Determinants of House Prices in Nine Asia-Pacific Economies*

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The paper investigates the characteristics of house price dynamics and the role of institutional factors in nine Asia-Pacific economies during 1993–2006. On average, house prices tend to be more volatile in markets with lower supply elasticity and a more flexible business environment. At the national level, the current run-up in house prices mainly reflects adjustment to improved fundamentals rather than speculative housing bubbles. However, evidence of bubbles does exist in some market segments.

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1. Introduction

House price risk has attracted much attention in recent years. A number of industrialized economies, including the United States, the United Kingdom, and Spain, had witnessed a protracted period of significant increases in house prices in the mid-2000s. The perceived lower risk encouraged lax lending criteria in mortgage markets, which greatly contributed to the U.S. subprime crisis and the consequent global financial crisis. Just as suggested by previous studies, house price fluctuations have caused a major impact on household consumption,[1] the banking system, and the real economy.[2]

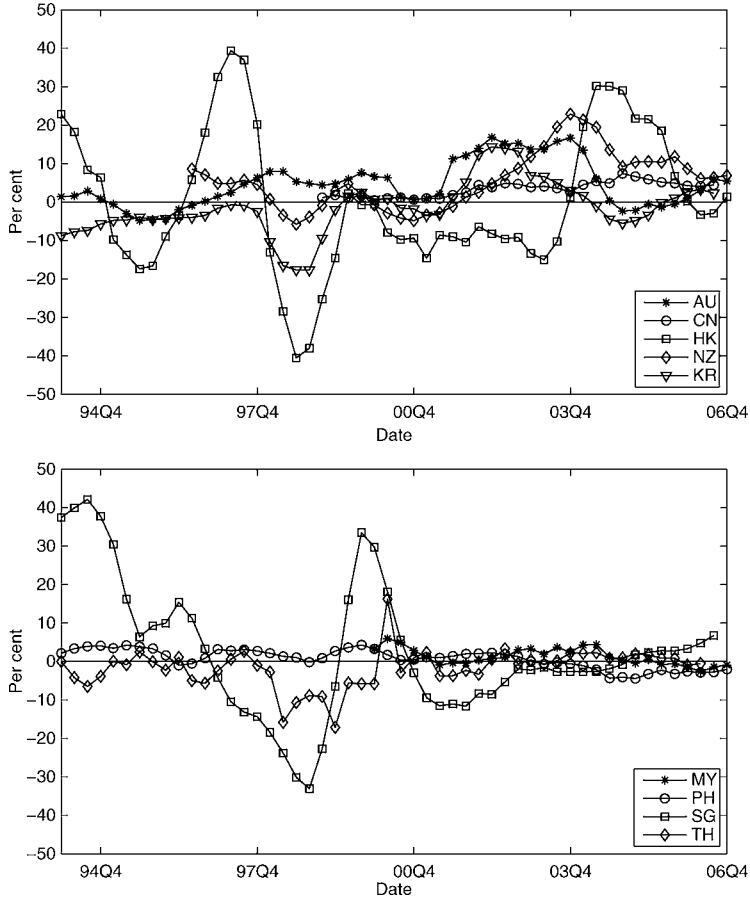
By comparison, housing markets in most Asian economies were relatively tranquil during the same period. In recent years, however, there have been growing concerns about the housing market in a few economies. China, Hong Kong SAR (Hong Kong hereafter), and South Korea (Korea hereafter) have witnessed very strong house price inflation in the past several years (see figure 1). Given the not-so-distant experience of financial crises in this region (such as the 1997 Asian crisis and the so-called lost decade in Japan), in which booms and busts in real estate markets played a crucial role, the question is whether the observed house price growth can potentially lead to bubble episodes.

There are two opposite views regarding the issue of possible housing bubbles in Asia. A pessimistic view argues that house prices have been overvalued in many countries and will face downward corrections in the near future. At the extreme, some consider it evidence of new speculative housing bubbles and call for supervisors and central banks to adopt prudential measures to contain them. By contrast, the optimistic view considers this round of house price growth as a manifestation of recovery from the previous crisis episode. The optimists argue that in the aftermath of previous crises, house prices were too low compared with their fundamental values. Therefore,

[1]See Girouard and Blöndal (2001), Cocco (2005), Yao and Zhang (2005), and Campbell and Cocco (2007). In addition, empirical findings (see Helbling and Terrones 2003; Case, Quigley, and Shiller 2005) also suggest that housing tends to have a bigger wealth effect than financial assets.

[2]Bernanke and Gertler (1995), Bernanke, Gertler, and Gilchrist (1996), Kiyotaki and Moore (1997), Aoki, Proudman, and Vlieghe (2004), and Gan (2007) show the strong linkages between the housing cycle and the credit cycle.

Figure 1. House Price Inflation (yoy) in Average Residential Markets, 1994–2006



Note: AU: Australia; CN: China; HK: Hong Kong SAR; KR: Korea; MY: Malaysia; NZ: New Zealand; PH: the Philippines; SG: Singapore; TH: Thailand.

the rebound of house prices from the very low levels is simply a consequence of the mean-reversion process. Moreover, the liberalization of housing markets and housing finance systems in the past decade, including a general trend towards more market-based housing markets, greater availability of mortgage products, and more liquid secondary mortgage markets, has arguably improved market efficiency, stimulated demand, and contributed to house price growth.

The paper sheds some light on this debate by examining house price developments in nine economies in the Asia-Pacific area, which include Australia, China, Hong Kong, Korea, Malaysia, New Zealand, the Philippines, Singapore, and Thailand.[3] Specifically, it attempts to address the following questions: What determines the fundamental values and short-term dynamics of house prices in Asia? What is the impact of institutional factors on house price movements? How can one gauge whether there is a housing bubble? To address these questions, we adopt the error-correction framework used by Capozza et al. (2002). The key results are as follows.

First, we find that the patterns of national house price dynamics exhibit significant cross-country heterogeneity. Moreover, institutional factors matter. In particular, distinction in house price dynamics can be largely attributable to cross-country differences in land supply and business environments.

