Property Valuation Models and House Price Indexes for the Provinces of Thailand: 1992–2000

by Charles A. Calhoun

INTRODUCTION

This paper presents the results of recent research to estimate hedonic property valuation models and regional house price indexes for the provinces of Thailand. House price indexes are an important input into the analysis of residential mortgage performance and the development of the credit loss projections needed for underwriting and pricing loans and mortgage insurance, establishing loss reserves against future credit losses, and setting risk-based capital requirements. The lack of coordinated information on the various sectors of the real estate industry in Thailand has been cited as a contributing factor in the severity of the boom-bust cycle in Thai real estate, and the availability of a broad-based residential property value indexes may help to fill an important information gap and improve the efficiency of real estate markets in Thailand.

The particular experience of the Thai real estate market indicates the potential benefits to lenders of statistical property valuation models. Traditional valuations based on cost, sales comparison, and income capitalization approaches have been hampered by the lack of uniform standards and a formal certification process.[1] The situation has been further complicated by the structural inefficiencies of an emerging real estate market. After many years of relatively steady and sustained growth, the real estate sector in Thailand began to contract in 1996, as housing completions declined sharply in response to an excess supply of housing units.[2] Price speculation in real estate continued, however, fueled in part by previous financial liberalization measures aimed at stimulating foreign capital investment in Thailand. Although the real estate bubble was already deflating by 1996, the subsequent decline in property values was compounded by the emergence of the 1997 Asian economic crisis.[3]

The availability of regional constant-quality house price indexes may have moderated uninformed speculation in property values and improved the ability of mortgage lenders to underwrite loans during this period. As a direct result of the decline in property values and the associated economic dislocations of the 1997 Asian economic crisis, the percentage of non-performing loans held by major public and private lenders increased to over 30 percent following devaluation of the Thai bhat (THB) in July 1997.[4] In response to the real estate crisis, the government suspended the lending authority of large numbers of finance companies, and introduced a series of residential mortgage loan stimulus packages.[5]

Residential mortgage loans outstanding in Thailand totaled THB 1,015 billion ($23.6 billion) as of March 2002, about 15 percent below the level at the end of 1997.[6] Issuers of housing loans in Thailand include: commercial banks, finance companies, credit foncier companies, life insurance companies, the Government Savings Bank (GSB), and the Government Housing Bank (GHB).[7] Commercial banks dominate the Thai financial system, holding roughly 45 percent of all domestic household savings and 71 percent of financial assets. As of March 2002, commercial bank home loans comprised about 53 percent of total home loans outstanding. GHB is the only specialized housing finance institution in Thailand and the single largest provider of mortgage credit, holding approximately 38.5 percent of total loans outstanding.[8]

The standard GHB mortgage product type for individual borrowers has been the 15-year, 80-LTV, revisable-rate loan.[9] GHB funding sources are dividend between time deposits (66 percent) and bonds and other domestic and offshore borrowing (34 percent). The Thailand Ministry of Finance guarantees GHB bonds, and their average cost of funds is lower than that of the commercial banks in Thailand. In return, GHB is required to undertake lending activities to serve lower-income borrowers, and this is reflected in loan pricing that

Charles A. Calhoun is an economic and statistical consultant based in Washington, DC. He has been involved in the development of several major house price indexes and property valuation models in the United States, and recently completed a project to develop loan performance models and house price indexes for the Government Housing Bank of Thailand. The opinions expressed in this report are those of the author.

varies significantly by loan size. GHB has undertaken research to better understand and manage the credit risk of its residential loan portfolio, including the development of loan-level models of mortgage performance.[10] An important input into that analysis has been the development of property value indexes that can be used to estimate changes in borrower equity levels and their impact on mortgage performance.

This paper reports on an initial effort to estimate hedonic property valuation models and house price indexes (HPIs) for the provinces of Thailand. Following standard practice in this area, our strategy has been to estimate hedonic models using property characteristic information from GHB collateral records, and to use the estimated models to compute constant-quality HPIs showing the time pattern of changes in housing values for a given location and a standard bundle of property attributes. We have estimated hedonic valuation models and HPIs at the regional level for the 76 total provinces of Thailand for the period from 1992 to 2000. We present detailed hedonic model estimates and HPI plots for the six provinces comprising the Bangkok Metropolitan Region (BMR). In addition, we use all of the provincial HPIs to quantify changes in property values in the periods before (1992-1997) and after (1997-2000) the Asian crises. The results are summarized by application of graphical information system (GIS) software to map the results and illustrate differences in regional appreciation rates.

RESIDENTIAL PROPERTY DATA

GHB collects and maintains loan-level data on current and historical mortgage loans and security properties. By any standard the data are of very high quality. The source of data for property valuation is GHB's collateral file, which includes land-only, land-and-building, and building-only (condominium unit) collateral properties.[11] Only the land-and-building property records were utilized in the statistical analysis reported here, because these have the requisite information on property characteristics needed for estimating hedonic models. The land-only and building-only collateral records did not include these detailed characteristics.[12] Either GHB staff or an outside property appraiser must appraise properties pledged as collateral on GHB loans. These appraisal values are the subject of analysis in this study. No independent information on sales prices is retained by GHB. The total number of property records used to estimate the hedonic valuation models was 490,000, with more than 20 percent of these properties located in Bangkok. Frequencies of observations for all 76 provinces are reported in Table 2.

PROPERTY CHARACTERISTICS

Following is a brief summary of the property characteristics from the GHB collateral file for which we were able to code hedonic variables:

Property Type – Three types of property structures were analyzed: single houses, twin houses, and townhouses.

Building Area – Building area is measured in square meters.

