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Inequity of land valuation in the highly developed city of Taipei, Taiwan

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ABSTRACT

Taiwan has a wealth of experience in employing a graded, or split-rate, property tax. It is believed that a graded property tax can increase the capital intensity of improvements to land, and thus improve economic activities. In order to achieve this, land value needs to be extracted from the price of an improved property. Despite the long history of a graded property tax in Taiwan, the accuracy and corresponding equity issues of land valuation have so far received scant attention. This study adopts a linear regression model with data sets of both vacant land and improved property to separate land and structure values. This approach solves the common problem of scarce land sales and the empirical results turn out satisfactorily. The empirical findings suggest that the ratio of land value to total property price varies across property types and age of property. In addition, the current practice is likely to contribute to assessment inequity, and consequently tax inequity. All these observations call for the need to overhaul the present property assessment system.

Introduction

It has long been held that land value taxation can increase the capital intensity of improvements to land. Pollock and Shoup (1977) provided one of the early empirical studies through simulation to support this proposition. Oates and Schwab (1997) offered probably by far the most convincing evidence in favour of a graded property tax. In the 1980s the city of Pittsburgh reconstructed its property tax system so that the rate on land is more than five times that on structures. As a result, Pittsburgh experienced a dramatic increase in building activity, far in excess of other cities in the region. The heavier reliance on land taxation enabled Pittsburgh to avoid rate increases in other taxes that could have impeded development.

Despite the appealing nature of a graded property tax in theory, the assessment of site and structure values poses grave challenges. In order to tax land and structures at different rates, their values have to be, respectively, assessed. A common method is to collect the sales data of vacant land to estimate the site value of an improved property, and also to use a prescribed construction costs manual with annual depreciation to arrive at the structure value. In an already densely built-up area where vacant land sales are scarce, a possible alternative is for an ad hoc land commission to determine the land value, whose members are knowledgeable about the local land market. However, a recent noted example highlights the potential problems behind this approach. The “true tax value” produced by application of regulations promulgated by the Indiana State Board of Tax Commissioners was in 1996 ruled unconstitutional by the State tax court. The primary reason for this ruling was that the State’s assessment system violated a constitutional requirement for a “just valuation”. The prescribed values for replacement costs and depreciation, among others, were found to bear no relationship to market values of properties (Smith, 2000; Birch et al., 2006).

Taiwan has long employed a graded property tax based on the belief that land and capital shall be treated differently, with land taxed at a higher rate than that on structure. Owners of an improved property are obliged to pay both land value tax and structure tax. The split-rate property tax naturally leads to the need for separate assessment of land and structure. However, the highly built-up nature of urban areas in Taiwan prevents the collection of sufficient sales of vacant land to estimate the value of improved sites. In response, the Taiwan government has over the years developed a sophisticated procedure for assessing land and structure in a mass-appraisal manner. This assessment procedure and its accompanying problems have been criticized by a significant number of studies (for example, Tsai, 2001). Very few of them, however, have supplied concrete evidence of how the current practice is biased and the likely causes of it.

The present study first illustrates the functioning of assessment procedure for real properties in Taiwan. Previous works on separating land and structure values are then reviewed and from this an empirical model is proposed. The model-derived estimated land values are compared with government-assessed land value. Evi-

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dence revealed through these comparisons is used to investigate the underlying assessment inequity that consequently leads to taxation inequity. Finally, a direction for future research is pointed out.

Assessment of land and structure in Taiwan

Land is assessed by the local land administration department based upon the Regulation of Investigating and Estimating Land Value. Properties with similar attributes, land use, special amenities, structure conditions, and proximities to transportation and other facilities, and close in location, etc., are grouped together and assigned into the same land value section. Assessors are required to collect information from real estate agents, financial institutions, and others of property transactions in each land value section. Assessed land value for individual properties is derived by subtracting from the sales price of an improved property current structure value with consideration given to depreciation, decoration, and equipment costs spent during construction and expected profits of structure investment. The figures for decoration, equipment costs, and expected profits, and some others, are left to the judgment of the local assessor and naturally to an extent are at their professional discretion.

Assessment of land value of this kind is an application of the market extraction method (or land residual approach) in the appraisal literature. The median of estimated land values for collected property sales in a land value section is designated as the representative sectional land value. The sectional land value is indicative of the general price level for improved sites within a section. For those properties facing thoroughfares, benefits of easy access to traffic flow are also taken into account. There were a total of over 3000 land value sections in Taipei as of September 2006. Current structure value of a real property is estimated by the local revenue service department and equals replacement costs new less accrued depreciation. Replacement costs and annual depreciation rate for various types of properties are specified and announced every January by individual local governments. Assessment of structure value is an application of the cost approach in appraisal literature. Assessed land value and structure value are, respectively, the tax base for land value tax and structure tax. All properties are assessed annually through the above-described procedures.