Second, based on the econometric analysis, we characterize house price movements as the sum of three separate factors: (i) the fundamental value of housing (a trend term) that is determined by longer-term economic conditions and institutional arrangements, (ii) the deviation from fundamental values that is attributable to frictions in the housing market (a cyclical term), and (iii) an irrational or "bubble" component that is likely to be driven by overly optimistic expectations (an error term). Applying this approach to nine economies in Asia and the Pacific, we find that national house price movements before the onset of the global financial crisis mainly reflected changes in fundamental values or cyclical adjustments towards fundamentals. In other words, there is little evidence of housing bubbles in these economies, at least at the national levels.

The decomposition analysis has important policy implications. It allows for distinction between house price overvaluation (the sum of cyclical and error components) and a housing bubble. Policy recommendations are different accordingly. To mitigate house price overvaluation that is driven by cyclical movements related to market frictions, a policymaker should probably focus on measures that

[3]In this paper, we use the term "Asia" to represent the set of economies mentioned above.

aim at reducing the magnitude and frequency of house price cycles, such as loosening land use regulation, improving information availability and transparency, and enhancing the freedom in the business environment. By contrast, to contain a bubble, the policymaker should instead adopt measures that control unwarranted high expectations of capital gains or overconfidence of investors in the housing market.

The remainder of the paper is organized as follows. Section 2 provides an overview of the literature and highlights the contributions of this study. Section 3 describes the data and explains the empirical method used to examine the questions of interest, and section 4 discusses the empirical results. Finally, section 5 concludes and provides some policy perspectives.

2. A Review of the Literature and Our Contributions

2.1 Literature Review

To monitor the housing market, it is important to understand first the determinants of house prices. Housing is a special type of asset that has a dual role as a consumption and an investment good. From the long-term perspective, the equilibrium price a household is willing to pay for a house should be equal to the present discounted value of future services provided by the property, i.e., the present value of future rents and the discounted resale value of the house. From the short-term perspective, however, house prices can deviate from their fundamental values, on account of some unique characteristics of the real estate market (such as asset heterogeneity, downpayment requirements, short-sale restrictions, lack of information, and lags in supply). For instance, Leung and Chen (2006) show that land prices can exhibit cycles due to the role of intertemporal elasticity of substitution. Wheaton (1999) and Davis and Zhu (2004) develop a model in which there are lags in the supply of real estate and bank lending decisions depend on the property's current market value (labeled as historical dependence). They show that in response to a change in fundamental values, real estate prices can either converge to or exhibit oscillation around the new equilibrium values.

Existing literature suggest that house price movements are closely related to a common set of macroeconomic variables, market-specific conditions, and housing finance characteristics. Hofmann (2004) and Tsatsaronis and Zhu (2004) examine the determinants of house prices in a number of industrialized economies and find that economic growth, inflation, interest rates, bank lending, and equity prices have significant explanatory power. The linkage between property and bank lending is particularly remarkable, as also highlighted by Herring and Wachter (1999), Chen (2001), Hilbers, Lei, and Zacho (2001), and Gerlach and Peng (2005). This is not surprising given the heavy reliance on mortgage financing in the housing market. Moreover, housing markets are local in nature. Garmaise and Moskowitz (2004) find strong evidence that asymmetric information about local market conditions plays an important role in reshaping property transactions and determining the choice of financing. Green, Malpezzi, and Mayo (2005) find that house price dynamics differ across metropolitan areas with different degrees of supply elasticities.

On the important issue of detecting house price bubbles, there are several approaches adopted in the literature. Bubble episodes are sometimes assessed by market analysts in terms of the price-rent ratio or the price-income ratio. A bubble is typically identified if the current ratio is well above the historical average level. These measures, however, may be inadequate barometers for policy analysis because they ignore the variation in "equilibrium" price-rent (or price-income) ratios driven by fluctuations in economic fundamentals (e.g., rent growth, income growth, and the desired rate of return). To overcome these problems, two methods have been proposed. The first method compares observed price-rent ratios with time-varying discount factors that are determined by the user cost of owning a house, which consists of mortgage interest, property tax, maintenance cost, tax deductibility of mortgage interest payments, and an additional risk premium (see Himmelberg, Mayer, and Sinai 2005; Ayuso and Restoy 2006; Brunnermeier and Julliard 2008). The second method compares observed house prices with fundamental values that are predicted based on the long-run relationship between house prices and macroeconomic factors (see Abraham and Hendershott 1996; Kalra, Mihaljek, and Duenwald 2000; Capozza et al. 2002, and Holly, Pesaran, and Yamagata 2010, for example). In

this paper, we adopt the second method because of data limitations and heterogeneity in what constitutes appropriate measurement of the user cost across countries.[4]

2.2 Contributions of This Study

This paper examines the determinants of house price fundamentals and short-term dynamics in nine Asia-Pacific economies and thirty-two cities/market segments in these economies, discusses the role of distinctive institutional arrangements, and explores the possible emergence of housing bubbles. The empirical framework used in this study follows Capozza et al. (2002), which examines the long-term and short-term dynamics of house prices in a three-step econometric analysis and characterizes the pattern of house price dynamics via a combination of serial correlation and mean-reversion coefficients (see section 3.2).[5] However, our study extends the previous analysis in three important ways.

First, previous studies have mainly focused on the lessons from industrialized economies. This study is one of the first papers to investigate the evidence in the Asia-Pacific, which has gained an increasing importance in the global economy. Given the remarkable experience of housing bubbles in many of the Asian economies in the 1990s, it is interesting to examine the house price movements after the crisis episode. In addition, Asia-Pacific housing markets differ substantially from those of industrialized economies in terms of the level of economic and financial market developments as well as institutional arrangements. In this regard, the results could provide complementary views to existing studies.

[4]Rent data in our sample economies are often not available or not comparable with the house price data (referring to different samples). It is also difficult to quantify some key components of the user cost, such as the tax deductibility and the risk premium in individual markets.