Home Site – Home sites include housing projects (for which lot size is not recorded), and home sites with lots having area less than or equal to 50 square wa, and those with lots with area more than 50 square wa. (The wa is a Thai measure of length approximately equal to 2 meters.)

Structure Type – Structure types included concrete structures, combined concrete and wood structures, wood structures, gypsum board structures, and structures coded as other in the original data.

Roof Type – Roof types included tile, concrete and iron, zinc plate, and roof types coded as other in the original data.

Wall Type – Exterior wall types included brick and concrete, brick and wood, wood, and exterior wall types coded as other in the original data.

Fence Type – Fence types include no fence, bring and concrete, zinc plate, wire net, iron string, and fence type coded as other in the original data.

Floors – Number of floors was recoded to include 1, 2, 3, and 4 or more floors, and a category for missing was included, since there were a large number of cases where this value was not recorded.[13] It was typical for this item to be left blank by branch lenders when the property a single-floor property.

While the above list of variables is a reasonably complete set of hedonic characteristics it is not sufficiently detailed, for example, to enable us identify the separate contributions of land value versus building value from the estimated models.[14] On the other hand, the list includes property type and three different size-related variables that would be expected to contribute significant explanatory power to the models. The primary goal was the estimation of constant quality HPIs for tracking changes in borrower equity, rather than the ability to perform detailed comparisons of comparable properties or electronic appraisals. Thus, we maintain the assumption that these hedonic characteristics adequately represent any significant differences in the quality of housing units within the regions of Thailand represented by the models.

STATISTICAL METHODS

Hedonic models provide a method of computing "constant quality" house price indexes by controlling statistically for differences in the physical attributes of properties that affect housing values. The goal is to control for these quality differences and to identify the underlying appreciation in housing values for a typical house or standard bundle of property characteristics.[15] Standard statistical methods include log-linear models estimated by ordinary least squares (OLS) and Box-Cox transformation models utilizing maximum-likelihood estimation. These methods are widely applied in hedonic modeling.[16]

Log-linear models were estimated for this study. The dependent variable was the natural logarithm of the appraisal value for the property. All of the explanatory variables were coded as categorical values

and represented in the equations by 0/1-indicator (dummy) variables, and additional time-period dummies were included to enable us to compute an HPI for a specified bundle of property characteristics. It turns out that because all of the variables are 0/1-indicators, identical house price indexes are generated under either the log-linear or Box-Cox specification. We will review estimation results based on the log-linear models, as these are mathematically convenient for assessing the percentage impact of specific property attributes on property values. We estimated alternative models based on annual, semi-annual, quarterly, and monthly time-period indicators and our discussion focuses on the results for the semi-annual models.

EMPIRICAL RESULTS

Table 1 reports the hedonic valuation model coefficient estimates for the six provinces comprising the Bangkok Metropolitan Region (BMR).[17] The estimates reported in Table 1 are based on semi-annual time-period indicators. The time-period coefficient estimates are not reported in the table, but are used below to compute house price index series and cumulative appreciation rates for a selected bundle of property characteristics.

HEDONIC ESTIMATES FOR PROPERTY CHARACTERISTICS

Following is a summary of the hedonic model coefficient estimates for the BMR provinces. The majority of coefficient estimates are statistically significant.[18] The sample sizes for the six BMR provinces vary from a high of 104,734 for Bangkok (Krung Thep) to a low of 7,241 for the province of Samut Sakhon located southwest of Bangkok. The overall explanatory power of the regressions is reasonably high, with adjusted-R2 values ranging from 44 to 60 percent.

Property Type – Single-houses are consistently more expensive than twin houses, and twin houses more expensive than townhouses. For example, twin houses in Bangkok average only 80 percent of the value of an otherwise identical single house, while townhouses average only 57 percent of the value of a single house.

Building Area – Building area has the expected positive impact on property values. The returns to building area are greatest in Bangkok, reflecting higher construction costs and limited building space in the more densely populated urban area.

Home Site – Property values are higher for larger home sites, reflecting the premium place on building space. The omitted category in this case is properties located in housing projects, for which the actual size of the home site is unknown. These are more highly valued than smaller home sites, but less than larger home sites.

Structure Type – Concrete structures are the most highly valued across all six provinces, generally followed by gypsum board, wood, and combination concrete and wood structures, although there are some regional departures from the general pattern.

Roof Type – Concrete and iron roofs are the most highly valued in Bangkok, Samut Prakan, and Nonthaburi provinces. The other provinces show varying patterns, with zinc plate and "other" roof types increasing property values in Samut Sakhon, while Panthum Thani shows a significant discount associated with zinc plate and no difference associated with "other." Nakhon Pathom province shows no impact of roof type on property values.

Wall Type – Brick and concrete walls are the most highly valued in all of the provinces except Panthum Thani, which shows a slight premium associated with brick and wood walls, and Nonthaburi, which shows a premium associated with "other" wall types. "Other" wall types in Nakhon Pathom are associated with a significant discounting of property values.

Fence Type – For Bangkok properties, brick and concrete fences are the most highly valued, followed in turn by "other" fence types, iron string, wire net, no fence, and zinc plate fences (not significant). The results for fence type vary across the other BMR provinces. The results for Samut Prakan are generally similar to those for Bangkok, except that zinc plate fences are valued more highly than no fence. By contrast, zinc plate fences are valued least in Nonthaburi, Nakhon Pathom, and Samut Sakhon provinces. In Panthum Thani the least valued fence type is iron string.

Floors – Properties with 2, 3, and 4 or more floors levels are successively more highly valued than single-floor properties in all provinces except Nakhon Pathom, where 2-floor properties are most highly valued. The results for missing numbers of floors are most closely aligned with those of 2-floor properties for all regions except for Nakhon Pathom, where the results are not statistically different than those for 1-floor properties.

