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Pricing Factors in Real Estate Markets: A Simple Preference Based Approach

Su Han Chan
Professor, Department of Finance, College of Business and Economics, California State University – Fullerton, or schan@fullerton.edu

Ko Wang
Professor, Department of Finance, College of Business and Economics, California State University – Fullerton, or kwang@fullerton.edu

Jing Yang
Assistant Professor, Department of Finance, College of Business and Economics, California State University – Fullerton, or jyang@fullerton.edu

Conventional wisdom tells us that the price level of properties should be supported by the rent they receive. This paper examines the pricing factors of properties by analyzing how individuals allocate their income to housing consumption and other goods, which in turn become the rent (or implicit rent) to support property values. Our model's results can explain several puzzling observations in property markets, including why the variance of property appreciation rates is much higher than that of income growth rates in the same area.

Keywords

Preference-based model, pricing factors, property appreciation, property markets

Introduction

The frequently observed sharp price reversals in both residential and commercial property markets during the past decades have raised serious questions regarding the rationality of property markets. Even worse, some of the recent research documenting the rapid appreciation rates observed in certain cites in the U.S. is clearly not supported by changes in economic fundamentals (see, for example, Green [2002]). Indeed, there seems to be a consensus among researchers that property appreciation rates observed in cities around the world are not supported by similarly rising economic fundamentals.

To study this issue, much literature on the efficiency and predictability of property markets has been published in recent years (see Gu [2002] for a recent survey of the empirical evidence on this issue). Many researchers have also examined if property markets are rational, or if there are bubbles in the real estate market (see, for example, Wheaton [1987, 1999] and Quigley [1999]). However, both streams of research (examining whether property markets are rational or predictable) seem to provide mixed results.

The other stream of research on this issue examines the important factors that affect price movements in property markets (see, for example, Clapp and Giaccotto [1994], Mullbauer and Murphy [1995], Dolde and Tirtiroglue [2002], Jud and Winkler [2002], and Miller and Peng [2003]). However, many of these studies are empirical in nature. While most of them were able to identify pricing factors, it is not clear if their findings are capable of addressing the issue in question. For example, when an empirical study finds a relationship between income and property appreciation rates, it does not necessarily mean that the magnitude of the appreciation rate can be justified by the magnitude of the income growth rate. Furthermore, there is contradictory evidence on the predictability of certain economic variables and no consensus as to which economic variables should be included in the estimation equation.

This paper attempts to advance the literature by providing some theoretical links between property price movements and the underlying economic factors. For this paper, we have developed a model based on individuals' consumption preferences to analyze the pricing factors for both the residential and commercial property markets.[1] The results of our model seem to be able to explain several puzzles observed in real estate markets.

Section 2 discusses our model framework and derives the basic result of our model. In Section 3, we will add a preference factor into the model to find if the impact of certain economic variables on price movements is not straightforward. In other words, the magnitude of the impact of some

1 Benjamin, Chinloy, and Jud (2004) used a similar utility-based approach (estimating the marginal propensity to consume) to explain why households concentrate their wealth in housing.

economic variables on prices depends on the conditions and movements of other variables. The last section provides the conclusions of the paper.

Model Framework

The main thrust of our model is that the prices of both residential properties and commercial properties must be supported by the income level of residents in a market area. Given certain parameters, individuals allocate their incomes to the consumption of housing units and other goods based on their preferences. The income allocated to housing consumption will more or less determine the price level in the residential market. On the other hand, the income allocated to the consumption of other goods will have a significant effect on the price of commercial properties. This is true because the price of commercial properties must rely on the rents property owners can charge. How much rent they can receive depends on how much the tenants occupying the buildings can charge for the goods and services they produce. If individuals spend more on goods and services, the ability of the producers (tenants) to pay rent will increase. Of course, the price of commercial properties increases as the tenants' ability to pay rent increases.
In our model, we assumed that the market for goods and services is always in balance (i.e., supply equals demand). However, property markets might not always be clear.[2] We also allowed for the possibility that both residential and commercial properties can be acquired using equity and debt. However, we have followed U.S. tax laws, which declare that only the interest expenses on residential mortgage loans can be used to reduce personal income taxes, while the interest expenses on consumer loans are not tax deductible.

Based on these considerations, our model starts with a resident's consumption optimization problem. This optimization process allows us to draw implications from the impacts different factors have on the prices of residential and commercial properties. In the last stage of the model, we will explicitly model the formation of the preference factor and discuss its impact on price movements in property markets.