The belief that land is a natural gift and thus ought to be treated differently is deeply embedded in Taiwan's land and tax policies. In consequence, land and the structure upon it need to be separately assessed for tax purposes, among others. However, the number of vacant land sales in the market is so few that they cannot be used as reliable comparables to estimating the value of an improved site or the value as if the site was vacant. What is more, the sparse vacant land sales lead to a systematic accuracy check of assessed land values that is difficult if not impossible. Figures provided by the Department of Land Administration, Ministry of Interior, show the percentages of announced current land value as market value for Taiwan as a whole to be 58%, 59%, 64%, 65%, 67% and 68%, respectively, for the years of 2000 through 2005 (http://www.land.moi.gov.tw/). These figures indicate the noticeable divergence between assessed and market value. Nevertheless, no further figures are provided as to the percentages of assessed value to market value across properties of various types and ages. The percentages distribution among properties is indeed crucial to the tax equity. The following sections of this paper therefore set out to reveal the underlying assessment inequity, through the relationship between assessed values and market values. Finally, the possible causes for the assessment inequity are proposed. This could be the basis for future improvement.

Regression models of separating land and structure values

An intuitive way of estimating improved land value is through analysis of the sales data of vacant land. As pointed out earlier, this approach often fails in a thin market where the number of vacant land sales is fairly small. Hendriks (2005) argued that existing methods of separating land and structure values were unreliable after a review of the methods in practice. However, a series of attempts are noted for improving the accuracy and reliability of methods to extract land value from the price of an improved property. The difficulty of having scarce market evidence leads researchers to explore the possibility of combining data of both vacant land and improved properties to estimate the component of land value of an improved property. A review of previous efforts reveals two alternative empirical approaches along this line, and they are, respectively, the linear model and the non-linear model.

As for the linear regression model, the dependent variable is either the price of vacant land or improved properties regressed by site attributes, structure attributes, and other relevant variables, such as date of sales, neighborhoods, etc. A typical linear regression model is such as Eq. (1):

$$V = B_0 + B_1 * X_1 + B_2 * X_2 + \ldots + B_K * X_K \ldots \quad (1)$$

where V: the sales price of vacant land or improved property; X_i: site or property attributes; B_i: the coefficients.

When estimating the value of a site of an improved property as if vacant, respective values for land attributes are assigned and all structure attributes are given a value of zero. In contrast, the value of site as if improved of an improved property is derived by subtracting the structure value; the summed value of individual structure attributes, from the price of an improved property. In addition, a variable indicating whether a site is developed is included to account for the possible price difference between a vacant and an improved site. For this kind of model, it could be argued that some of the value of structure attributes is contained in the intercept of the fitted model (Sunderman and Birch, 2001, p. 337).

Guerin (2000) collected sales of 3838 improved properties and 166 vacant land from Peterborough County, Canada, for construction of valuation models. The author compared the prediction ability among models of vacant land only, improved properties only, and a combination of improved properties and vacant land. The adjusted coefficient of determination for the combined model is as high as 95.3%, with the value of coefficient of dispersion (COD) at 8.29. This COD value not only satisfies the standard suggested by the International Association of Assessing Officers (Eckert, 1990) but also performs better than the model with vacant land samples only. Sunderman and Birch (2001) looked into sales data from a community in Wyoming, U.S. A total of 2252 improved properties and 154 vacant lands were put into a regression model. The resulting coefficient of determination was 91.8%. A hold-out sample of 20 sales of vacant land was compared with their estimated values based on the regression model, and the calculated COD value was 21.5. This figure is smaller than the COD of 28.8 for the original appraisals versus hold-out sales. The authors further argued that the COD of 21.5 could be significantly improved through removal of some extreme observations with unusually large or small appraisal to sales price ratios. These two recent studies suggest that a combination of vacant land with improved properties in a valuation model tends to advance the prediction accuracy in comparison with models with only vacant land or improved properties samples.

In contrast to the linear model, the non-linear model explicitly divides the value of an improved property into a land value component and a structure value component without inclusion of the intercept term that implies a merger value (Lin, 2006, p. 372) as specified in the linear model. In order to do so, a Cobb-Dogulas functional form is often employed as Eq. (2):

$$V = V_L + V_S = \alpha X_1^{\beta 1} X_2^{\beta 2} \ldots + \gamma_1 Y^{\theta 1} Y_2^{\theta 2} \ldots \quad (2)$$

where V: sales price of vacant land or improved property; V_L: site value; V_S: structure value; X_i: site attributes; Y_i: structure attributes; B_i, θi: coefficients.

The dependent variable is either the price of vacant land or improved properties, with two groups of independent variables including land attributes and structure attributes. Two features of the non-linear model deserve some attention. Firstly, there is no intercept, so it is without the question of partition of land and structure portions in the merger value. Secondly, the same variable, such as distance to school or park, etc., is allowed to appear in both groups of land and structure variables. This kind of arrangement for variables admits the possibility that some variables might affect both land and structure values. This type of model avoids the thorny problem of separating land and structure values expressed in the intercept that are encountered in a linear model. Despite this advantage, the solution of a non-linear model is found through an iterative process, and a true value might not always be ascertained.