HOUSE PRICE INDEXES

Exhibit 1 presents plots of HPIs computed using the semi-annual time-period coefficient estimates for each regression in Table 1, and the following standardized bundle of property characteristics: single house, housing project, building area 100-150 sq m, structure concrete, roof tile, wall brick and concrete, fence none, floors 1. The choice of semi-annual index coefficients represents a compromise between more detailed and volatile monthly or quarterly coefficients and higher levels of temporal aggregation corresponding to annual index coefficients. The additional detail provided by indexes at lower levels of temporal aggregation may be important for estimating changes in housing values between specific dates. However, not all of these differences will be statistically significant. Final assessment of the relative accuracy of indexes based on different levels of temporal aggregation requires the construction of statistical confidence intervals for each time series and is beyond the scope of this discussion.[19]

The Bangkok HPI indicates the general decline in residential property values that occurred following the end of the real estate boom and the emergence of the Asian currency crisis in July 1997. The Bangkok

index also indicates episodes of severe property depreciation in 1998-1999. What is interesting, and somewhat puzzling is the temporary rebound in the index in mid-1999 before continuing its downward trend. These periods coincide with major restructuring of residential loan portfolios, booking of losses on non-performing loans, and the introduction of various foreclosure alternatives intended to stabilize real estate markets in Thailand. Thus, the specific time periods in question may have included the marking down of collateral values on existing loans, which may have selectively introduced below- average collateral values to the data sample used for estimation. The other provinces of the BMR show similar fluctuations around these dates, although not quite as pronounced as those for Bangkok.[20] The BMR indexes also indicate substantial differences in the timing of peaks and troughs across the real estate boom and bust cycle in Thailand, although all indicate that increases in housing values since 1992 were effectively wiped out following the 1997 crisis. Finally, the BMR indexes indicate a leveling off in housing values since 2000, which is consistent with the reemergence of slow positive economic growth in the overall Thai economy over the past two years.

PRE- AND POST-1997 TRENDS IN HOUSING VALUES

We have used the semi-annual HPIs for all 76 provinces of Thailand to compute total appreciation before and after the onset of the 1997 Asian economic crises. Total appreciation before the crisis is measured by the percent change in HPI from January 1992 to June 1997, and total appreciation after the crisis is given by the percent change in HPI between July 1997 and December 2000. Table 2 reports the results of these calculations for each of the 76 provinces. We also applied GIS software has to generate maps showing the pre- and post-1997 rates of property appreciation by province. Exhibit 2 summarizes trends in housing values during the 1992-1997 period, while Exhibit 3 shows the results for the 1997-2000 period.[21]

Notwithstanding a general impression that the trends in residential property values were more or less universal across Thailand, our analysis of regional house price indexes shows that there was significant regional variation in appreciation rates both before and after the 1997 crises, as can be seen quite clearly in Exhibits 2 and 3. The detailed results in Table 2 confirm the significant regional diversity in house price appreciation rates prior to 1997, with 30 of 76 provinces having negative appreciation over the 1992-1997 period, and 8 of these provinces having negative appreciation exceeding 30 percent. Thus, even during the well-know boom in Thai real estate, many regions appear to have experienced negative house price growth. During the same period, 13 provinces had positive appreciation exceeding 30 percent, and another 6 had positive appreciation exceeding 20 percent.

Trends in appreciation following the 1997 crisis have been more uniform across provinces. Table 2 indicates that 69 of 76 provinces experienced negative appreciation during the 1997-2000 period. The severity of the decline in housing values during 1997-2000 was not as great as might have been expected, with no provinces having negative appreciation in excess of 30 percent. On the other hand, 27 of the 69 provinces with negative appreciation during 1997-2000 also had negative appreciation during 1992-2000, highlighting the fact that many provinces may have benefited less from the Thai real estate boom than believed previously.

While some regions are projected to have experienced spectacular rates of positive appreciation prior to the 1997 crisis, the comparatively modest rates of depreciation during the 1997-2000 period may not seem severe enough to have produced NPL rates in excess of 30 percent. Likewise, the HPI series for the BMR provinces shown in Exhibit 1 may not, at first glance, appear to decline enough to explain high NPL rates following the 1997 crisis. However, one must keep in mind that the HPIs summarize average rates of appreciation for all properties within the selected market regions. If they could be observed directly, the time paths of individual property values would exhibit considerable volatility and would be distributed more-or-less symmetrically around the average index. This implies that a significant proportion of properties would experience significantly more severe declines in housing values than those represented by the index, thereby increasing the likelihood of negative equity and mortgage default.[22]

SUMMARY

The property valuation models and house price indexes reported in this paper represent a first attempt to apply standard hedonic methods to the analysis of residential housing values in Thailand and to develop a broad-based set of regional HPIs. The GHB collateral data provide a large sample of appraisal values and property characteristics for analysis of housing values in Bangkok, the surrounding provinces of the BMR, and the other regions of Thailand. House price indexes are important inputs to the statistical models of loan performance that are required for pricing loans, reserving for losses, and setting risk-based capital requirements. The availability of a broad-based residential property value indexes should help to fill an important information gap and improve the efficiency of real estate markets in Thailand.