Consumption Decisions

The first step in our model is to allocate the total resources that are available for the consumption of housing and other goods over time. This implicitly assumes that there are only two types of consumption an individual needs to

2 There are many theories that argue that the property market should not always be clear (see, for example, Wang and Zhou [2000]). Although one of the most popular explanations is based on the construction lag, Wang, Zhou, Chan, and Chau (2000) argued that developers' irrational behavior could also increase the supply level in the market.

consider: the level of housing unit Xh,t and the quantity of all other goods Xc,t. To start the analyses, we assumed that in period t, there are Nt homogenous residents. The inventory of residential properties at time t is specified as Mh,t, and the inventory of a commercial property type is Mc,t. A resident, called "Her," has an income level at It. Her utility Ut = U (Xh,t , Xc,t | θt) is a function of her consumption quantities of Xh,t and Xc,t. We also assumed that her preference for housing and other goods can change over time. We used a preference factor θt to capture this specification. The prices of housing and consumption goods per unit are specified as Ph,t and Pc,t, respectively. As expected, the resident's utility function is increasing in Xh,t and Xc,t , or dU /dXh,t > 0 and dU /dXc,t >0.

The resident can finance her consumption of the housing product and other goods with both equity and debt. We assumed that αh, percentage of housing consumption and αc,t percentage of other goods' consumption can be financed by mortgages and consumer loans, respectively. We further assumed that the mortgage interest rate is rh,t, the consumer loan interest rate is rc,t, and the opportunity cost to the resident for using her own equity capital is st. The current period personal-income tax rate is τt.

To simplify the model presentation, we made two additional assumptions. First, we assumed that the risk-free rate is zero. Second, we assumed that there are no savings. With these two assumptions, a resident can choose the quantities of her consumption to maximize her current period utility.[3] Under this framework, the optimization problem of the resident is:

$$\underset{\{X_{h,t},X_{c,t}\}}{Max} U_t = U(X_{h,t}, X_{c,t} \mid \theta_t) \qquad (1)\text{s.t.}$$

$$[(1-\alpha_{h,t})s_t + \alpha_{h,t} r_{h,t}(1-\tau_t)]P_{h,t}X_{h,t} + [(1-\alpha_{c,t})s_t + \alpha_{c,t} r_{c,t}]P_{c,t}X_{c,t} = I_t(1-\tau_t) \quad (2)$$

Equation (2) is the resident's budget constraint. The left-hand side of the constraint is her total expenses in period t, including the cost of equity and the after-tax cost of mortgages and loans. The right-hand side of the constraint is her after-tax income in period t. Since we assumed that there are no savings, the total expenses (left-hand side of Equation [2]) equal the total income (right-hand side of Equation [2]). The budget constraint is binding due to the positive marginal utilities of consumption. The Eular equation of this optimization problem is:

3 In most cases, we believe that the results of our model should not be affected if we relax these two assumptions. However, incorporating these two additional variables might make the model too complicated to solve.

$$\frac{U'_{X_{h,t}}(X_{h,t}, X_{h,t} \mid \theta_t)}{U'_{X_{c,t}}(X_{c,t}, X_{c,t} \mid \theta_t)} = \frac{P_{h,t}[(1-\alpha_{h,t})s_t + \alpha_{h,t} r_{h,t}(1-\tau_t)]}{P_{c,t}[(1-\alpha_{c,t})s_t + \alpha_{c,t} r_{c,t}]} \tag{3}$$

In other words, the marginal rate of substitution between these two consumption goods must be equal to the ratio of their net prices.

Market and Price Clearing Conditions

The second step of the model is to specify market clearing conditions. We assumed that the market for all other goods always clears.[4] Given this assumption, we have:

$$M_{c,t} = N_t X_{c,t} \tag{4}$$

where the left-hand side of Equation (4), or the total supply of other goods, is always equal to the right-hand side of the equation (or the total demand for other goods). However, as mentioned earlier, the housing market may not clear in the short run. For simplicity, we used a factor βht to measure the imbalance between the supply and the demand during the period. Given this, the market condition of residential properties can be specified as:

$$\beta_{h,t} M_{h,t} = N_t X_{h,t} \tag{5}$$

Since NtXht can be viewed as the total demand in the market, βht can be considered the occupancy rate in the housing market when Mht is considered the total inventory in the market. From Equations (4) and (5), we know that:

$$X_{c,t} = \frac{M_{c,t}}{N_t} \tag{6}$$

and

$$X_{h,t} = \beta_{h,t} \frac{M_{h,t}}{N_t} \tag{7}$$

After combining Equations (2), (3), (6), and (7), we can see that, depending on the explicit form of the utility function used, Ph,t and Pc,t can be solved explicitly as a function of income It, utility preference factor θt, borrowing