Examples of the application of non-linear models include Gloudemans (2000) who examined sales of 3842 improved properties and 900 vacant lands in Ada County, Edomonton, and Jefferson County. The adjusted coefficient of determination was as high as 95.7% and the COD for the ratio of predicted land value to real sale price was 9.85. McCain et al. (2003) included neighborhood variables in both land and structure value components and noted that the neighborhood variable affects structure value more significantly than land value. Rossini and Kershaw (2005, 2006), using sales data from Metropolitan Adelaide, Australia, concluded that the non-linear model outperforms slightly other linear models based upon a thorough examination of their prediction performance. Several studies of non-linear model applications conclude that certain locational or amenity variables, such as distance to local facilities or neighborhood quality, are likely to affect both values of land and structure. This finding corresponds to the concept of merger value that is represented by the intercept term of a linear model.

As far as these study results are concerned, inclusion of both vacant land and improved properties in a model tends to improve the model performance and modestly solve the problem of scarcity of vacant land sales. Also, part of the value of an improved property is contributed jointly by both land and structure; the so-called merger value. A linear model is easy to comprehend but partition of individual land and structure value is difficult. A non-linear model can distinctly separate value components but might not be able to arrive at a correct solution. A non-linear model outperforms a linear model in predicting values, but only marginally. All in all, there is no apparent foundation as a basis on which to argue for either linear or non-linear model as being better than the other.

A linear regression model, largely following Guerin (2000) and Sunderman and Birch (2001), is considered appropriate in the current context, primarily because of its easier implementation and interpretation. Inclusion of vacant land sales provides a benchmark for comparing the predicted land value with the sales price, so as to more properly assess the model. Features of this model, however, deserve some further discussion. This model's intercept is assumed to consist of both the value of the land and the structure attributes. The value of the intercept is representative of the total merger value contributed by land and structure through land development. In addition, Sunderman and Birch regard the coefficient of the dummy variable of whether land is vacant or improved to represent the price difference between vacant and improved land, and that equals the structure portion of merger value. We approve the perspective of treating the intercept as the merger value, and the coefficient of the dummy variable of vacant land as the price difference. We are, however, not convinced that the price difference best stands for the structure portion of the merger value. The inherent nature of the previous linear model proposed by Guerin (2000) and Sunderman and Birch (2001) is that the price difference between vacant and improved land is constant and independent of the land attributes. We will attempt to better deal with these issues in our later analysis.

Explanation of research areas and data

Sales data analysed in this study are improved residential properties and vacant land for residential use in Taipei City. Data of improved properties are provided by the Department of Land Administration, Taipei City Government. These sales are collected for valuation for the purpose of land value tax. Data for vacant land are obtained from the database of real estate transactions at the Department of Real Estate and Built Environment, National Taipei University. The data are primarily of land sales by auction by the public organizations. These land parcels were sold to the general public through sealed-bid auctions. The auction prices are generally regarded to represent the market price. Sales of both improved properties and vacant land occurred from January 1999 through June 2004. A total of 617 vacant land sales are assembled. A screening of these sales leaves only 226 samples, mostly due to the omission of sales date, location, land use, etc., for later analysis. Twenty sales are kept as the hold-out samples for model assessment. The hold-out samples are scattered over the districts in the city to avoid assessment bias. In addition, the prices of hold-out samples represent the general price level of the whole vacant land samples in their respective districts. In order to select samples of improved properties to be comparable to vacant land samples, we include improved properties within 300 meters from our 226 vacant land samples. It is based on a recent study (Lin and Liao, 2006) that suggests in Taipei City, 80–85% of comparables are within 300 m from the subject property. A total of 4016 improved properties are therefore selected. The spatial distribution of hold-out vacant land sample and selected improved properties are depicted in Fig. 1.

Distances for all samples of improved properties and vacant land to the nearest MRT station, park, and school are computed through network analysis in GIS software. A summary of the statistics of basic characteristics of vacant land and improved properties in our analysis is indicated in Table 1.

Model building and results interpretation

We construct a linear type model with the empirical regression model of Eq. (3):

$$\begin{aligned} V = {} & \beta_0 + \beta_1\,\text{Dvacant} + \beta_{2-13}\,\Sigma\text{sitesize} * \text{Ddistrict}^{\alpha 1} \\ & + \beta_{14}\,\text{builtarea}^{\alpha 2} + \beta_{15}\,\text{Dfrontroad} + \beta_{16}\,\text{age}^{\alpha 3} \\ & + \beta_{17}\,\text{Downership} + \beta_{18\sim 22}\,\Sigma\text{Ddate} + \beta_{23-24}\Sigma\text{Ddevelopment} \\ & + \beta_{25}\,\text{dmrt} + \beta_{26}\,\text{dpark} + \beta_{27}\,\text{dschool}\ldots \end{aligned} \quad (3)$$

where V: sales price of vacant land or improved properties; Dvacant: if subject is a vacant site; sitesize: size of the site; Ddistrict: the district that a site or property is located; builtarea: floor space; Dfrontroad: if the subject is fronted onto a major road; age: structure age; Downership: site is in single or joint ownership; Ddate: sales year; Ddevelopment: if the subject is within a declining,