[5]The methodology is also similar to that of Holly, Pesaran, and Yamagata (2010), which determines the extent to which real house prices in forty-nine U.S. states (over a sample period of twenty-nine years) are driven by fundamentals such as real per capita disposable income and common shocks. Their study also looks into the speed of adjustment of real house prices to macroeconomic and local disturbances. However, it differs from ours in that it explicitly examines the role of spatial factors—in particular, the effect of contiguous states by use of a weighting matrix.

Second, our analysis emphasizes the impact of institutional factors on house price dynamics. The original paper by Capozza et al. (2002) analyzes the impact of a number of factors (such as population, income, and construction cost) on house price dynamics, but the role of institutions in not examined.[6] In this study, we construct a composite measure of institutional factors on the basis of four different aspects of market developments. This measure not only differs across countries but also varies over time. Indeed, our analysis shows that the institutional factor is important in explaining house price determination in the nine Asian economies.

Third, we extend the housing bubble literature by (i) distinguishing between house price growth and house price overvaluation, and (ii) decomposing house price overvaluation into cyclical and bubble components. The first distinction is quite obvious. House price growth may simply reflect the increase in the fundamental value of the property, which is driven by income, mortgage rates, and other factors. By contrast, house price overvaluation refers to the situation that current house prices are higher than the fundamental values. The second distinction is more subtle. A bubble is necessarily related to house price overvaluation, but not vice versa. This is because frictions in the housing market, including lags in supply and credit market imperfections, may cause house prices to deviate from their fundamental values in the short term. In this paper, this cyclical component of house price overvaluation is captured by the serial correlation and mean reversion of house price dynamics. The unexplained part is then defined as the bubble component that is more likely to be driven by overly optimistic expectations in the housing market. Understanding the source of house price overvaluation sheds important light on the appropriate policy actions.

3. Data Description and Empirical Methodology

In this section, we briefly describe the data used in this study and outline the empirical methodology adopted to characterize house

[6]One reason for the omission of institutional factors is that Capozza et al. examine the house price determination in a number of metropolitan areas in the United States. The institutional arrangements—such as business freedom, legal framework, and property rights protection—have little variation across areas.

price dynamics and to analyze the bubble component in house price overvaluation.

3.1 Data Description

Quarterly data for the residential property sector in nine economies and thirty-two cities/market segments in Asia[7] were used in the analysis. Where data are available, quarterly series spanning the period 1993–2006 were used.

The house price data have certain limitations. There are some subtle variations in the definition of house prices used in the estimation (see table 6 in the appendix). While some series are derived using a hedonic pricing method, some are simply based on floor-area prices collected by land registration authorities and the private sector, for which no quality adjustment was done. Moreover, the time series are relatively short. Except for Hong Kong, Korea, Singapore, and Thailand, quarterly house price data only cover the post-Asian-crisis period. However, longer time series of house price data may not necessarily improve the results in the sense that many Asian economies have experienced a regime shift in housing markets and housing finance systems, which has arguably led to discontinuities in the dynamics.

Apart from residential property prices, other series used in this study include real GDP, population, construction cost index, land supply index, mortgage credit-to-GDP ratios, real mortgage rates, real effective exchange rates, stock price index, and the first principal component of four institutional indices—the business freedom index, the financial freedom index, the corruption index, and the property

[7]Other emerging Asian economies are excluded from this study because house price data are not available. At the city level, Beijing, Chongqing, Guangzhou, Shanghai, Shenzhen, and Tianjin are included in China; Busan, Daegu, Daejon, Gwangju, Incheon, Seoul, and Ulsan are included in Korea; Johor, Kuala Lumpur, Pahang, Perak, and Pinang are included in Malaysia; and Caloocan, Makati, Manila, Pasay, Pasig, and Quezon are included in the Philippines. In addition, for Hong Kong, Singapore, Bangkok, Manila, and Kuala Lumpur, there are two separate sets of house prices for the average market and for the luxury market segments, respectively.

rights index[8]—which we believe to be the most relevant representation of the institutional factors that affect the housing market and, hence, house price movements. Table 1 reports summary statistics of key variables used in this study, for each country and for the whole sample.

3.2 Empirical Methodology: Characterizing House Price Dynamics

We follow the framework used by Capozza et al. (2002) to investigate the long-term and short-term determinants of house price movements. The approach can be divided into three steps. In the first step, the fundamental value of housing is calculated. In the second step, the short-term dynamics of house prices are characterized by a mean-reversion process to their fundamental values and by a serial correlation movement. In the third step, the degree of persistence in house prices and the relative speed by which house prices revert to their fundamental values are assessed by interacting the serial correlation and mean-reversion coefficients with macroeconomic and housing market variables as well as institutional factors.

3.2.1 The Fundamental Value of Housing

It is assumed that in each period and in each area (a country or a city), there is a fundamental value of housing that is largely determined by economic conditions and institutional arrangements:

$$P_{it}^{*} = f(X_{it}), \tag{1}$$

where P_{it}^{*} is the log of the real fundamental value of house prices in country i at time t, $f(\cdot)$ is a function, and X_{it} is a vector

[8]The business freedom index measures the ability to create, operate, and close an enterprise quickly and easily. Burdensome, redundant regulatory rules are the most harmful barriers to business freedom. The financial freedom index is a measure of banking security as well as independence from government control. The corruption index is a measure of the perception of corruption in the business environment, including levels of governmental legal, judicial, and administrative corruption. The property rights index measures the ability of individuals to accumulate private property, secured by clear laws that are fully enforced by the state (www.heritage.org).