4 Although it is conceivable that the markets for many other goods may not clear every period, it is not necessary to make such a detailed specification for the purpose of our analyses.

percentages (leverage ratios) $\alpha_{h,t}$ and $\alpha_{c,t}$, interest rates $r_{h,t}$ and $r_{c,t}$, tax rate τ_t, number of residents N_t, inventories $M_{h,t}$ and $M_{c,t}$, and the housing market imbalance factor $\beta_{h,t}$. For our analyses, we will illustrate the results using a Cobb-Douglas utility function, or:

$$U_t = U(X_{h,t}, X_{c,t} \mid \theta_t) = X_{h,t}^{\theta_t} X_{c,t}^{(1-\theta_t)} \tag{8}$$

With this utility function, the prices of housing units and other goods are:

$$P_{h,t} = \frac{\theta_t I_t}{\left[\frac{(1-\alpha_{h,t})s_t}{1-\tau_t} + \alpha_{h,t} r_{h,t}\right] \beta_{h,t} \frac{M_{h,t}}{N_t}} \tag{9}$$

and

$$P_{c,t} = \frac{(1-\theta_t) I_t}{\left[\frac{(1-\alpha_{c,t})s_t + \alpha_{c,t} r_{c,t}}{1-\tau_t}\right] \frac{M_{c,t}}{N_t}} \tag{10}$$

respectively.

We can draw some preliminary implications from Equations (9) and (10). Consistent with intuition, when income I_t goes up the potential demand for both goods and services increases, and so do prices. When the preference for housing consumption is high, the prices for housing units increase, while the prices for other goods decrease. In other words, residential property prices increase in θ_t and other goods prices decrease in θ_t. The personal income tax rate, however, has two opposite effects on housing demand and price. It has a negative effect by reducing disposable income, and a positive effect by increasing residential mortgage interest tax shields. The change in mortgage interest rates also has a similar effect. Of course, under the current model framework, the net effect of the personal income tax rate (or interest rate) is negative.[5]

Movements in the Housing Market

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5 At this moment, we assume that the change in tax shelters offered by housing consumption does not affect an individual's consumption of housing and other goods. However, an increase in the interest rate might encourage an individual to rely more on mortgages than on consumer loans. If this is the case, it will change the preference factor of the utility function and the dynamics of price movements. We will discuss this in detail in Section 3.

From Equation (9), we can derive a cross-period housing price appreciation rate by examining the equation at periods t and t-1. Equation (11) reports the result:

$$\frac{P_{h,t}}{P_{h,t-1}}=\left(\frac{\theta_t}{\theta_{t-1}}\right)\left(\frac{I_t}{I_{t-1}}\right)\left(\frac{\left[\frac{(1-\alpha_{h,t-1})s_{t-1}}{1-\tau_{t-1}}+\alpha_{h,t-1}r_{h,t-1}\right]}{\left[\frac{(1-\alpha_{h,t})s_t}{1-\tau_t}+\alpha_{h,t}r_{h,t}\right]}\right)\left(\frac{\beta_{h,t-1}\frac{M_{h,t-1}}{N_{t-1}}}{\beta_{h,t}\frac{M_{h,t}}{N_t}}\right) \tag{11}$$

Equation (11) shows that the time-series change in residential property prices is subjected to the time-series changes in four factors: the change in preferences ($\frac{\theta_t}{\theta_{t-1}}$), the change in incomes ($\frac{I_t}{I_{t-1}}$), the changes in monetary and tax policies $\frac{\left[\frac{(1-\alpha_{h,t-1})s_{t-1}}{1-\tau_{t-1}}+\alpha_{h,t-1}r_{h,t-1}\right]}{\left[\frac{(1-\alpha_{h,t})s_t}{1-\tau_t}+\alpha_{h,t}r_{h,t}\right]}$ (which includes changes in leverage ratios, interest rates, and personal income tax rates), and the change in market condition parameters $\frac{\beta_{h,t-1}\frac{M_{h,t-1}}{N_{t-1}}}{\beta_{h,t}\frac{M_{h,t}}{N_t}}$, which includes the change in housing inventories, the change in the number of households, and the change in market imbalance factors (occupancy rates).

