or equal (if \( \delta = 1 \)) to the going-in capitalization rate (Wang et al., 1990).

Finally, there is an important difference between discount rate and capitalization rate. The discount rate is a “prospective” measure of financial performance which reflects the future expectations of real estate investors; instead, the capitalization rate is a “partial” measure of financial performance. It follows that only the capitalization rates can be directly extracted or obtained from observed property transactions and market rents (Sevelka, 2004; Clayton and Glass, 2009).

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\(^8\) For example, in the DCF model with income-growth, the discount rate cannot be interchanged with the capitalization rate. Equivalency between \( c \) and \( r \) can be achieved when the discount rate equals the capitalization rate increased by the income growth rate \( g \), i.e. \( r = c + g \) (see also Hamilton and Schwab, 1985). Furthermore, an inflation-adjusted capitalization rate is synonymous with a discount rate, i.e. \( r = c + \pi \), where \( \pi \) is the inflation rate (Sevelka, 2004).

\(^9\) “[…] the going-in and the going-out capitalization rates should be the same if there is no reason to assume that income growth rates, required rates of return, or property appreciation rates are different during and after the projected holding period.” (Wang et al., p. 235, 1990).

\(^10\) The explanation of the negative relationship between income-growth rates and the cap rate is the following: the higher the property income growth, the larger the expected cash flows in subsequent years. Hence, the house price is higher and cap rate is lower.
2. The income capitalization approach: the model with hedonic prices

In order to develop a direct relationship between hedonic prices and capitalization rate, we introduce the standard hedonic price functions à la Linneman and Voith (1991) in equation (4):

$$P(x) = \frac{R(x) - C}{r} \cdot \left[1 - (1 + r)^{-n}\right]$$

(7)

where \(P(x)\) is the hedonic home value price function, \(R(x)\) is the hedonic rental price function, and \(x\) is the set of housing characteristics. It follows that a generic implicit or hedonic price \((p)\) can be obtained from equation (7):

$$p(x) = \frac{\partial P(x)}{\partial x} = \frac{\partial R(x) / \partial x}{r} \cdot \left[1 - (1 + r)^{-n}\right]$$

(8)

For binary variables, such as the presence or absence of an elevator, the implicit or hedonic price \(p(x)\) is the price difference between the properties with an elevator and the properties without that characteristic, namely \(p(x) = P^1 - P^0\). Following Del Giudice (1992), the price difference is assumed equal to the discounted rental income difference. Hence, a special case of equation (8) would be the following:

$$p = (P^1 - P^0) = \left(\frac{R^1 - R^0}{r}\right) \cdot \left[1 - (1 + r)^{-n}\right]$$

(8')

Since the price (rental income) difference is positive,\(^{11}\) we assume that when indefinite holding of the property is expected, i.e. the economic life of the property tends to infinity, the (desired and relevant) housing characteristic becomes increasingly important. Mathematically, we spell out this assumption in the following way:

$$\lim_{n \to \infty} (P^1 - P^0) \approx P^i$$

Hence, for each relevant (i.e. statistically significant) housing characteristic it must be true that:

$$P^i = \left(\frac{R^1 - R^0}{r}\right)$$

(9)

Therefore, using equations (8') and (9) we can obtain an explicit expression for estimating a “partial” capitalization rate associated with each (binary variable) housing characteristic \(i\).\(^{12}\)

\(^{11}\) Since we talk about “desired” housing characteristic (such as the presence of an elevator), the price difference is positive, namely \(p(x) = P^1 - P^0 > 0\). In fact, \(ceteris paribus\), the mean price of properties with an elevator is higher than the mean price of properties without that characteristic (see the Canadian dataset, for example). It follows that also the rental income difference must be positive.