Table 1. Summary Statistics

Variables	Total	AU	CN	HK	KR	MY	NZ	PH	SG	TH
RHP	109.07	109.05	108.35	114.28	116.87	102.29	116.87	105.95	95.73	109.50
	20.0	26.0	10.0	27.1	13.4	3.7	24.6	20.2	13.9	11.7
ΔRHP(%)	0.19	1.08	0.80	−0.25	−0.45	0.31	1.41	−0.93	0.60	−0.36
	5.5	1.8	0.9	6.3	2.2	1.1	2.0	12.5	4.1	5.0
ΔReal GDP(%)	5.12	3.72	9.08	4.33	5.26	5.66	3.51	4.36	6.183	4.01
	4.0	1.2	1.5	4.3	4.3	4.9	1.7	2.0	4.8	5.3
Population (mn)	161.41	19.09	1249.03	6.57	46.37	22.62	3.87	73.73	3.87	61.73
	380.5	0.9	39.5	0.2	1.3	2.1	0.2	5.6	0.3	2.4
RMR (%)	4.84	5.13	2.32	4.75	2.98	3.33	6.60	6.06	5.37	5.64
	3.3	1.7	6.1	3.9	0.7	2.1	1.3	2.4	1.3	2.4
Mort/GDP (%)	97.09	151.76	8.22	164.21	7.60	91.26	252.49	20.55	147.19	15.38
	82.1	40.6	1.7	34.5	7.6	15.1	37.5	5.9	31.3	1.4
LSI	147.05	105.95	108.47	91.74	123.18	87.94	119.26	115.26	138.75	440.68
	185.7	14.5	56.4	47.8	32.8	18.3	29.1	30.5	137.8	448.7
RCC	102.53	99.39	108.51	92.15	103.96	102.02	102.34	105.12	103.60	104.47
	7.7	3.1	11.1	5.9	4.9	3.7	3.5	10.1	4.4	5.9
EPI	104.16	110.89	94.48	93.24	103.46	106.14	120.41	102.72	100.31	105.83
	13.3	10.4	8.8	10.5	11.0	11.1	13.5	12.6	5.7	12.0
REER	110.32	93.82	73.67	74.13	110.41	99.76	108.94	130.99	90.00	106.04
	57.9	27.8	21.2	17.8	32.3	22.7	16.7	41.8	16.0	11.7

(continued)

Table 1. (Continued)

Variables	Total	AU	CN	HK	KR	MY	NZ	PH	SG	TH
BFI	60.64	60.37	31.74	89.78	52.80	61.73	72.55	35.35	90.36	52.12
	21.4	13.9	5.8	0.8	9.4	10.0	8.1	9.4	1.2	7.1
FFI	63.46	90	40	88.33	56.67	40	90	48.33	70	50
	21.0	0	10.1	5.6	9.5	10.1	0	5.6	0	0
CI	64.83	83.33	31.583	85.67	58.75	61.583	92.18	27	91.08	54.58
	25.1	8.1	2.1	5.3	13.5	10.1	2.5	5.5	1.5	18.5
PRI	72.80	90	30	90	83.33	60	90	53.33	90	70
	22.0	0	0	0	9.5	10.1	0	16.2	0	14.3

Notes: This table reports the summary statistics of key variables, in each country and in the whole sample (1993–2006). For each variable, the numbers in the first row represent sample mean and those in the second row represent the standard deviation. RHP: real house price index; ΔRHP: real house price growth (quarterly); RMR: real mortgage rate; Mort/GDP: mortgage credit/GDP ratio; LSI: land supply index; RCC: real construction cost index; EPI: equity price index; REER: real effective exchange rate; BFI: business freedom index; FFI: financial freedom index; CI: corruption index; PRI: property rights index.

of macroeconomic and institutional variables that determine house price fundamentals.

We adopt a general-to-specific approach in assessing the determinants of house price fundamentals. We start by including all the identified explanatory factors in our list to investigate their long-term relationship with house prices, using either single-equation ordinary least squares (OLS) or panel data techniques.[9] Only regressors found to be significant at the 5 percent level are retained in the final model specification. We choose four blocks of explanatory variables based on theoretic reasoning or previous empirical work.

The first block of explanatory variables consists of demand-side factors, including real GDP, population, the real mortgage rate, and the mortgage credit-to-GDP ratio. The inclusion of the real mortgage rate and mortgage credit is premised on the bank-dominated nature of financial systems across Asia. We posit that *higher income and higher population* tend to encourage greater demand for new housing and housing improvements. In addition, *mortgage rate* is expected to be negatively related to housing prices. A higher mortgage rate entails higher amortization, which, in turn, impinges on the cash flow of households. This reduces the affordability of new housing, dampens housing demand, and pushes down house prices. Similarly, the growth in *mortgage credit* increases the financing capacity of households and stimulates the demand for housing.

The second block of variables is made up of supply-side factors consisting of the land supply index and real construction cost. The *land supply index*, which refers to the building permit index in most countries, measures the flexibility of supply to demand conditions. In the long run, an increase in land supply tends to bring down house prices. By contrast, the burden of higher *real construction costs* will be shared by purchasers, and we expect a positive relationship between real construction costs and equilibrium house prices.

The third block of variables consists of prices of other types of assets such as equity prices and exchange rates. It is well documented that house prices tend to co-move with other asset prices. For instance, Sutton (2002) and Borio and McGuire (2004) find

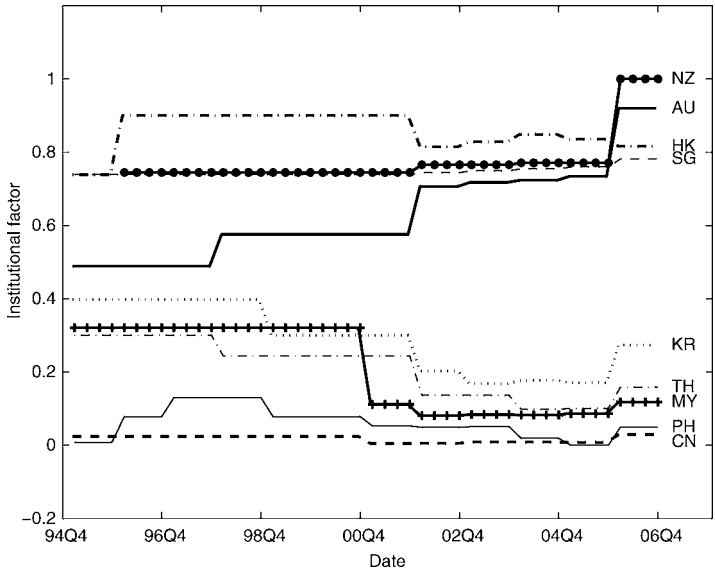
[9] To avoid simultaneity bias, contemporaneous variables are instrumented with own lags.

strong linkages between *equity price* and house price movements. The direction of such linkage, from a theoretical perspective, is not clear, as the substitution effect and wealth effect point in opposite directions.[10] Moreover, a *real effective exchange rate appreciation* is expected to exert positive influence on property market prices, particularly in markets where there is substantial demand from non-residents for investment purposes. In countries where foreign investment plays an important role in the economy, such as in Asia, an exchange rate appreciation is normally associated with housing booms.