Table 1
Hedonic Property Valuation Model Coefficient Estimates
Provinces of the Bangkok Metropolitan Region

Explanatory Variables[1]	Bangkok (10)	Samut Prakan (11)	Nonthaburi (12)	Panthum Thani (13)	Nakhon Pathom (73)	Samut Sakhon (74)
Constant	13.2916	13.2529	13.3898	13.3886	13.3327	13.0514
Single House	—	—	—	—	—	—
Twin House	-0.2054	-0.1151	-0.2788	-0.3643	-0.4158	-0.3402
Townhouse	-0.4296	-0.4351	-0.5604	-0.5969	-0.5599	-0.4460
Bldg Area ≤ 50 sq m	—	—	—	—	—	—
Bldg Area 50-100 sq m	0.2966	0.2189	0.2520	0.1167	0.0362	0.1685
Bldg Area 100-150 sq m	0.6082	0.4844	0.5504	0.4634	0.2977	0.3359
Bldg Area 150-200 sq m	0.8815	0.6630	0.7840	0.6939	0.4127	0.6174
Bldg Area 200-250 sq m	1.0754	0.7788	0.9586	0.8050	0.5258	0.7597
Bldg Area >250 sq m	1.2679	0.8980	1.1156	1.1768	0.7196	0.7836
Housing Project	—	—	—	—	—	—
Homesite ≤ 50 sq wa	-0.0925	-0.1153	-0.0432	-0.0675	-0.1208	-0.0646
Homesite > 50 sq wa	0.1916	0.1837	0.1701	0.1380	0.1037	0.2028
Homesite Other	-0.1340	-0.1533	-0.2588	-0.1916	-0.0383*	-0.1209
Structure Concrete	—	—	—	—	—	—
Structure Concrete & Wood	-0.3644	-0.4266	-0.3697	-0.6369	-0.4749	-0.2398
Structure Wood	-0.2254	-0.3400	-0.2287	-0.4488	-0.0345*	-0.4155
Structure Gypsum Board	-0.0473*	-0.3106	-0.0277*	-0.4425	0.4119*	-0.1217*
Structure Other	-0.3719	-0.3922	-0.3410	0.1660*	—	—
Roof Tile	—	—	—	—	—	—
Roof Concrete & Iron	0.1028	0.0713	0.0623	0.0387*	0.0478*	0.1180*
Roof Zinc Plate	-0.0110*	-0.0707	-0.0917	-0.1912	-0.0896*	0.1923
Roof Other	0.0405	0.0164*	0.0912	-0.0603*	0.0886*	0.3387
Wall Brick & Concrete	—	—	—	—	—	—
Wall Brick & Wood	-0.0872	-0.0632	-0.0972	0.0400	0.0351*	-0.1586
Wall Wood	-0.1205	-0.0568	-0.0139*	0.0835*	-0.0885*	0.0991*
Wall Other	-0.1504	-0.0585*	0.1313*	-0.007*	-0.4588	-0.0916*
Fence None	—	—	—	—	—	—
Fence Brick & Concrete	0.1377	0.1219	0.0892	0.1548	0.1225	0.0810
Fence Zinc Plate	0.0102*	0.0415	-0.1683	0.0405*	-0.8490	-0.3051
Fence Wire Net	0.0740	0.1191	0.2539	0.1183	0.2179	0.1003*
Fence Iron String	0.0881	0.1233	0.1343	-0.2734	0.0963*	0.1551*
Fence Other	0.1197	0.1493	0.1125	0.2191	0.2332	0.0858
Floors = 1	—	—	—	—	—	—
Floors = 2	0.2082	0.2481	0.2769	0.3247	0.3929	0.2894
Floors = 3	0.4218	0.4982	0.5910	0.4699	0.6162	0.3624
Floors ≥ 4	0.5784	0.5686	0.6119	0.5727	0.4556	0.5773
Floors Missing	0.2071	0.1044*	0.3063	0.3809	0.2197*	0.2024
N	104,734	34,089	46,052	22,200	11,158	7,241
$\bar{R}^2$	0.5268	0.5129	0.5591	0.6008	0.4826	0.4435
F (df_1, $N - df_1$)	2535.68	781.24	918.68	727.37	232.25	129.23
(df_1)	(46)	(46)	(46)	(46)	(45)	(45)

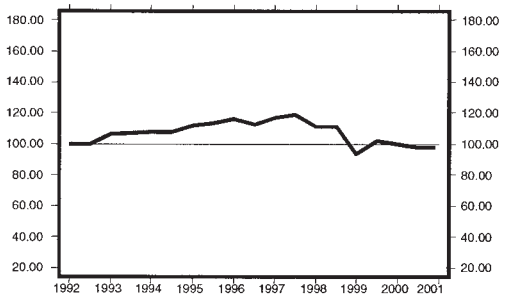
[1] Semi-annual time-period coefficient estimates not reported.
*Coefficient estimate not statistically significant for 0.05-level test.