\(^{12}\) By using real house prices, the inflation rate is implicitly included in equation (10).
\[
\begin{align*}
\{ r \cdot p^i &= (R^i - R^0) \\
p &= \frac{(R^i - R^0)}{r} \cdot [1 - (1 + r)^{-n}] \Rightarrow c_i = r = \left(1 - \frac{p}{p^i}\right)^{\frac{1}{n}} - 1
\end{align*}
\]

which is positive for each \( n < \infty \), since \( 0 < \frac{p}{p^i} < 1 \). In order to obtain an “overall” capitalization rate equation (10) must be calculated for each relevant housing characteristic \( i \). It follows that:

\[
c = \prod_{i=1}^{m} (1 + c_i) - 1
\]

Data on housing characteristics typically consists of many ordered and unordered categorical variables. Thus, transforming the ordered housing characteristics into binary variables, it is possible to extend the procedure to the full dataset with the exception of the continuous regressors (such as the lot size). As regards the lot size, for example, a simple way to include it into the model is the following:

- we estimate both the full hedonic price model and a univariate regression (price vs. lot size);
- we calculate the ratio of the adjusted R-squared of the two regression models (univariate vs. full model), thus obtaining a “weight” (\( \omega_{\text{lot size}} \));
- we obtain that the share of cap rate attributable to the hedonic price of the lot size and the “final” cap rate are, respectively, given by:

\[
\begin{align*}
\omega_{\text{lot size}} &= c \cdot \omega_{\text{lot size}} \\
\epsilon_{\text{final}} &= (1 + c) \cdot (1 + \epsilon_{\text{lot size}}) - 1
\end{align*}
\]

2. Empirical testing

In order to provide empirical evidence for the theoretical result obtained in the previous section, we develop an empirical analysis. We employ data from the Canadian housing market. The dataset used is especially useful since it is characterised by many binary variables. Precisely, the dataset contain 546 observations on sales prices of houses sold during July, August and September, 1987, in

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\(^{13}\) In fact, \( p^i \) is the (mean) price of the properties where the (desired) characteristic is present, while \( p(x) \) is the implicit/hedonic price of that housing characteristic. At the limit, when the relevant and desired housing characteristic becomes increasingly important, we get \( \lim_{n \to \infty} (p^i - p) \cdot p^i \). Hence, \( p(x) \cdot p^i \) in general and \( p(x) \cdot p^i \) only when \( n = \infty \).

\(^{14}\) We will see that it is possible to extend this procedure also to the discrete variables.

\(^{15}\) The procedure used for the lot size can be applied to the other continuous variables.
the city of Windsor (Canada). Details about this dataset are reported in Table 1 (source: Anglin and Gencay, 1996).

### Table 1. Summary statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>price</td>
<td>sale price of a house</td>
<td>546</td>
<td>68121.6</td>
<td>26702.7</td>
<td>25000</td>
<td>190000</td>
</tr>
<tr>
<td>lotsize</td>
<td>the lot size of a property in square feet</td>
<td>546</td>
<td>5150.27</td>
<td>2168.16</td>
<td>1650</td>
<td>16200</td>
</tr>
<tr>
<td>bedrooms</td>
<td>number of bedrooms</td>
<td>546</td>
<td>2.9652</td>
<td>0.73739</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>bathms</td>
<td>number of full bathrooms</td>
<td>546</td>
<td>1.28571</td>
<td>0.50216</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>stories</td>
<td>number of stories excluding basement</td>
<td>546</td>
<td>1.80769</td>
<td>0.8682</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>driveway</td>
<td>dummy, 1 if the house has a driveway</td>
<td>546</td>
<td>0.85897</td>
<td>0.34837</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>recroom</td>
<td>dummy, 1 if the house has a recreational room</td>
<td>546</td>
<td>0.17766</td>
<td>0.38257</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>fullbase</td>
<td>dummy, 1 if the house has a full finished basement</td>
<td>546</td>
<td>0.34982</td>
<td>0.47735</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>gashw</td>
<td>dummy, 1 if the house uses gas for hot water heating</td>
<td>546</td>
<td>0.04579</td>
<td>0.20922</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>airco</td>
<td>dummy, 1 if there is central air conditioning</td>
<td>546</td>
<td>0.31685</td>
<td>0.46568</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>garagepl</td>
<td>number of garage places</td>
<td>546</td>
<td>0.69231</td>
<td>0.86131</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>prefarea</td>
<td>dummy, 1 if located in the preferred neighbourhood of the city</td>
<td>546</td>
<td>0.23443</td>
<td>0.42403</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

As regards the discrete variables “bathms” and “stories”, we use the number one as a threshold value for creating binary variables (“bathms_d” and “stories_d”). In fact, the mean of both variables is lower than 2 and higher than 1. The same reasoning applies to the discrete variable “bedrooms” where the threshold value for creating “bedrooms_d” is 2 (since the mean is 2.965201).