Lastly, the fourth block consists of an institutional factor that attempts to account for the impact of market arrangements on equilibrium house prices. The institutional factor is constructed as the first principal component of four index variables compiled by the Heritage Foundation: the business freedom index, the corruption index, the financial sector index, and the property rights index. It is constructed so that we can examine the impact of business, regulatory, and financial conditions on the determination of house prices in a parsimonious way. The first principal component has approximately equal weights of the four indices and accounts for about 80 percent of the variability in the four-index series. A higher score in the institutional factor is associated with higher business freedom, better regulatory conditions, lower corruption, a greater range of intermediation functions by the financial sector, a higher degree of flexibility in acquiring land, and better legal protection to land/home owners. As shown in figure 2, the institutional factor exhibits substantial time variation and cross-country differences. The nine economies can be easily divided into two groups: Australia, Hong Kong, New Zealand, and Singapore are classified as more business friendly and the other five economies as less so. Over time, Australia and New Zealand experienced major improvements, while Malaysia and Thailand witnessed deterioration in their business environment during the period under review.

[10] A substitution effect predicts a negative relationship between the prices of the two assets, as the high return in one market tends to cause investors to leave the other market. A wealth effect, by contrast, predicts a positive relationship because the high return in one market will increase the total wealth of investors and their capability of investing in other assets.

Figure 2. Time Series of Institutional Factors



Notes: The figure plots the time series of the institutional factor in each of the nine economies under review. The institutional factor is defined as the first principal component of four index series: the business freedom index, the financial freedom index, the corruption index, and the property rights index. The institutional factor is rescaled into a range between 0 and 1.

Several remarks are worth mentioning here. First, we use the *trend* component of mortgage credit-to-GDP ratios and equity prices in explaining the long-run house price fundamentals. This modification recognizes that the original raw series may contain non-fundamental components and that a housing bubble often comes together with excessive growth in mortgage credit and sometimes interacts with extreme equity price movements. Using the trend series of the two variables can ensure that our estimates of house price fundamentals are not contaminated by the non-fundamental (or bubble) components and, by extension, minimize potential errors in the analysis.[11]

[11] We do recognize, nonetheless, that the trend needs to be estimated over a long enough sample period that is not dominated by bubble episodes. Data constraints, however, prevented us from estimating the trend series over a longer period of time.

Second, since the stochastic variables included in the long-run equation are mostly non-stationary, we check for cointegration by establishing first the stationarity of the residuals of the long-term equation before proceeding to the second stage. This is to address the concern of Gallin (2006) who, using the U.S. data, suggests that standard and more powerful panel data tests fail to reject the hypothesis of no cointegration, and therefore the error-correction specification in analyzing short-term dynamics may be inappropriate.

Third, there has been substantial evidence that mortgage finance system arrangements, including the terms of mortgage contract, lending practices, valuation method of collateral assets, real estate taxes, and innovations in the mortgage markets, have important implications on house price dynamics.[12] Ideally, we would like to also include a set of variables indicating the time variation and cross-country differences in housing finance systems. Nevertheless, information on housing finance systems is at best only available on a snapshot basis, and often with qualitative rather than quantitative features. Therefore, the impact of housing finance systems cannot be directly examined in this study. However, there is evidence that housing finance system arrangements may depend on the stage of economic development, the advances in credit information systems, and the strength of legal rights (Warnock and Warnock 2008). It is probably no accident that economies with a higher score in the composite institutional factor (including Australia, Hong Kong, New Zealand, and Singapore) coincide with those with more advanced housing financing systems and more active secondary mortgage markets (Zhu 2006). Therefore, the institutional factor in our study may also be interpreted as a proxy variable for the development in housing financing systems, although the link is very loose and at best an indirect one.

[12]See, for example, Estrella (2002), McCarthy and Peach (2002), Tsatsaronis and Zhu (2004), Peek and Wilcox (2006), and Égert and Mihaljek (2007). For descriptions of developments of housing finance systems in the past several decades, see Diamond and Lea (1992), European Central Bank (2003), Hegedüs and Struyk (2005), Organisation for Economic Co-operation and Development (2005), and Committee on the Global Financial System (2006).

3.2.2 Short-Run Dynamics of House Prices

Arguably, equilibrium is rarely observed in the short run due to the inability of economic agents to adjust instantaneously to new information. As suggested by Capozza et al. (2002), house price changes in the short run are governed by reversion to fundamental values and by serial correlation according to

$$\Delta P_{it} = \alpha \Delta P_{i,t-1} + \beta\big(P^*_{i,t-1} - P_{i,t-1}\big) + \gamma \Delta P^*_{it}, \tag{2}$$

where P_{it} is the log of (observed) real house prices and Δ is the difference operator.

If housing markets are efficient, prices will adjust instantaneously such that $\gamma = 1$ and $\alpha = 0$. Considering that housing is a slow-clearing durable asset, it is reasonable to expect that current price changes are partly governed by previous changes in own price levels ($\alpha > 0$), by the deviation from the fundamental value ($0 < \beta < 1$), and partly by contemporaneous adjustment to changes in fundamentals ($0 < \gamma < 1$).