At first glance, the model's predictions seem to be counter-intuitive. We know that in a residential property market, the price level can change dramatically in a short period (say several months to two years). However, we also know that in most cities, the occupancy rate (the fourth term in the above equation) does not vary much in a short period unless there is a special event. Similarly, the income level (the second term in the equation) in an area normally grows at a steady pace. Given the difference in magnitude between the changes in income and the occupancy rate, it is quite reasonable to argue that the changes in both factors are not capable of explaining the change in prices. On the other hand, interest rates and the tax laws governing tax shelters may vary quite dramatically. However, anecdotal evidence tells us that price movements in property markets do not seem to be very sensitive to (or maintain a one-to-one relationship with) a change in interest rates or tax policies. Given this, there seems to be a need to examine the determinants of the preference factor (the first term in the equation) more carefully. This will be done in Section 3.

Movements in Commercial Property Markets

We rely on a reasonable and standard argument that prices of commercial properties are supported by rent levels, and that the rent levels are determined by the demand of services rendered by the properties. Under this argument, the price of a particular type of commercial property should be a function of the aggregate demand for particular types of goods or services. For example, if many people dine out, then there will be a demand for restaurant spaces. If people spend more money on purchasing goods, then there will be a demand for spaces in shopping centers (for the distribution of goods) or industrial parks (for the production of goods). When people demand more services, then there will be a price pressure on office buildings. In other words, how much people are willing to spend on a particular type of good or service will affect the price level of a corresponding type of commercial property.

From Equation (10), we know how much income an individual is willing to allocate to the consumption of other goods. We assumed that there are J types of commercial activities in a market and that the percentage of total income allocated to goods provided by the jth type of commercial firms in period t is wcj,t, where j = 1, 2,…, J. In other words, of all the income that is allocated to the consumption of other goods (Pc,tXc,tNt), the part that flows to commercial activity J is wcj,tRc,tXc,tNt. We assumed that this income will be used to support (in the form of rent or implicit rent) a particular commercial property type.

To calculate the exact amount that can be used to support the existence of a commercial property, we need to take tax and leverage into consideration. Similar to residential properties, we also assumed that each commercial property type can be financed by both equity and commercial mortgages, where the leverage ratio is αcj,t, the cost of equity is ecj,t, and the commercial mortgage interest rate is rcj,t. We defined the depreciation rate allowed by the tax policy for a commercial property as dt. The depreciation expenses together with the commercial loan interest expenses form the corporate-income tax shields. The current corporate income tax rate is ρt. We also assumed that the expense required to operate the properties is $l_{cj,t}$ percent of the income allocated to the property type. Given this, Equation (12) details the budget constraint of a particular property type, or:

$$(1-\alpha_{cj,t})e_{cj,t}P_{cj,t}X_{cj,t}+[r_{cj,t}\alpha_{cj,t}P_{cj,t}X_{cj,t}+d_tP_{cj,t}X_{cj,t}+l_{cj,t}w_{cj,t}P_{c,t}N_tX_{c,t}](1-\rho_t)$$
$$=w_{cj,t}P_{c,t}N_tX_{c,t}(1-\rho_t). \quad (12)$$

We already know that the total after-tax income that can be used to support a particular commercial property type is $w_{cj,t}P_{c,t}N_tX_{c,t}(1-\rho_t)$. How much people are willing to pay for this particular type of commercial property depends critically on the level of this income. This forms the right-hand side of Equation (12). The left side of the equation details the different claims on the investment of this particular type of commercial property, which include the cost of equity, the after-tax interest payment, depreciation benefits, and other after-tax operating expenses. Since the income allocated to this property type must equal the total claims on this property type, the equation gives us a base to calculate the price of a commercial property that can be supported by the income from all the residents in a particular area.

Similar to the assumption we made for the residential property market, we also assumed that the market for the jth commercial property may not clear in the short run, and we also used factor $\beta_{cj,t}$ to measure the imbalance between supply and demand conditions, or:

$$\beta_{cj,t}M_{cj,t} = X_{cj,t} \tag{13}$$

Substituting this into Equation (12) for $X_{cj,t}$, we derive the price of the jth commercial property type as:

$$P_{cj,t} = \frac{w_{cj,t}P_{c,t}N_tX_{c,t}(1-l_{cj,t})}{\left[\frac{(1-\alpha_{cj,t})e_{cj,t}}{1-\rho_t} + (\alpha_{cj,t}r_{cj,t} + d_t)\right]\beta_{cj,t}M_{cj,t}} \tag{14}$$