Table 2
Pre- and Post-1997 Trends in Housing Values

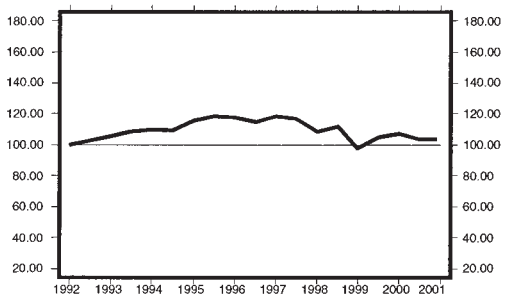
Province Code	Province Name	Observations	Pct Chg HPI 1992-1997	Pct Chg HPI 1997-2000	Province Code	Province Name	Observations	Pct Chg HPI 1992-1997	Pct Chg HPI 1997-2000
10	Bangkok (Krung Thep)	104,734	19.11	-17.70	51	Lamphun	4,445	-24.41	-6.15
11	Samut Prakan	34,089	17.11	-11.63	52	Lampang	8,970	38.96	-27.94
12	Nonthaburi	46,052	12.86	-12.60	53	Uttaradit	1,740	-3.49	-2.49
13	Pathum Thani	22,200	8.76	-10.63	54	Phrae	3,186	3.71	-11.20
14	Ayutthaya	6,236	25.14	-8.65	55	Nan	3,030	6.81	-6.96
15	Ang Thong	693	-29.75	-7.25	56	Phayao	2,946	-9.36	-9.41
16	Lop Buri	2,362	-12.16	-0.06	57	Chaing Rai	6,663	3.02	-12.73
17	Sing Buri	625	8.72	0.09	58	Mae Hong Son	700	19.99	0.26
18	Chai Nat	886	23.34	-11.38	60	Nakhon Sawan	4,922	74.22	-8.48
19	Saraburi	4,736	-0.21	-14.55	61	Uthai Thani	716	104.24	-18.07
20	Chonburi	18,325	-4.27	-6.48	62	Kamphaeng Phet	1,611	-5.20	-7.41
21	Rayong	8,964	13.06	-14.58	63	Tak	1,801	93.32	-8.00
22	Chanthaburi	2,649	-48.85	-7.27	64	Sukhothai	1,393	43.34	-19.95
23	Trat	727	-3.93	-26.06	65	Phitsanulok	6,725	56.59	-7.59
24	Chachoengsao	4,539	29.72	-14.15	66	Phichit	1,212	73.22	1.31
25	Prachin Buri	3,857	0.20	-14.98	67	Phetchabun	2,661	17.96	-16.34
26	Nakhon Nayok	880	0.21	-10.32	70	Ratchaburi	4,864	-35.33	-6.80
27*	Sa Keao	1,414-	26.27	-15.71	71	Kanchanaburi	3,964	-83.99	-10.87
30	Nakon Ratchasima	10,096	6.93	-12.25	72	Suphan Buri	3,179	-4.58	-4.86
31	Buriram	2,643	-9.00	-8.57	73	Nakhon Pathom	11,158	18.21	-15.21
32	Surin	2,418	-1.48	-20.16	74	Samut Sakhon	7,241	25.03	-14.35
33	Si Sa Ket	2,131	5.44	-24.79	75	Samut Songkhram	589	-12.01	-1.24
34	Ubon Ratchathani	5,665	32.69	-27.42	76	Petchaburi	2,263	7.42	-17.48
35	Yasothon	1,495	-12.53	-14.22	77	Prachuap Khiri Khan	3,599	-40.61	-2.41
36	Chaiyaphum	2,955	-30.08	-11.83	80	Nakhon Si Thammarat	7,822	-62.70	-17.69
37*	Amnad Charoen	810	5.50	-19.07	81	Krabi	1,981	-61.50	-2.86
39*	Nong Bua Lampoo	1,127	-2.26	0.82	82	Phangnga	963	-15.13	-28.70
40	Khon Kaen	14,250	24.11	-14.28	83	Phuket	4,496	39.65	-12.44
41	Udon Thani	8,391	0.43	-15.48	84	Surat Thani	7,202	67.76	-14.79
42	Loei	1,838	-26.56	6.09	85	Ranong	616	24.55	-15.92
43	Nong Khai	2,450	-48.27	-10.71	86	Chumphon	2,010	-25.68	-11.75
44	Maha Sarakham	2,870	5.92	-9.50	90	Songkhla	9,282	6.75	-9.28
45	Roi Et	4,201	45.20	-3.17	91	Satun	913	18.27	-21.72
46	Kalasin	3,197	48.82	-6.18	92	Trang	3,562	13.00	-8.49
47	Sakon Nakhon	3,582	-1.19	2.38	93	Phattalung	2,687	17.22	-11.29
48	Nakhon Phanom	1,990	-5.63	-7.26	94	Pattani	1,271	3.39	1.98
49*	Mukdahan	1,141	46.76	11.88	95	Yala	1,635	7.59	-18.74
50	Chiang Mai	17,547	-5.05	-6.10	96	Narathiwat	1,218	3.24	-15.76

* Provinces not shown on maps in Exhibits 2 and 3. See footnote 21.

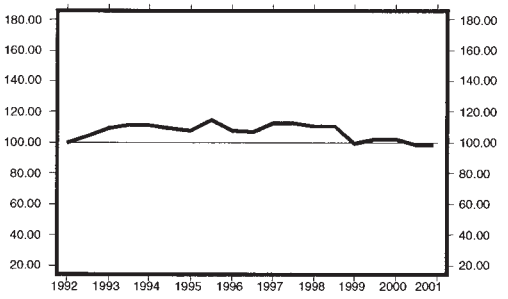
Exhibit 1
Semi-Annual House Price Indexes
BMR Provinces 1992-2000



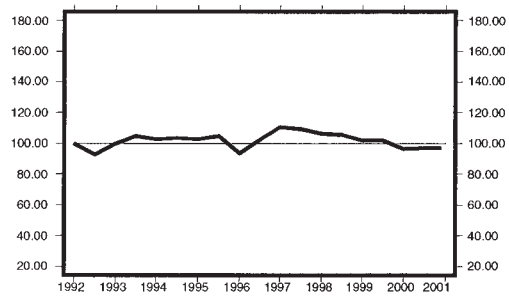
HPI Bangkok (10)



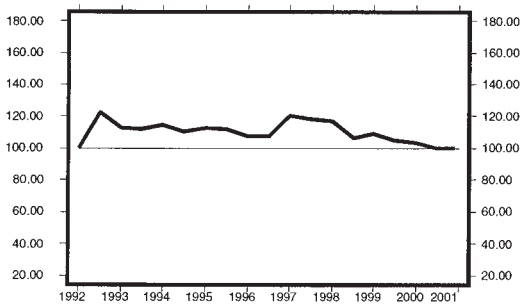
HPI Samut Prakan (11)