Capozza et al. (2002) shows that the above model specification allows for rich dynamics of house price movements, depending on the size of the coefficients α and β. The various patterns of house price dynamics can be summarized in figure 3.[13]

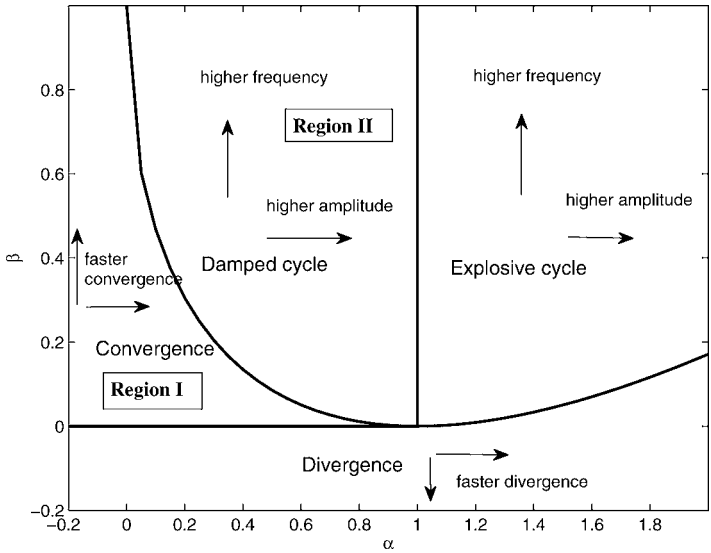
To summarize, the sufficient and necessary condition for a house price cycle to be stable is $\alpha < 1$ and $\beta > 0$. If satisfied, there are two possible types of house price movements:

(i) If $(1 + \alpha - \beta)^2 - 4\alpha \geq 0$ (region I in figure 3), the house price will converge monotonically to the equilibrium level. In this case, the transitory path itself does not generate house price cycles. In other words, house price cycles only reflect cyclical movements in their fundamental values. The speed of convergence depends on the magnitude of the two coefficients: the convergence rate is generally higher when α and β are larger.

(ii) If $(1 + \alpha - \beta)^2 - 4\alpha > 0$ (region II in figure 3), the transitory path in response to changes in equilibrium house price

[13]The strict proof is available upon request.

Figure 3. Characteristics of House Price Dynamics: Illustration



Note: The figure plots the characteristics of house price dynamics for different combinations of persistence (α) and mean-reversion (β) parameters.

values exhibits a damped fluctuation around the equilibrium level. The magnitude of the two coefficients, again, determines the property of the oscillation. Generally, a higher α implies a higher amplitude and a higher β implies a higher frequency of the fluctuation process.

If $\alpha \geq 1$ or $\beta \leq 0$, then the house price cycle is unstable. House prices may either diverge or exhibit an amplified fluctuation away from the equilibrium level, but such movements cannot be sustainable. In general, such features should not exist in any housing market for a prolonged period.

3.2.3 Endogenous Adjustment in Short-Run Dynamics

Given the importance of mean-reversion and serial correlation coefficients, the next step is to analyze what determines α and β.

Following Capozza et al. (2002), we introduce interactive terms in the mean-reversion and serial correlation coefficients:

$$\Delta P_{it} = \left[\alpha_0 + \sum_j \alpha_j Y_{ijt}\right] \Delta P_{i,t-1} + \left[\beta_0 + \sum_j \beta_j Y_{ijt}\right] \left(P^*_{i,t-1} - P_{i,t-1}\right) + \gamma \Delta P^*_{it}, \quad (3)$$

where Y_{ijt} is a list of region-specific economic variables, housing market variables, and—what is new in this study—the composite institutional factor.[14] Introducing the interactive terms allows the two coefficients to differ across regions and to vary over time. For each country, the average serial correlation and mean-reversion coefficients are $\alpha_i = \alpha_0 + \sum_j \alpha_j \overline{Y_{ijt}}$ and $\beta_i = \beta_0 + \sum_j \beta_j \overline{Y_{ijt}}$, respectively, where $\overline{Y_{ijt}}$ represents the time average of Y_j in country i.

3.3 Detecting Housing Bubbles

We employ the above empirical results to investigate the issue of house price overvaluation and to quantify the two components of such overvaluation. One is the cyclical component that is attributable to the intrinsic house price cycles (related to supply and institutional frictions in the adjustment process) and the other is a bubble component that cannot be explained by these cyclical factors.

House price overvaluation is defined as observed house prices (P_t) being higher than predicted house price fundamentals (P^*_t) (see section 3.2.1, subscript i omitted). Intuitively, it is distinct from high house price inflation because the latter may simply reflect the increase in house price fundamentals.

More importantly, we also make a clear distinction between house price overvaluation and a house price bubble, which are often mixed in the existing literature. Throughout this paper, a housing bubble is defined via component analysis of house price overvaluation. As

[14] Similarly, we also adopt a general-to-specific approach, in that we start by including a list of possible factors but the final model specification only includes those variables with significant interactive effects.

suggested by Wheaton (1999) and Davis and Zhu (2004), frictions in housing markets can generate intrinsic house price cycles, causing house prices to deviate (sometimes substantially) from their fundamental values in the short term. We consider this cyclical component of house price overvaluation to be reflected in our estimates of short-term dynamics. The residual component that cannot be explained by the intrinsic adjustment process is what we define in this paper as the "bubble" component (also see Brunnermeier and Julliard 2008).

Specifically, for a given house price overvaluation $(P_t - P_t^*)$, the cyclical component is calculated as $P_{t-1} + E(\Delta P_t) - P_t^*$, where $E(\Delta P_t)$ is the predicted value from short-term dynamics (see equation (3)). Notice that the sum of the first two elements is the predicted house price based on short-term dynamics; its deviation from the fundamental value P_t^* is attributable to the short-run cyclical movement of house prices. By comparison, the residual component, labeled as the "bubble" component in this study, is defined as house price overvaluation minus this cyclical component. Hence, house price overvaluation is not equivalent to a house price bubble in our framework.