The first step is the estimation of the hedonic home value price function in order to obtain the implicit/hedonic prices. From the popular Ramsey RESET test we find that the statistically correct econometric model is the semi-logarithmic. For details about the estimation results, see Table 2.

### Table 2. Estimation results

16 The only hedonic model which overcomes the fundamental Ramsey Rest test, i.e. which does not reject the null hypothesis of no omitted variables, is the semi-log (Prob > F = 0.3348). Indeed, a semi-logarithmic functional form for
Indeed, since the housing characteristics are expressed by dummy variables and the model used is the semi-logarithmic, the procedure proposed by Halvorsen and Palmquist (1980) must be applied in order to correct the estimated regression coefficients. Precisely, the implicit/hedonic price of each housing characteristic \( i \) is given by:

\[
p_i = \bar{P} \cdot (e^{\beta_i} - 1)
\]

(14)

where \( \bar{P} \) is the average price (68,121.60), \( \beta_i \) is the estimated regression coefficient, and \((e^{\beta_i} - 1)\) is the correction factor. The hedonic prices are reported in Table 3.

**Table 3. Hedonic prices**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Correction Factor</th>
<th>Hedonic price</th>
</tr>
</thead>
<tbody>
<tr>
<td>garagepl</td>
<td>0.048</td>
<td>0.049</td>
<td>3,350.59</td>
</tr>
<tr>
<td>recroom</td>
<td>0.065</td>
<td>0.067</td>
<td>4,574.70</td>
</tr>
<tr>
<td>bedrooms d</td>
<td>0.072</td>
<td>0.075</td>
<td>5,077.36</td>
</tr>
<tr>
<td>fullbase</td>
<td>0.073</td>
<td>0.076</td>
<td>5,160.14</td>
</tr>
<tr>
<td>stories d</td>
<td>0.107</td>
<td>0.113</td>
<td>7,719.56</td>
</tr>
<tr>
<td>driveway</td>
<td>0.117</td>
<td>0.124</td>
<td>8,457.86</td>
</tr>
<tr>
<td>prefarea</td>
<td>0.126</td>
<td>0.134</td>
<td>9,153.62</td>
</tr>
<tr>
<td>gashw</td>
<td>0.175</td>
<td>0.191</td>
<td>13,010.32</td>
</tr>
</tbody>
</table>

hedonic house price models is also used in Hamilton and Schwab (1985), Phillips (1988), Linneman and Voith (1991), Garner and Short (2009). Furthermore, the adjusted R-square of semi-log hedonic model with the lot-size in natural logarithm is higher than the adjusted R-square of semi-log hedonic model with the lot size in level.
The next step is to calculate $P^i$ of equation (9). $P^i$ is the (mean) price of the properties where the characteristic is present. Hence, for each characteristic in Table 3 we calculate $P^i$ by dropping in the dataset the observations where the characteristic is absent, thus obtaining both the (mean) price of the properties where the characteristic is present and the fundamental ratio between hedonic price and $P^i$ of equation (10) (see Table 4).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hedonic price ($p$)</th>
<th>$P^i$ (mean)</th>
<th>Ratio ($p/P^i$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>garagepl</td>
<td>3,350.59</td>
<td>79,047.53</td>
<td>0.0424</td>
</tr>
<tr>
<td>recroom</td>
<td>4,574.70</td>
<td>82,753.67</td>
<td>0.0553</td>
</tr>
<tr>
<td>bedrooms_d</td>
<td>5,077.36</td>
<td>73,677.43</td>
<td>0.0689</td>
</tr>
<tr>
<td>fullbase</td>
<td>5,160.14</td>
<td>74,894.50</td>
<td>0.0689</td>
</tr>
<tr>
<td>stories_d</td>
<td>7,719.56</td>
<td>74,199.19</td>
<td>0.1040</td>
</tr>
<tr>
<td>driveway</td>
<td>8,457.86</td>
<td>71,333.90</td>
<td>0.1186</td>
</tr>
<tr>
<td>prefarea</td>
<td>9,153.62</td>
<td>83,986.37</td>
<td>0.1090</td>
</tr>
<tr>
<td>gashw</td>
<td>13,010.32</td>
<td>79,428.00</td>
<td>0.1638</td>
</tr>
<tr>
<td>airco</td>
<td>13,791.52</td>
<td>85,880.59</td>
<td>0.1606</td>
</tr>
<tr>
<td>bathrms_d</td>
<td>15,865.54</td>
<td>90,366.61</td>
<td>0.1756</td>
</tr>
</tbody>
</table>

Obviously, since the hedonic prices are positive, i.e. all the housing characteristics are desired, the mean of $P^i$ is always larger than the mean of the “overall” price $P$.