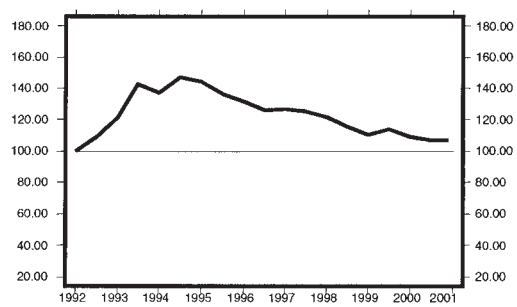
HPI Nonthaburi (12)



HPI Pathum Thani (13)



HPI Nakhon Pathom (73)



HPI Samut Sakhon (74)

Exhibit 2
Percent Change in HPI 1992-1997

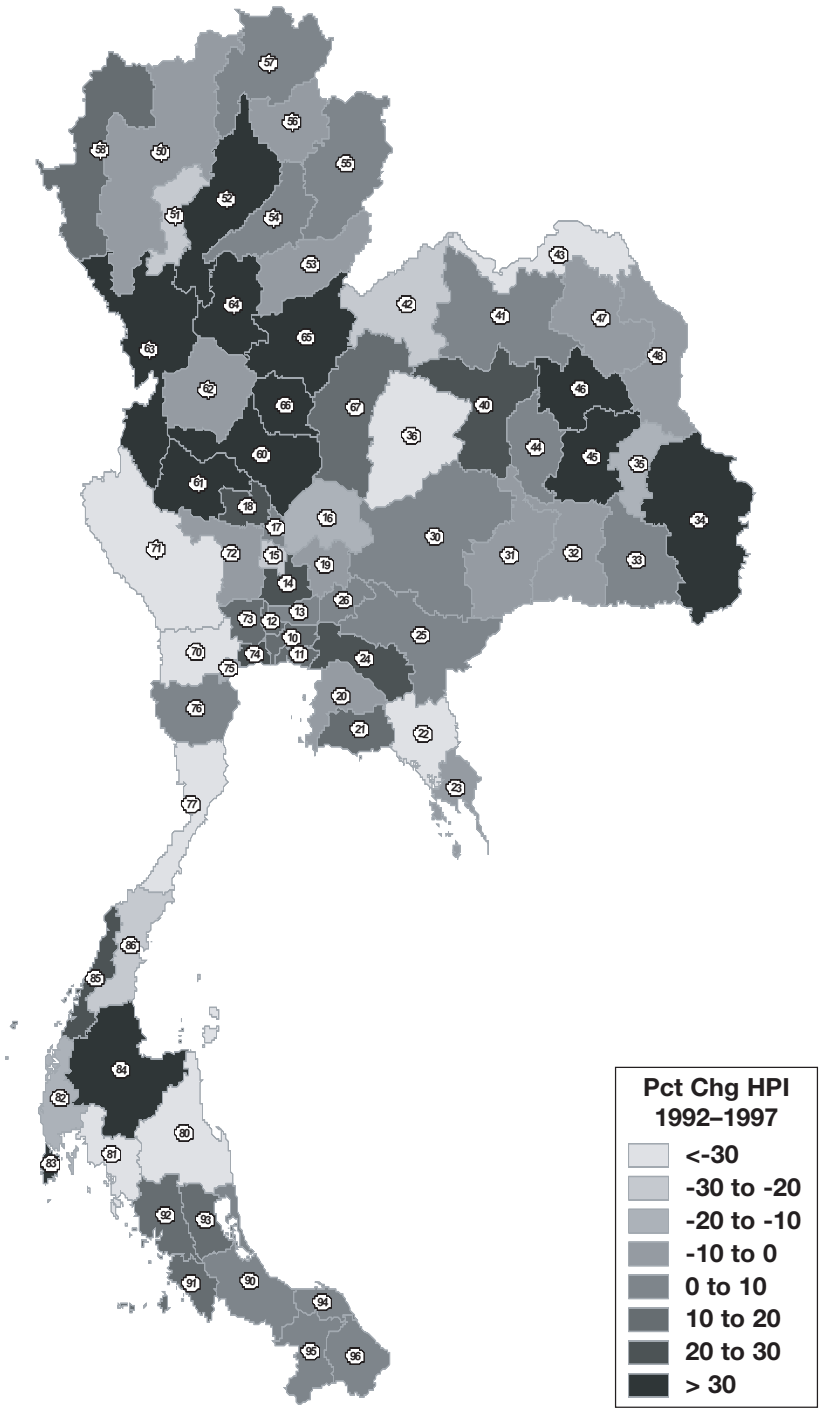
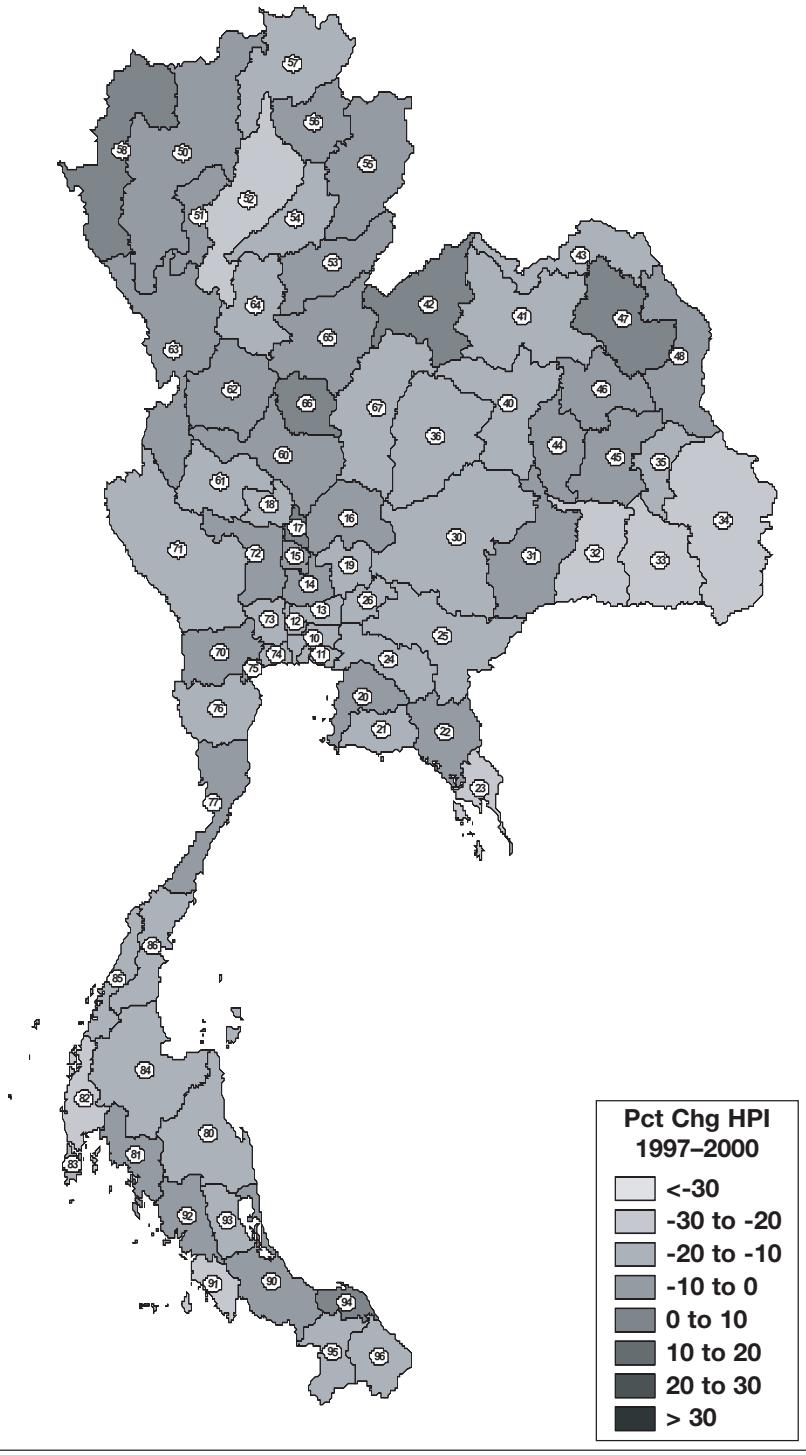