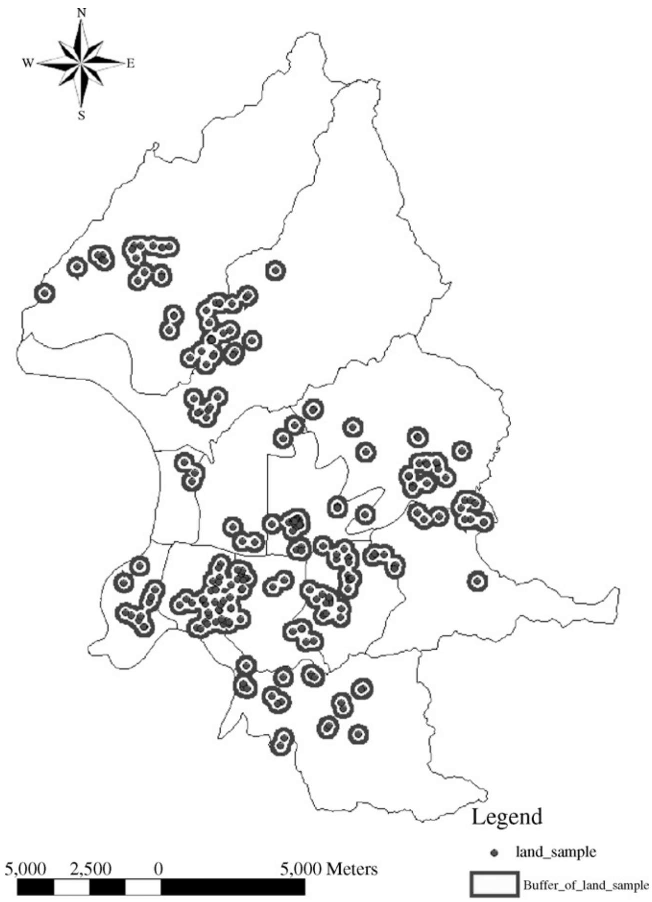

Fig. 1. Spatial distribution of samples of vacant land and improved properties.

steady or developing area; dmrt: distance to MRT station; dpark: distance to park; dschool: distance to school.

Gloudemans (2000), Sunderman and Birch (2001) and Colwell and Colwell (2004) all indicated the possible price difference between vacant and improved sites. The direction and extent of the price difference largely depends upon the market conditions. The non-linear relationship between land or property value and site size or structure (floor) space has been recorded in Colwell and Munneke (1999), Lin and Evan (2000), and Sunderman and Birch (2001), among others. Two exponents are inserted to detect the respective degree of curvature of this relationship. In addition, site size is multiplied by a district dummy to take account

Table 2
Comparison between different exponential values.

	$\alpha_1 = \alpha_2 = 1.1$	$\alpha_1 = \alpha_2 = 1.2$
Average assessment/market value	1.17	0.58
Average prediction error	25%	45%
COD	23	33
COV	33	43

of the locational effects on the size–value relationship (see Smith, 2004 for a similar application). A similar relationship is expected to exist between structure value and its age; that is, the property depreciation. This relationship has been documented at least in Cannaday and Sunderman (1986) and Wolverton (1998). In addition, a variable of ownership type is especially included to account for the price premium of sites in a single ownership over those in joint ownership. Assembly of contiguous sites is commonplace in a city where land redevelopment is in high demand. In consequence, sites in a single ownership are expected to command a price premium over those jointly owned, primarily due to the saving of negotiation costs across the great number of joint owners (Colwell and Munneke, 1999; Lin and Evan, 2000). Properties with similar characteristics are often found to differ in their values across districts alongside different phases of urban development (Lin and Lin, 2005). In this light, all 12 districts are, respectively, grouped into declining, steady and developing areas in terms of their urban development stage. This variable is included in the hope of capturing the spatial element of land or property values. In addition, a number of variables that are widely acknowledged as factors that determine the value levels are also included, such as frontage onto a main road, transaction date, and access to the nearest MRT, park, and school.

For the purpose of simplicity, the values of α_1 and α_2 are set equal. Previous studies suggested an exponential value different from unity, thus values of 0.8, 0.9, 1.1 and 1.2 are attempted so as to find a better transformation value. Adoption of values smaller than unity results in a negative regression intercept. A negative intercept is against the expectation of a positive merger value of site and structure. Also, employment of smaller-than-unit values tends to contribute to negative predicted land and property values. Regression results with transformation values of 1.1 and 1.2 are overall in accord with prior expectations, also with a positive intercept. Prediction performance for the hold-out samples of regressions with respective values of 1.1 and 1.2 are compared. Figures in Table 2 suggest 1.1 as a better exponential value.

In addition to a non-linear size–value relationship for site and structure, the literature also reveals the non-linear depreciation path for structure. Lin and Chang (2006) find that the value of resi-

Table 1
Summary statistics of sample properties.

	Min.	Max.	Average	S.D.
Vacant land				
Sales price (NT dollars)	500,000	900,000,000	167,209,138	618,696,593
Site size (m^2)	5	49,871	1,376	3,193
Distance to MRT (m)	108	6,060	1,018	666
Distance to park (m)	7	1,332	268	203
Distance to school (m)	14	4,962	408	408
Improved properties				
Sales price (NT dollars)	900,000	49,999,941	7,409,988	4,305,672
Site size (m^2)	1	666	47	32
Structure size (m^2)	5	593	111	45
Structure age (years)	0	46	19	8
Distance to MRT (m)	20	4,249	788	567
Distance to park (m)	7	694	178	116
Distance to school (m)	24	2,446	289	193

Table 3
Regression results.