With the Cobb-Douglas utility function, the market price of the jth commercial property type can be re-written as:

$$P_{cj,t} = \frac{w_{cj,t}I_t(1-\theta_t)(1-\tau_t)(1-l_{cj,t})N_t}{\left[\frac{(1-\alpha_{cj,t})e_{cj,t}}{1-\rho_t} + (\alpha_{cj,t}r_{cj,t} + d_t)\right][(1-\alpha_{c,t})s_t + \alpha_{c,t}r_{c,t}]\beta_{cj,t}M_{cj,t}} \tag{15}$$

Equation (15) shows that the price of the jth commercial property type is negatively affected by the preference factor. This is true because when people spend more of their income on housing consumption, there will be fewer resources to support commercial properties. The impacts other parameters have on the price level of the commercial properties are generally consistent with our intuition. The price movement in a commercial property market can now be easily derived from Equation (15) as:

$$\frac{P_{cj,t}}{P_{cj,t-1}} =$$

$$\left(\frac{1-\theta_t}{1-\theta_{t-1}}\right)\left(\frac{I_t}{I_{t-1}}\right)\left(\frac{w_{cj,t}}{w_{cj,t-1}}\right)\left(\frac{1-\tau_t}{1-\tau_{t-1}}\right)\left(\frac{1-l_{cj,t}}{1-l_{cj,t-1}}\right)\left(\frac{\left[\frac{(1-\alpha_{cj,t-1})e_{cj,t-1}}{1-\rho_{t-1}}+(\alpha_{cj,t-1}r_{cj,t-1}+d_{t-1})\right]}{\left[\frac{(1-\alpha_{cj,t})e_{cj,t}}{1-\rho_t}+(\alpha_{cj,t}r_{cj,t}+d_t)\right]}\right) \quad (16)$$

$$*\left(\frac{(1-\alpha_{c,t-1})s_t+\alpha_{c,t-1}r_{c,t-1}}{(1-\alpha_{c,t})s_t+\alpha_{c,t}r_{c,t}}\right)\left(\frac{\frac{\beta_{cj,t-1}M_{cj,t-1}}{N_{t-1}}}{\frac{\beta_{cj,t}M_{cj,t}}{N_t}}\right).$$

Equation (16) shows that the time-series change in the prices of a commercial property type is subjected to the time-series changes in seven factors: the change in preferences $\left(\frac{1-\theta_t}{1-\theta_{t-1}}\right)$, the change in incomes ($\frac{I_t}{I_{t-1}}$), the change in tax rates on personal income $\left(\frac{1-\tau_t}{1-\tau_{t-1}}\right)$, the change in operating expenses ratios $\left(\frac{1-l_{cj,t}}{1-l_{cj,t-1}}\right)$, the changes in tax and monetary policies $\left(\frac{\left[\frac{(1-\alpha_{cj,t-1})e_{cj,t-1}}{1-\rho_{t-1}}+(\alpha_{cj,t-1}r_{cj,t-1}+d_{t-1})\right]}{\left[\frac{(1-\alpha_{cj,t})e_{cj,t}}{1-\rho_t}+(\alpha_{cj,t}r_{cj,t}+d_t)\right]}\right) \quad *\left(\frac{(1-\alpha_{c,t-1})s_t+\alpha_{c,t-1}r_{c,t-1}}{(1-\alpha_{c,t})s_t+\alpha_{c,t}r_{c,t}}\right)$, which include changes in leverage ratios, commercial and residential mortgage interest rates, corporate income tax rates, and depreciation allowances, and the market condition parameters $\left(\frac{\frac{\beta_{cj,t-1}M_{cj,t-1}}{N_{t-1}}}{\frac{\beta_{cj,t}M_{cj,t}}{N_t}}\right)$, including the change in inventories, the change in the number of households, and the change in market imbalance factors (occupancy rates).

Comparing the residential property price in Equation (11) with the commercial property price in Equation (16), we see that the latter has noticeably more factors than the former (seven versus four), which might provide an explanation for the anecdotal observation that commercial property prices are more volatile than residential property prices. However, similar to our discussion on price movements in the residential property market, it seems that the changes in incomes, interest rates, and tax policies alone are not able to fully explain the volatile price movements observed in commercial property markets. Again, a more careful examination of the formation of the preference factor seems to be warranted.