Exhibit 3
Percent Change in HPI 1997-2000



NOTES

[1] Layne (2002) discusses the state of the valuation profession in Thailand and recent efforts aimed at establishing uniform standards or professional appraisal practice similar to those that exist in other countries, such as the Uniform Standards of Professional Appraisal Practice (USPAP) that apply in the United States.

[2] See Renaud *et al.* (2001). The authors report that the decline in housing completions in the Bangkok Metropolitan Region was greater for townhouses than detached houses, and even more rapid for apartments and condominiums. Our analysis of housing values includes single houses, twin houses, and townhouses, but excludes condominiums. Trends in office completions paralleled those in residential housing. The authors cite the emergence of professional property developers as a contributing factor to the excess supply of housing.

[3] Renaud *et al.* (2001) discuss the role of the creation of the Bangkok International Banking Facilities (BIBF) regulations in extending a real estate boom that had already started to turn down and transforming it into a speculative bubble that burst prior to the July 1997 currency crisis.

[4] Sector-wide statistics on the level of mortgage default are not available, but default levels prior to the real estate crisis have been estimated at 3 to 5 percent and increased to more than 30 percent of mortgage loans by the end of 1998 (Kritayanavaj, 1999).

[5] Chansakulthaworn (2001) discusses the impact of the 1997 financial crisis on the market for home loans, including the changing composition of the market and government measures to respond to the crisis.

[6] The overall home ownership rate in Thailand is 86 percent (1990 Census of Housing), with higher rates in rural areas than in urban areas. For example, the home ownership rate in Bangkok is 56.7 percent (Kritayanavaj, 1999).

[7] GHB is supervised by the Ministry of Finance (MOF), while all the other financial institutions are regulated by the Bank of Thailand (BOT). GHB operates as a state enterprise on a commercial basis without direct government funding or subsidies.

[8] GHB's market share increased from 28 percent in March 2000 to 38.5 percent as of March 2002, largely as a result of the suspension of the lending authority of 70 finance companies by the BOT (Chansakulthaworn, 2001; Kritayanavaj, 2002).

[9] In contrast to the typical indexed adjustable-rate loan products offered by mortgage lenders in the United States, these loans more closely resemble the reviewable-rate instruments that have dominated residential mortgage lending in the United Kingdom. GHB periodically announces rate changes in response to changes in their cost of funds, which are applicable to all outstanding floating-rate mortgages. The potential for payment shock is offset by loan contract provisions that reduce the impact of interest rate changes on borrower payments. For example, the initial monthly payment obligation is determined by adding one percent to the contract rate, and results in early principal reduction if rates remain constant. If rates increase by less than one percent then the monthly payment does not change. If rates increase by more than one percent the higher interest cost is amortized by extending the term of the mortgage. Most GHB loans are made for 15-year terms.

[10] GHB's non-performing loan (NPL) rate reached a high of 28 percent in 1999. The NPL rate declined to about 19 percent at the end of 2001, and stood at 17.4 percent at the end of June 2002. This compares with an industry-wide average of 23.8 percent as of March 2002 (Kritayanavaj, 2002).