As regards the continuous variable “lot size”, we run a univariate regression (see again Table 2). The Adjusted R-squared is exactly half of the full model (0.33/0.66). Hence, the share of cap rate attributable to the hedonic price of the lot size is $\omega_{lotsize} = 0.5$.

The final step is to calibrate the model. Unfortunately, the value of $n$ is difficult to calibrate unequivocally since the very concept of ‘economic life of the property’ is open to different interpretations and the real estate is a highly heterogeneous goods (in other word, it varies across goods and individuals). In order to overcome this problem, the cap rate is calculated for different but realistic periods of economic life or holding of the property. Indeed, we consider a range (minimum and maximum) of $n$, rather than establishing a single value of $n$.

Precisely, we define equations (10), (11), (12) and (13) for different $n$ (from 8 to 55) and compute an average capitalization rate for several ranges. Intuitively, the larger is the range of $n$, the higher is the average cap rate (see Table 5).
Table 5. Going-in cap rates in Canada during the second half of the eighties: a comparison between theoretical results and observed data

<table>
<thead>
<tr>
<th>Canada (1987)</th>
<th>range of n (min – max)</th>
<th>Canada (1985 - 1988)</th>
<th>cap rates – observed data (Source: Pagliari et al. (1998))</th>
<th>index</th>
</tr>
</thead>
<tbody>
<tr>
<td>average cap rates</td>
<td>range of n (min – max)</td>
<td>cap rates – observed data</td>
<td>index</td>
<td></td>
</tr>
<tr>
<td>Source: Theoretical model</td>
<td>Source: Pagliari et al. (1998)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.01 %</td>
<td>25 – 35</td>
<td>6.52 %</td>
<td>office</td>
<td></td>
</tr>
<tr>
<td>6.28 %</td>
<td>20 – 40</td>
<td>8.51 %</td>
<td>warehouse</td>
<td></td>
</tr>
<tr>
<td>6.78 %</td>
<td>15 – 45</td>
<td>8.62 %</td>
<td>retail</td>
<td></td>
</tr>
<tr>
<td>7.76 %</td>
<td>10 – 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.83 %</td>
<td>8 – 55</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We compare the theoretical results with data on Canada (period 1985-1988) reported in Pagliari et al. (1998). The result appear to be consistent with the observed data since the capitalization rate in Canada during the 1985-1988 period varies from 6.52% to 8.62% (see again Table 5). Indeed, with a few exceptions, capitalization rates remain within a range of 6.75% to 8.75%, never getting too far from their long-run average of 7.6% (Kaiser, 1997; Clayton and Glass, 2009).17

However, this is a first and simple attempt to test the theoretical model developed here and it would be desirable to verify these results with another dataset.

Conclusions

In this paper a unified model of income capitalization and hedonic method is developed for estimating the capitalization rate. Precisely, we introduce the standard hedonic functions for rental and selling price into the basic model of income capitalization. From the modified model it is possible to derive a direct relationship between hedonic prices and capitalization rate. An advantage of the proposed procedure is that the estimation of the capitalization rate can be made without considering data on rental income. Indeed, selling prices and implicit (hedonic) prices incorporate all of the information required to correctly estimate the capitalization rate. Furthermore, this model can be particularly useful when the data referring to the rents is not entirely reliable. The obtained capitalization rate can be used both for building the discount rate as well as for estimating the going-out capitalization rate. A first attempt to test the theoretical model has produced satisfactory results since the theoretical results appear to be consistent with the observed data.

17 Indeed, capitalization rates seem to vary across property types and over time in a somewhat predictable manner (Kaiser, 1997; Clayton and Glass, 2009).
References