Cross-Market Analyses

From Equations (9) and (15), we can derive the price ratio of the two types of properties, or:

$$\frac{P_{cj,t}}{P_{h,t}}=\left(\frac{1-\theta_t}{\theta_t}\right)\left(\frac{[(1-\alpha_{h,t})s_t+\alpha_{h,t}r_{h,t}(1-\tau_t))]}{\left[\frac{(1-\alpha_{cj,t})e_{cj,t}}{1-\rho_t}+(\alpha_{cj,t}r_{cj,t}+d_t)\right][(1-\alpha_{c,t})s_t+\alpha_{c,t}r_{c,t})]}\right) \quad (17)$$

$$*\left(\frac{\beta_{h,t}M_{h,t}}{\beta_{cj,t}M_{cj,t}}\right)w_{cj,t}(1-l_{cj,t})$$

Equation (17) indicates that the relative change in the commercial and residential property markets can be affected by three factors: the change in preference $\left(\frac{1-\theta_t}{\theta_t}\right)$, the change in tax and monetary policies for both residential and commercial property markets $\frac{[(1-\alpha_{h,t})s_t+\alpha_{h,t}r_{h,t}(1-\tau_t))]}{\left[\frac{(1-\alpha_{cj,t})e_{cj,t}}{1-\rho_t}+(\alpha_{cj,t}r_{cj,t}+d_t)\right][(1-\alpha_{c,t})s_t+\alpha_{c,t}r_{c,t})]}$, and the change in market conditions $\left(\frac{\beta_{h,t}M_{h,t}}{\beta_{cj,t}M_{cj,t}}\right)$.

While the second factor (tax and monetary conditions) and the third factor are market specific, the first factor (preference) affects both markets simultaneously. Holding everything else constant, if the price increase (or decrease) in the residential market is due to a change in preferences, then Equation (17) implies that there must be a corresponding price decrease (or increase) in the commercial property market. This is true, because if the income level is fixed, an increase in spending on housing units implies a decrease in spending on other goods, which in turn reduces the amount of rent that can be used to support commercial properties.

Given this, there seems to be a need to examine the determinants of preference more carefully. So far in our model, we have treated the preference factor as exogenously determined. Can the preference factor be a function of the income level, relative level of interest rates, or tax policies?

If the answer is yes, then the implications of the second term (tax and monetary variables) of Equation (17) on the price movements of residential and commercial property markets will be more complicated than what we have derived so far. We will examine this issue in the next section.

When Preference is Endogenously Determined

In this section, we will relax the exogenous assumptions on consumption preference and the leverage decision, and write them as endogenous functions of other variables in the model. The consumption preference, as measured by parameter θt, is critically important to an individual's consumption decision.[6] It is very reasonable to argue that a resident's consumption preference is affected by her income level, tax policies, interest rates, and other factors. When the income level of residents in an area is low, it is quite reasonable to assume that a big portion of the income will be allocated to housing consumption. However, in an area with high-income residents, we might observe that the percentage of income allocated to housing consumption is lower (even though the total spending on housing consumption is higher) than that in a low income area. Given this, it might be reasonable to model θt as a concave function of It. The slope of the curve is positive until the income level reaches a critical point It', beyond which the slope of the curve becomes negative.[7]

We also know that individuals can decide between the use of consumer loans and mortgages. One of the most important factors determining the type of loans selected is the value of a tax shelter. The change in tax and monetary policies will affect the value of the tax shelter, and hence affects an individual's preference on the use of mortgages or consumer loans. This will, in turn, affect individuals' decisions on how to allocate their incomes to purchase different consumer goods.
Summarizing these effects, we write the preference parameter θt as:

$$\theta_t = \theta(I_t, \tau_t, r_{h,t}, O_t) \tag{18}$$

where:

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6 This can be easily seen by looking at an individual's welfare allocation ratio between a housing unit and other goods (denoted as A). From Equations (3) to (5), we know that A = $\frac{[(1-\alpha_{h,t})s_t + \alpha_{h,t} r_{h,t}(1-\tau_t)]P_{h,t}X_{h,t}}{[(1-\alpha_{c,t})s_t + \alpha_{c,t} r_{c,t}]P_{c,t}X_{c,t}}$, which can be re-written as $\frac{\theta_t I_t(1-\tau_t)}{(1-\theta_t)I_t(1-\tau_t)} = \frac{\theta_t}{1-\theta_t}$. This clearly shows that welfare allocation is determined by consumption preference.