	Parameter estimate	T-value	Pr > |t|	VIF
Intercept	2,887,264	1.47	0.1427	0
Dvacant	1,580,001	1.04	0.2993	4.67068
Sitesize*district1	59,393	2.83**	0.0046	1.32712
Sitesize*district2	48,213	65.77**	<.0001	1.04309
Sitesize*district3	93,845	60.55**	<.0001	1.10977
Sitesize*district4	42,716	50.22**	<.0001	1.06980
Sitesize*district5	5,221	6.69**	<.0001	1.02022
Sitesize*district6	31,781	11.55**	<.0001	1.01623
Sitesize*district7	43,200	72.68**	<.0001	1.04621
Sitesize*district8	119,303	66.08**	<.0001	1.10303
Sitesize*district9	134,267	95.41**	<.0001	1.01194
Sitesize*district10	180,216	676.07**	<.0001	1.01482
Sitesize*district11	58,507	1.98*	0.0482	1.16681
Sitesize*district12	49,095	71.82**	<.0001	1.04113
Builtarea	24,390	12.13**	<.0001	1.21081
Dfrontroad	6,04,972	1.32	0.1872	1.16305
Age	−27,217	−2.18*	0.0293	1.53851
Downership (multi-ownership)	−2,891,212	−3.50**	0.0005	3.26727
Date2000	564,401	0.85	0.3928	1.73905
Date2001	−340,027	−0.53	0.5978	1.75852
Date2002	−598,107	−0.85	0.3956	1.64694
Date2003	−865,157	−1.24	0.2140	1.68995
Date2004	−411,682	−0.47	0.6396	1.44862
Ddevelopment (steady)	410,042	0.56	0.5772	2.49095
Ddevelopment (developing)	2,506,863	4.01**	<.0001	2.77976
Distance to MRT	−1205.79983	−3.12**	0.0018	1.19296
Distance to park	2315.66919	1.31	0.1906	1.30260
Distance to school	1384.41773	1.34	0.1803	1.14853
Adjusted R^2		89.2%		
White's test		<0.001		
Observation number		4312		

* At 95% significance.
** At 99% significance.

dential properties in Taipei City decreases with age and at a higher rate during the final life span than the early stages. In order to reflect the concave-type property depreciation, the value of α_3 is set larger than unity, and a value of 1.2 is chosen. The regression results are exhibited in Table 3.

There is no collinearity problem based on the value of the variance-inflating factor. In addition, no heteroscedasticity is found through White's test. The high-adjusted R^2 suggests a satisfactory explanation of land and property value through this regression model. It is noted that, contrary to some prior studies, vacant land is found to be in the direction of a higher value than improved sites, although not at a statistically significant level. There are at least two candidate explanations for this difference in value. One is that the highest and best use to which a site would be developed if there were no existing structure on it has shifted over time (Geltner and Miller, 2001, p. 99). The vacant land holds the opportunity of developing with a (more suitable) structure that differs from the current one on the improved sites. This deduction is reinforced by the average structure age of nineteen years in our sample of improved properties. The structure type of a 19-year-old property is likely to be different from the current highest and best use. The second is that the soaring costs in negotiation over, normally, a great number of joint owners of an improved property have discouraged new development. This is well documented in studies by Adams and Hutchison (2000) and Lin (2005) in addition to many others. In the light of ownership constraint, vacant land is relatively easy to develop, and so attracts more demand which consequently raises its price. The non-linear site size–value relationship is pervasive in all districts. It is even noted that the size-effect is more eminent in districts 8, 9, and 10. These districts are places where properties are overall expensive and a larger parcel of land is in high demand. The non-linearity of size–price relationship also applies to structure. Property value decreases with structure age as expected indicating a clear property depreciation. Furthermore, the negative sign of the ownership variable suggests multiple ownership to be a detriment to site value. Moreover, properties or land within developing areas are considerably more valuable than those in declining areas. Finally, the distance from individual parcel of land or properties to the nearest MRT substantially influences their values. The direction and magnitude of regression coefficients are all in all within our expectations.

Evaluation of property assessment inequity

A consequent thorny issue following the calibration of the regression model is how to separate the respective site and structure component of the merger value expressed by the intercept term. As no widely received theory can help with deciding prior relative contribution of site and structure to merger value, we decided to make use of the Monte-Carlo method of simulation. The Monte-Carlo method combines sensitivity analysis with probability distribution of input variables to tackle the uncertain nature of the value distribution (Kelliher and Mahoney, 2000). We, before the simulation, exclude the sample of 1723 properties whose deviation of predicted price, based on our regression model, is over 20% from sales price. As our regression model does not perform satisfactorily on these developed properties, further estimation for site value component for them is not too meaningful.