There are certain limitations in our definition of a housing bubble. For one, it is defined loosely. The definition of the bubble component is contingent on the accuracy of the model used to estimate house price dynamics. Strictly speaking, a house price bubble in our paper refers to the component that cannot be explained by the list of macrofinancial variables and institutional factors used in this study. If the list of variables is incomplete, then the bubble may mistakenly include a fundamental-related component. By contrast, if the estimates of house price fundamentals are not efficient and include a non-fundamental-driven component, they will introduce errors in the decomposition analysis. Certain aspects of the methodology are designed specifically to minimize the relevance of these concerns. As a reiteration, we use trend series of mortgage credit-to-GDP ratios and equity prices in examining the determination of house price fundamentals. Moreover, our analysis is constrained by the fact that the sample time series are not very long. To overcome this shortcoming, we adopt panel regressions (whenever data are available) to estimate house price fundamentals, in the hope of revealing the general relationship between house price fundamentals and macrofinancial factors. Nevertheless, these refinements are by no means perfect.

In addition, the above empirical methodology also provides another complementary evidence on the characteristics of house price cycles. If $\alpha \geq 1$ or $\beta \leq 0$, house prices are on a divergent path and their movement cannot be sustainable. Such evidence, although not directly related to the bubble component analysis, can shed light on irrational developments in the housing markets under review.

4. Empirical Findings

The empirical results consist of two parts: the characteristics of house price dynamics and the analysis on house price overvaluation and its bubble component.

To contextualize the findings, table 2 summarizes and compares the developments of housing markets in the nine Asia-Pacific economies. Culturally, there is a general trend towards encouraging homeownership in Asia during the period under review. The property sector is normally dominated by a few major developers. The banking system, alongside the government housing finance system, plays an important role in meeting the demand for housing in most sample economies. The national housing markets share certain similarities (e.g., the prevalent use of floating-rate mortgage contracts) but there exist important differences as well.

4.1 Characterizing House Price Dynamics

To investigate the characteristics of house price dynamics, we follow the Capozza et al. (2002) approach described in section 3.2. We run three sets of regressions, which are described below sequentially. The second regression is used as the benchmark for the bubble analysis discussed in section 4.2. The emphasis of analysis is based on the first and third steps of each regression, i.e., the determination of long-run fundamentals and endogenous adjustment in short-term dynamics.

The first regression relies on a panel data technique to estimate both the determinants of fundamental house prices and the short-run dynamics, with the results reported in table 3A and 3B, respectively. The regression attempts to capture the common picture, if any, of house price cycles for the nine economies during the sample period, i.e., 1993–2006.

Table 2. House Market Conditions in Selected Asia-Pacific Economies

Country	Mortgage Credit			Government Housing Finance Corporation	Homeownership Rates[a]
	LTV Ratio	Mortgage Rate	Loan Term		
Australia	60–70	Variable	25	—	72.0 (2002–04)
China	80	Variable	10–15 ($\leq$ 30)	HPF	59.0 (2000)
Hong Kong	70	Variable	20	HKMC	57.0 (2004)
Korea	70	Variable	3–20	KHFC	56.0 (2000)
Malaysia	80	Variable	30	Cagamas	85.0 (1998)
New Zealand	80–85	Variable	25–30	—	68.0 (2002–04)
Philippines	70	Variable	10–20	HDMF	71.1 (2000)
Singapore	80	Variable	30–35	HDB	92.0 (2005)
Thailand	80	Variable	10–20 ($\leq$ 30)	GHB	82.4 (2005)

[a]Various survey years reported in Cruz (2006) for Southeast Asian and East Asian countries and Ellis (2006) for Australia and New Zealand.
Sources: Global Property Guide (2007); Zhu (2006); national sources.

Table 3. Panel Regression Results

A. Determinants of House Price Fundamentals (Dependent Variable: Log of Real House Prices)		
Variables	**Coefficient**	**t-statistics**
Real GDP	0.36	2.0
Real Mortgage Rate	−0.033	6.4
Mort/GDP Trend	0.37	4.6
Land Supply Index	0.078	4.1
Real Effective Exchange Rate	0.55	3.8
EPI Trend	−0.22	3.6
Institutional Factor (IF)	0.14	3.4
Adjusted R^2	0.55	
B. Short-Run House Price Dynamics (Dependent Variable: Real House Price Growth)		
	Coefficient	**t-value**
Persistence Parameter (α)	0.24	5.1
Mean-Reversion Parameter (β)	0.22	7.8
Contemporaneous Adjustment Parameter (γ)	0.30	5.6
α^* (Change in Land Supply Index)	−0.42	3.9
α^* (Change in Construction Cost)	−10.95	2.9
α^* Institutional Factor	0.37	6.9
β^* (Change in Mortgage Rate)	0.14	4.4
β^* (Change in Land Supply Index)	−4.67	2.4
β^* Institutional Factor	−0.12	4.3
Adjusted R^2	0.36	

Notes: This table shows the regression results on the long-term determinants of house price fundamentals and short-term house price dynamics. Both regressions adopt the panel data regressions with fixed effects. "Mort/GDP Trend" and "EPI Trend" refer to the HP-filtered trend series of mortgage credit/GDP ratios and equity price indices, respectively. The institutional factor (IF) refers to the first principal component of four institutional variables: BFI, FFI, CI, and RPI as defined in table 1. In panel A, all variables (except for "Real Mortgage Rate" and "Mort/GDP Trend") are in logs. To avoid simultaneity bias, regressors are instrumented with own lags. Panel unit-root tests on the residuals reject null of unit-root process. Moreover, panel B uses the model as specified in equation (3).