7 Capozza, et. al. (2002) reported that the serial correlation in housing prices is higher in metropolitan areas with higher real incomes. This evidence indicates that the income level of an area can affect the dynamics of the housing price movement.

and Ot represent all other factors that influence consumption preference, which will not be modeled explicitly in our analyses.

$$\frac{d\theta_t}{dI_t} > 0, \quad when \;\; I_t \le I_t',$$
$$\frac{d\theta_t}{dI_t} < 0, \quad when \; I_t > I_t',$$
$$\frac{d\theta_t}{d\tau_t} > 0,$$
$$\frac{d\theta_t}{dr_{h,t}} < 0,$$

Besides consumption preference, borrowing decisions can also be affected by other variables in the model, such as the relative levels of interest rates among different loans and tax policies. Intuitively, a resident's leverage ratio in purchasing residential properties, αh,t, is decreasing in the residential mortgage rate rh,t and increasing in the personal-income tax rate τt. Similarly, a resident's borrowing ratio in purchasing consumption goods, αc,t, is decreasing in the consumer loan rate rc,t. Finally, a commercial firm's leverage ratio in purchasing commercial properties, αcj,t, is decreasing in the commercial mortgage rate rcj,t, increasing in the corporate-income tax rate ρt, and increasing in the depreciation rate allowed by tax policies dt. Summarizing these effects, we write the borrowing rates as:

$$\alpha_{h,t} = \alpha_h(\tau_t, r_{h,t}) \tag{19}$$

$$\alpha_{c,t} = \alpha_c(r_{c,t}) \tag{20}$$

$$\alpha_{cj,t} = \alpha_{cj}(\rho_t, r_{cj,t}, d_t) \tag{21}$$

where:

$$\frac{d\alpha_{h,t}}{d\tau_t} > 0,$$

$$\frac{d\alpha_{h,t}}{dr_{h,t}} < 0,$$

$$\frac{d\alpha_{c,t}}{dr_{c,t}} < 0,$$

$$\frac{d\alpha_{cj,t}}{d\rho_t} > 0,$$

$$\frac{d\alpha_{cj,t}}{dr_{cj,t}} < 0,$$

$$\frac{d\alpha_{cj,t}}{dd_t} > 0.$$

Substituting Equations (18) to (21) into Equations (9), (15), and (17), we can derive some additional insights that were not reported in Section 2. In the interest of saving space, we did not report the detailed equations for the comparative statistics of our results. Instead, we only summarized the implications of our findings based on those comparative statistics. The detailed derivations, however, are available from the authors upon request.

Economic Growth

When the income level is low, an increase in income always has a positive effect on the price level in the residential market because it increases both the overall purchasing ability and the allocation of income to housing consumption. Because of the allocation effect, with everything else constant, the property appreciation rate could be even higher than the income growth rate. If this prediction is true, then we should expect to observe a period of extraordinary high property appreciation rates in developing countries that are experiencing high GNP growth rates. We should add that many countries in Asia could be in this category.

When the income level is high, there is an offsetting effect between the increase in purchasing ability and the decrease in consumption preferences. However, we suspect that the positive income effect will dominate the negative allocation effect, so the overall result is still positive. However, under this circumstance, the property appreciation rate should be lower than the income growth rate. We should also add that many mature or developed areas in Asia could belong to this category.

Our model also predicts that an increase in income has a stronger (weaker) effect on commercial property markets than on residential property markets when the income level of the area is high (low). This implication can be seen by combining Equation (17) with Equation (18). This finding implies that when a country is in an early development stage, we should observe high residential property appreciation rates. At this stage, we probably do not see much activity in the commercial property markets. However, once the country reaches a mature stage in which people tend to spend more of their incomes on other goods and services, we would expect much of the activities and price appreciations to be in the commercial property markets.

As mentioned before, anecdotal evidence indicates that the property appreciation rate could be much more volatile than the income growth rate. Our proposition, that income could have an amplified or a chilling effect on property appreciation rates, depending on the absolute level of income and the type of property, could provide a partial answer to this observation. In other words, because of the amplified and chilling effects, it is possible, holding everything else constant, that the variance of property appreciation rates are higher than that of income growth rates.

Tax Policies

The impact of the personal-income tax rate τt on residential property price is also twofold. When a government increases the tax rate, the increase in tax liability decreases a resident's purchasing ability and, therefore, puts a negative pressure on the price of housing units. However, a higher tax rate also increases a resident's incentive to use more residential mortgages because of the tax shields provided by interest payments. In other words, because the tax shelter will be more valuable when the tax rate is higher, a resident will have more incentive to borrow using mortgages than using consumer loans (which do not provide a tax shelter). Indirectly, an increase in τt will increase the level of residential unit demand (holding the leverage ratio in the residential property market constant). This will give a positive price boost to residential units. With these offsetting effects, the net effect of the tax rate on residential property price cannot be defined (although we suspect that the net effect is still negative).