For the remaining 2383 developed properties, the structure variables of builtarea and age are set to zero and values of site variables are inserted into the regression model to derive a value of their site component without consideration of the intercept term. This can be reasoned as the magnitude of value solely contributed by site. Due to the lack of a prior theory regarding apportion of the merger value, a uniform distribution of land-contributed value is assumed. That is to say, the probability of any figure from zero through 2,887,264 is the same for the land component of the merger value. A random number selected from the value domain of zero to 2,887,264 following the uniform distribution is added to the sole site value to arrive at the estimated site value component of an improved property or the estimated value of an improved site. This estimated improved land value divided by the sales price of this improved property is the percentage of land value for an improved property. This procedure applies to all 2383 improved properties and the averaged percentage stands for the general percentage level for them. This process is iterated for 1000 times and the distribution of the 1000 general percentage levels are shown in Fig. 2.

It is found through simulation that site value is most likely to be 75% of the property price. This figure is in accord with previous findings and occasional observations at local real estate markets. In addition, the site–value percentage is expected to differ across various types of properties (McCain et al., 2003). The respective distributions of site value percentages for 20 houses, 1467 apartments and 896 high-rise apartments are 78.5%, 76.5% and 68.8%, respectively (see Fig. 3). The proportion of site value to property price decreases with the density of a property. As a larger parcel of land is devoted to constructing a house, this size effect on site value seems to yield the observed higher land value percentage.

In addition to the properties across various types, properties along different life stages, indicated by the structure age, are expected to exhibit distinct site value percentages over a range of property prices. Rossini and Kershaw (2005) have confirmed this age effect on land value percentages. Properties in our sample set

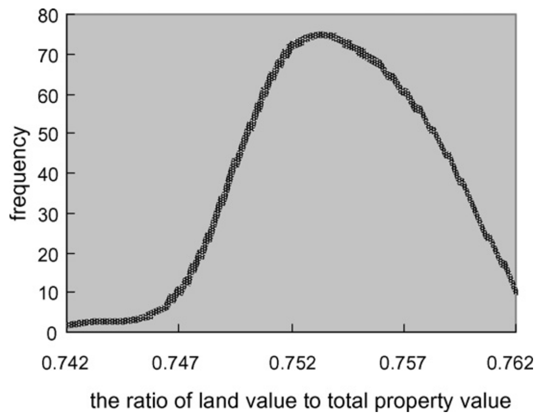

Fig. 2. Distribution of percentages of land value to property price.

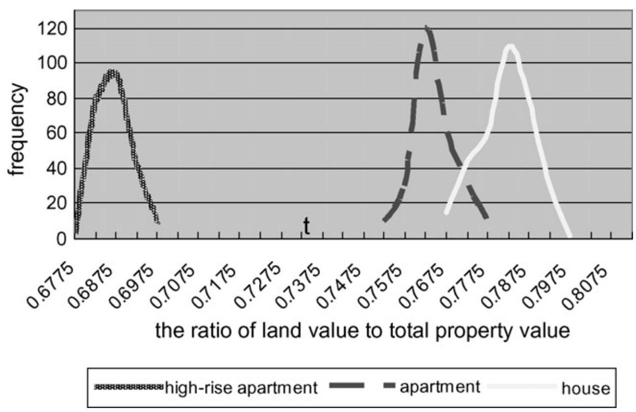

Fig. 3. Distributions of site value percentage across property types.

are divided into groups of those under 3 years old (67 properties), 4–30 years old (1104 properties) and 31–45 years old (103 properties). This classification is based on the distribution of ages of our sample properties and also the market conditions in the local housing market. The distributions of the ratio of land value to property price for the new, medium aged, and old properties are shown in Fig. 4.

It is to be noted that slightly over 90% of value is in the land portion for old properties, followed by 79% for medium aged and then 60% for the new properties. The site value percentage rises with the property age. Property depreciation leads to continuing decrease in the structure value, thus lowering its relative value proportion. Also,

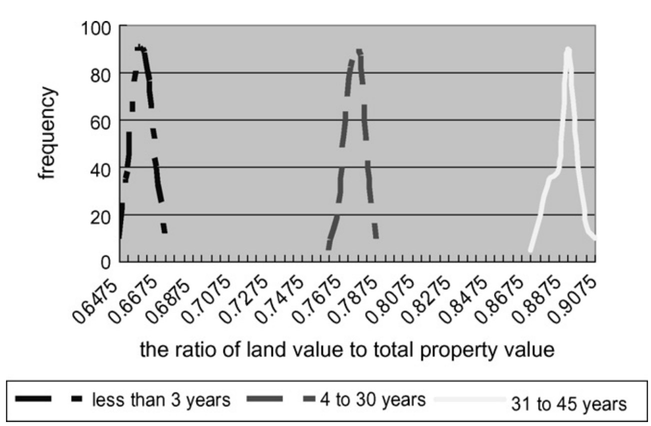

Fig. 4. Distributions of site value percentage across properties of different ages.

following the aging of a property, the highest and best use for the site is liable to change. The approach of redevelopment opportunity raises the site value and consequently contributes to a higher land value percentage.