[11] GHB offers long-term mortgage loans for individual borrowers, construction loans for housing projects, and construction loans for rental apartments. While GHB's principal lending activity is lending to individual borrowers through retail operations at branch locations, or through package deals with developers to provide mortgages for borrowers who buy their products, GHB also undertakes various social lending activities by which it makes arrangements for government or private entities to provide targeted lending on more favorable terms. While these lending programs are referred to as "welfare" programs, they appear to be undertaken according to commercial lending principles and have higher than average credit quality.

[12] Building-only collateral are primarily apartment and condominiums units.

[13] The expectation was that branch lenders often would not bother to record this value in the case of 1-floor properties. However, as discussed below, the estimation results vary by region.

[14] This is not unusual in hedonic index estimation. For example, the C-25 Series Constant Quality Index issued by the U.S. Secretary of Commerce is based on models for the prices of new housing units sold or offered for sale, but there is no separate variable for lot size among the list of hedonic characteristics used to fit the model.

[15] Alternative methods for estimating constant quality house price indexes include repeat-transactions methods and hybrid models combining hedonic and repeat transactions methods. Estimation of these models was not feasible with GHB data. Although the GHB data include multiple loans to the same borrower(s) and secured by the same property (thus giving rise to the possibility of observing repeat transactions), when properties are reappraised and used as collateral for subsequent loans the original appraisal information is overwritten. Calhoun (2001) discusses alternative property valuation

methods and sources of data in the United States.

[16] The log-linear model is a limiting case of the familiar Box-Cox transformation given by: $V^{(\theta)} = (V^{\theta} - 1)/\theta$, where V represents the untransformed property value and $\lim_{\theta \to 0} V^{(\theta)} = \ln(V)$.

See Greene (1993) for further details on Box-Cox estimation. A brief survey of hedonic methods is given by Triplett (1987).

[17] All 76 province names and numbers are listed in Table 2. The BMR includes Bangkok (10) and the five surrounding provinces of Samut Prakan (11), Nonthaburi (12), Pathum Thani (13), Nakhon Pathom (73), and Samut Sakhon (74).

[18] Coefficient estimates that are not statistically significant at the .05-level for a two-tailed normal test are identified by (*) in the Table 1.

[19] Calhoun, Megbolugbe, and Chinloy (1995) examine issues related to temporal aggregation of house price indexes.

[20] This suggests that the sharp deviations from the general decline in HPI values between 1997 and 2000 may be an artifact of GHB operations rather than a direct indication of market performance. Future research will attempt to control for this effect by identifying which collateral values may have resulted from the reappraisal of collateral on non-performing loans.

[21] The GIS software used was Maptitude Version 4.2. A digital line map for the provinces of Thailand was obtained from the Environmental Systems Research Institute (ESRI) web site (http://www.esri.com/data/online/). See Malcolm (2000) for a discussion of GIS data for Thailand. Note that four of the provinces listed in Table 2 are not identified separately on the map. These regions comprise smaller administrative areas that recently became provinces. Amnad Charoen (37), Nong Bua Lampoo (39), and Mukdahan (49) provinces are located in the Northeast region of Thailand. Sa Keao (27) is located 220 km east of Bangkok in Thailand's Central region, on the eastern border with Cambodia.

[22] A similar argument helps to explain why mortgage defaults still occur during periods when market-wide indexes are increasing. Volatility refers here to the underlying variation in individual housing values that results in the distribution of housing values and borrower equity levels as housing values diffuse over time. It is this notion of volatility that underlies most option-based models of mortgage default and prepayment. See, for example, the recent paper by Deng, Quigley, and Van Order (2000).

REFERENCES

C.A. Calhoun, P. Chinloy, and I. Megbolugbe (1995) "Temporal Aggregation and House Price Index Construction," *Journal of Housing Research*, 6(3): 419-438, 1995.

Calhoun, C.A. (2001) "Property Valuation Methods and Data in the United States," *Housing Finance International*, 16(2):12-23, December 2001.

Chansakulthaworn, N. (2001) "Housing Loan Situation After the Financial Crisis in 1997," Bank of Thailand, *Monthly Bulletin*, June 2001.

Deng, Y., J.M. Quiqley, and R. Van Order (2000) "Mortgage Termination, Heterogeneity, and the Exercise of Mortgage Options," *Econometrica*, 68(2):275-307, 2000.

Greene, W.H. (1993) *Econometric Analysis*, Second Edition, New York: Macmillan, 1993.

Kritayanavaj, B. (1999) "The Mortgage-Backed Securities Market in Thailand," Chapter 8, pp. 555-616 in G.S. Rhee and Y. Shimomoto (eds.), *Mortgage-Backed Securities Markets in Asia*, Asian Development Bank, 1999.

Kritayanavaj, B. (2002) "Financing Affordable Homeownership in Thailand: Roles of the Government Housing Bank Since the Economic Crisis (1997-2002), paper presented at The International Conference on Financing Social Housing, Baotou, Autonomous Region of Inner Mongolia, August 6-8, 2002.

Layne, D. (2002) "The State of Valuation in Thailand," *The Appraisal Journal*, 70(3):254-259, July 2002.

Malcom, N. (2000) "Building a Useful GIS Database from Secondary Sources: The Case Study of Thailand," Waterloo University, March 2000.

Renaud, B., M. Zhang, and S. Koeberle (1998) "Real Estate and the Asian Crisis: Lessons of the Thailand Experience," Chapter 3, pp. 25-61 in S.J. Brown and C.H. Liu (eds.), *A Global Perspective on Real Estate Cycles*, Boston: Kluwer Academic Publications, 2001.

Triplett, J.E. (1987) "Hedonic Functions and Hedonic Indexes," pp. 630-634 in J. Eatwell, M. Milgate, and P. Newman (eds.), *The New Palgrave: A Dictionary of Economics*, London: Macmillan, 1987.