It should be noted, however, that under our model framework, an increase in the personal tax rate has a much stronger effect on the prices of commercial properties than on the prices of residential properties. This is true because an increase in the tax rate will reduce both the residents' purchasing ability and preference for commercial goods. Both have a negative effect on the price movements of commercial properties.

Corporate tax rate ρt also has two competing effects on commercial property markets. It negatively affects the commercial property market by reducing the after-tax income generated by the building. However, because an increase in the tax rate increases the value of a tax shelter, there is more incentive to increase the use of commercial mortgage loans, which in turn increases the demand for commercial property units (holding the leverage ratio of commercial properties constant). Given these two competing effects, the net effect of ρt on the commercial property market cannot be determined, although we suspect that the effect would most likely be negative.

It should be noted that in our preference-based approach, ρt does not affect the price in the residential property market. However, in a more complicated model (not developed here) in which the income level of residents is specified as a function of corporate earnings, the result of our model will be different because an increase in corporate tax liability will affect the level of personal income.

The third tax parameter is the depreciation allowance. Similar to the change in tax rates, the depreciation allowance dt can also affect the price of commercial property in opposite ways. The implications derived from the change in depreciation shelters should be the same as that derived from the change in corporate tax rates.

From the analyses, it is safe to conclude that the impact tax policies have on property markets (especially the residential property market) should be limited. Most of the time, the negative impact resulting from an increase in tax liability will most likely be offset (at least partially) by an increase in demand for the tax shelter offered by property markets. This might explain why when the government announces an increase (or a decrease) in the tax rate, we rarely see a corresponding price change in the property market that is of a similar magnitude.

Monetary Policies

Clearly, an increase in the residential mortgage rate rh,t negatively affects the price of residential properties. However, if the change in interest rates affects both mortgage loans and consumer loans in the same magnitude, then there is an incentive for an individual to switch from the use of consumer loans to the use of mortgages (because mortgage interest is tax deductible). Under this circumstance, the value of the tax shelter offered by owning a residential unit becomes more significant than before. The change will then affect the preference factor of an individual's utility function and will result in a positive effect on the prices of residential units. Given this, similar to the change in tax policies, there are also two effects that tend to offset each other. Although the influence of rh,t on residential property price is not clear, we suspect that the net effect is negative.

However, it is quite certain that an increase in the interest rate, with everything else constant, will not cause a price decrease of similar magnitude in the property markets (especially in the residential property market) because of the offsetting effect. For example, if the interest rate changes from 4% to 6% (an increase of 50%), it is unlikely that a drop in property prices will be of the same magnitude. Furthermore, anecdotal evidence also tells us that in a period of increasing interest rates, we frequently find that residential property prices can still increase at a significant pace. (This observation holds true even in areas with quite stable supply-and-demand and employment conditions.) Indeed, given the possibility of changing preferences due to tax shelter benefits, we believe that a change in interest rates might not be a determining factor affecting the movement of price levels in residential property markets.

On the other hand, the change in interest rates might have a stronger negative price effect on commercial properties. This is true because an increase in the interest rate will increase individuals' allocation of income to the consumption of housing units, which in turn will reduce their consumption of other goods and the rent available to support commercial properties. In other words, the change in preference in this case works against (not for) commercial properties. Given this, we would expect the change in interest rates to have a stronger effect on the price movements of commercial properties than on residential properties. (This is an empirically testable proposition.)

Conclusion

In this paper, we developed a preference-based model to analyze the pricing factors in the residential and commercial property markets. Our model was able to explain why the price movements in the residential property market are not very sensitive to changes in the monetary environmental and tax policies. The results of the model also indicated that it is possible for the property price movement in an area to be more volatile than the income movement in the same area.

Our model also predicted that the price movement in commercial property markets should be more volatile than that in residential markets. More interestingly, we argued that in a given area (or country), holding everything else constant, residential properties should appreciate faster than commercial properties if the area (or country) is at an initial development phase. Once the area (or country) matures, commercial properties might perform better than residential properties in terms of the property appreciation rate.

Our model has two limitations. First, we did not take expectations into consideration. In our model, prices are determined by current income levels, not expected future incomes. In other words, the expected income growth rate is absent from our model. Second, our analyses did not explicitly model the supply decisions of developers. In other words, we took the occupancy rate in an area as a given. Realistically, the supply decision should also be a function of the price level in the market. However, while we believe that an inclusion of the income growth rate and supply decisions in the model (which might make the model unsolvable) will enable us to understand property markets better, we do not believe that results of the model presented here will be altered in any way if these two variables had been included in the model.[8]

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8 An attempt to include these two variables in the model is underway to verify this claim.

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