When the site of an improved property is assessed for taxation purposes, discussion often arises about the appropriate tax base: the value of an improved site or the value of the site as if vacant (Rossini and Kershaw, 2005). Relevant laws and practicing procedures do not specify which tax base shall be valued. The mean percentage of site value to total property price derived earlier (see Fig. 2) is therefore employed to estimate both the value of an improved site and that as if it was vacant, so as to examine their relationships with the announced current land value. Announced current land value is supposed to represent the market value of sites. It is found that the announced current land value is on average 72.1% of improved site value, with the respective figures of 87.6%, 77.2% and 60.6% for houses, apartments, and high-rise apartments. In addition, the announced current land value is on average 64.2% of the value of sites as if vacant, with the respective figures of 78.5%, 67.4%, and 56.4% for houses, apartments and high-rise apartments. The relationships between individual announced current land values and estimated improved site values, and estimated vacant land values are depicted in Fig. 5a and b. Most of the points are scattered above the 45° diagonal line. The announced current land value is below its estimated market value for the majority of sites. In addition, visual inspection suggests that the deviation of announced current land values from estimated market values seems to augment as estimated values increase. The values

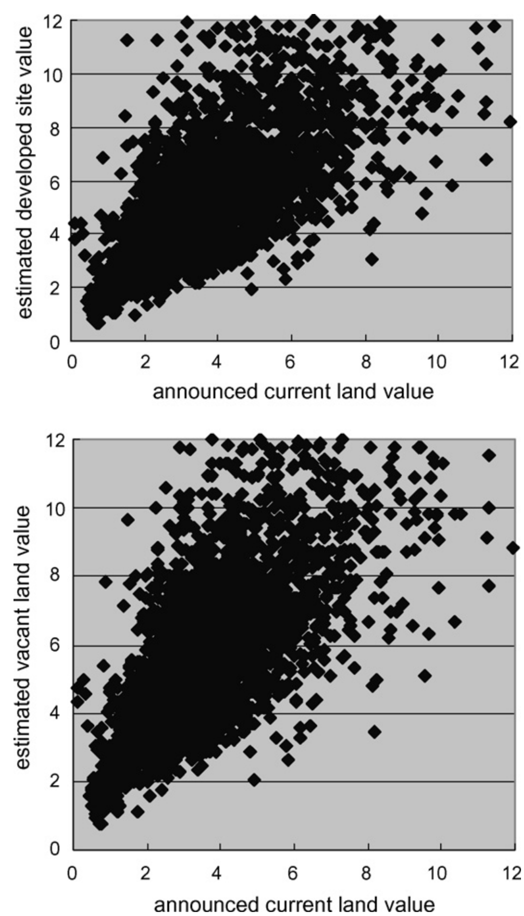

Fig. 5. (a) Announced land values vs. estimated improved site values (in millions of New Taiwan Dollars) and (b) announced land values vs. estimated vacant land values (in millions of New Taiwan Dollars).

of the coefficient of dispersion (25.8 for improved sites and 25.2 for sites as if vacant) indeed suggest problems with assessment uniformity. Moreover, the values of price-related differential are 0.5 for improved sites and 0.4 for sites as if vacant. The percentage of announced current land values to estimated market values of sites, for both improved and that as if vacant, is lower for high-priced sites than for low-priced ones. As far as ad valorem tax is concerned, this observation suggests an under-assessment of high-priced sites or an over-assessment of low-priced sites; that is, a regressive type of inequity.

Conclusions

The current paper employs the regression model that combines both improved properties and vacant land to undertake land valuation. The results overall correspond to the widely held views and thus proven to be credible. The satisfactory results are suggestive for the acceptance of a vacant site-improved property combined model for the purpose of land valuation, at least in Taipei City. The empirical figures of ratios of land value to property price are expected to provide an educated rule-of-thumb for practitioners when valuing land of an improved property. The ratio of estimated land value to property price is highest for houses as they consume a larger land parcel. Also, structure depreciation and potential land redevelopment together lead to a higher land value ratio for properties approaching their demolition, likely followed by redevelopment. In addition, contrary to most studies but not entirely out of expectation, vacant land tends to be more valuable than comparable improved sites. The highest and best use seems to alter rapidly in response to the fast changing real estate market. The regressivity of the ratio of announced current land value to estimated improved and vacant site is discovered. This suggests that the deduction of structure related costs and profits for high-priced properties might be excessive. All these findings call for the need of an overhaul in present land valuation practices. It seems that a fit-for-all assessment procedure is likely to contribute to tax inequity.

In addition to the reported empirical findings, a number of institutional issues associated with land valuation in Taiwan are also worth addressing. Due to the lack of evidence of vacant land sales, the estimation of land value relies mostly upon the method of market extraction. However, the market extraction method is generally applied to properties in rural areas and properties in which the improvements contribute little to total property value (Appraisal Institute, 2008, p. 366). Moreover, this method will be successful only when the improvements are within the range of expected uses of the site as if vacant (Lusht, 2001, p. 172). In practice, the market extraction method is applied in Taiwan to all improved properties, though, of course, largely to those in urban areas. Also, little attention is paid to determine the expected highest and best use of a site. To make the situation even worse, the depreciated cost of improvements are derived through an ad hoc formula generally held to be unreliable. In consequence, the assessed land value has long attracted fierce criticism in respect to its accuracy. Despite the criticism, the announced current land value has expanded its application from tax levy and expropriation compensation to a value reference in transferable development rights, corporate accounting, and rental of leased government-owned land, only to mention some of them. The expanding application of announced current land value is because of its transparency (available on a website) and comprehensiveness (all registered lands are assessed) (Huang, 2007). The identified valuation inequity in this paper is therefore expected to flow into other policy arenas because of the multi-purposes the announced current land value has served.

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References

Adams, D., Hutchison, N., 2000. The Urban task force report: reviewing land ownership constraints to Brownfield redevelopment. Regional Studies 34 (8), 777–792.
Appraisal Institute, 2008. The Appraisal of Real Estate. Appraisal Institute, Chicago.
Birch, J., Sunderman, M., Smith, B., 2006. Cost-based property tax inequity: evidence from Indiana. The Appraisal Journal 74 (3), 257–2669.
Cannaday, R., Sunderman, M., 1986. Estimation of depreciation for single-family appraisals. Journal of the American Real Estate & Urban Economics Association 14 (2), 255–273.
Colwell, M.D., Colwell, P.F., 2004. The timing of development revealed by the market: an options approach. The Appraisal Journal 72 (3), 121–126.
Colwell, P.F., Munneke, H.J., 1999. Land prices and land assembly in the CBD. Journal of Real Estate Finance and Economics 18 (2), 169.
Eckert, J., 1990. Property Appraisal and Assessment Administration. The International Association of Assessing Officers, Chicago.
Geltner, D., Miller, N., 2001. Commercial Real Estate Analysis and Investments. South-Western Thomson Learning, Ohio.
Gloudemans, R., 2000. Implementing a land value tax in urban residential communities. Journal of Property Tax Assessment and Administration 5 (4).
Guerin, B., 2000. MRA model development using vacant land and improved property in single valuation model. Assessment Journal 7 (4), 27–34.
Hendriks, D., 2005. Apportionment in property valuation: should we separate the inseparable? Journal of Property Investment and Finance 23 (5), 455–470.
Huang, L.-M., 2007. The policy roles of announced current land value. In: The Proceedings of Land Policy Forum. National Chengchi University, Taipei.
Kelliher, C., Mahoney, L., 2000. Using Monte Carlo simulation to improve long-term investment decisions. The Appraisal Journal 68 (1), 44–56.
Lin, T.-C., 2005. Land assembly in a fragmented land market through land readjustment. Land Use Policy 22 (2), 95–102.
Lin, T.-C., Chang, K.-P., 2006. Divergence between Market and Legislation: Calculating Tax Depreciation for Residential Properties. Working Paper.
Lin, T.-C., Evan, A.W., 2000. The relationship between the price of land and size of plot when plots are small. Land Economics 76 (3), 386–394.
Lin, T.-C., Liao, Y.-C., 2006. Price Prediction for Residential Properties consistent with Sales Comparison Approach. Working Paper.
Lin, T.-C., Lin, C.-M., 2005. Equity of property assessment—applications and extension of assessment ratio study. In: Proceedings of the Twelfth Annual Pacific-Rim Real Estate Society Conference, Auckland, New Zealand, pp. 1–26.
Lin, I.-Y., 2006. The Appraisal of Real Estate. Wen-Sheng Publishing, Taipei (in Chinese).
Lusht, K., 2001. Real Estate Valuation: Principles and Applications. KML Publishing.
McCain, R.A., Jensen, J., Meyer, S., 2003. Research on Valuation of Land and Improvements in Philadelphia, Preliminary Report. Department of Economics and International Business, LeBow College of Business Administration Drexel University, Philadelphia, PA19104, pp. 1–25.
Oates, W., Schwab, R., 1997. The impact of urban land taxation: the Pittsburgh experience. National Tax Journal 50 (1), 1–21.
Pollock, R., Shoup, D., 1977. The effect of shifting the property tax base from improvement value to land value: an empirical estimate. Land Economics 53 (1), 67–77.
Rossini, P., Kershaw, P., 2005. Using a hybrid automated valuation model to estimate capital and site values. In: Proceedings of the Eleventh Annual Pacific-Rim Real Estate Society Conference, Melbourne, Australia.
Rossini, P., Kershaw, P., 2006. Can a hybrid automated valuation model outperform individually assessed capital and site values. In: Proceedings of the Twelfth Annual Pacific-Rim Real Estate Society Conference, Auckland, New Zealand.
Smith, B., 2000. Applying models for vertical inequity in the property tax to a non-market value state. Journal of Real Estate Research 19 (3), 321–344.
Smith, B., 2004. Economic depreciation of residential real estate: microlevel space and time analysis. Real Estate Economics 32 (1), 161–180.
Sunderman, M.A., Birch, J.W., 2001. Valuation of land using regression analysis. In: Wang, K., Wolverton, M. (Eds.), Real Estate Valuation Theory. Kluwer Academic Publishers, Boston.
Tsai, C.-Y., 2001. Land tax in Taiwan: problems, impact and reforms. Journal of Property Tax Assessment and Administration 6 (3), 81–108.
Wolverton, M., 1998. Empirical analysis of the breakdown method of estimating physical depreciation. The Appraisal Journal 66 (2), 163–171.