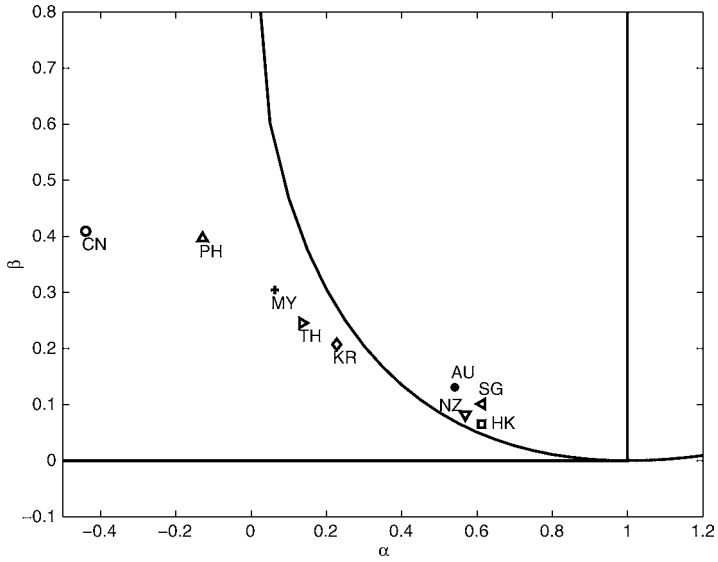
In the first stage, the determination of house price fundamentals yields results that are largely consistent with the theoretical predictions (table 3A). First, higher income, prospects of higher capital gains from real effective exchange rate appreciation, and greater credit availability (mortgage credit-to-GDP ratios) are associated with increases in house prices in Asia-Pacific economies. Second, increases in real mortgage rates have a dampening effect on house prices by raising the cost of housing purchase, but the magnitude is relatively small. Third, the coefficient of the land supply index is positive, which contradicts the theoretical prediction that increases in land supply have a dampening effect on house prices in the long run. This may, however, reflect a linkage in the opposite direction, i.e., higher house prices provide an incentive for developers to build up new residential property projects. Fourth, the institutional factor has a positive and significant effect, suggesting that the improvement in business environment (higher transparency in business regulations, lower corruption, a higher degree of financial sector development) facilitates greater transactions and exerts a positive impact on house prices. Lastly, equity prices are negatively related to house prices, suggesting that the substitution effect dominates the wealth effect during the sample period.

The results on the short-term dynamics, which embed the predicted house price fundamentals from stage 1 regression and the interactive terms to characterize the serial correlation and mean-reversion coefficients, are reported in table 3B. Figure 4 summarizes the characteristics of house price dynamics in each of the nine economies, by plotting the average persistence and mean-reversion coefficients using the time average of country-specific variables. They are separated into two groups. Australia, Hong Kong, New Zealand, and Singapore typically observe damped oscillation of house prices if the fundamental values change, whereas China, Korea, Malaysia, the Philippines, and Thailand observe a convergence to the fundamental values.[15]

The distinction in national house price dynamics as reflected in the persistence and mean-reversion coefficients can be explained by

[15]No country is in the zone of unstable divergence or amplified oscillation.

Figure 4. House Price Dynamics: Panel Regression Results



Note: The results are based on a panel regression on the determinants of house price fundamentals and a panel regression on the short-run dynamics (with fixed effects in both regressions).

differences in market arrangements, such as the supply elasticity embodied in the land supply index and real construction cost, mortgage rate adjustability, and the institutional factor (table 3B). The land supply index and real construction cost both have a negative interactive effect on the persistence coefficient. This means that increases in the land supply index and the construction cost index (which proxy for higher supply elasticity) temper the magnitude of house price cycles. As such, persistence of house prices is moderated in the process.

In addition, changes in mortgage rates have a positive interactive effect on the mean-reversion coefficient. This is probably because larger changes in mortgage rates may indicate a more liberalized mortgage market or higher flexibility in mortgage rate adjustment, thus reflecting faster speed of convergence to the equilibrium price (a higher mean-reversion coefficient).

Lastly, the institutional factor has a positive interactive effect on the persistence parameter and a negative interactive effect on the mean-reversion parameter. That is, a higher score in the institutional factor tends to increase the amplitude but lower the frequency of house price cycles. As the institutional factors become more favorable to growth, the price discovery function strengthens and the incentive to participate in the market improves. Thus, one would expect greater demand for housing. However, the housing market is unique because of inherent supply lags in the housing market. The processes of searching for a house and completing the transaction between sellers and buyers take longer than those in any other asset markets. Improved institutional environment, thus, causes house price growth to persist over a longer period of time.[16]

It is commonly known that housing is a local product and the determination of house prices tends to be market specific. To reflect this, we conduct a second regression that uses country-specific predicted fundamental values.[17] The results are reported in table 4.

Table 4A confirms that the driving factors of house price fundamentals are market specific; therefore, it is important to incorporate this heterogeneity in the analysis. Nevertheless, the results of short-run house price dynamics are quite robust, as reported in table 4B. The sign and significance of all coefficients, including the interactive terms, are retained. The cross-country differences in terms of the average persistence and mean-reversion coefficients do not change in the regression that uses country-specific fundamentals (figure 5 versus figure 4).

It is also worth reporting that when running the country-specific regressions on long-run fundamentals (reported in table 4A), the augmented Dickey-Fuller test confirms the stationarity of the

[16]This is shown in the plots of the persistence and mean-reversion parameters in figure 4. Along the same line, Zhu (2006) also suggests that house prices in Hong Kong and Singapore, the two economies with the most flexible housing finance arrangement, are much more volatile than those in a number of other Asian economies.

[17]For those countries with city-level data, the country-specific analysis is based on a panel regression within the country. This is to overcome major data limitations, i.e., the short time series and the quality difference in computing house price indices.

Table 4. Panel Regression Based on Country-Specific Models of House Price Fundamentals

A. Determinants of House Price Fundamentals (Dependent Variable: Log of Real House Prices)									
	AU (OLS)	**CN (Panel)**	**HK (OLS)**	**KR (Panel)**	**MY (Panel)**	**NZ (OLS)**	**PH (Panel)**	**SG (OLS)**	**TH (OLS)**
Constant	4.21	4.07	−8.39	5.60	2.42	−4.01	3.50	−4.82	4.76
Real GDP	0.38	0.18	0.022	—	0.41	0.56	—	—	−0.18
Mort/GDP Trend	0.92	—	—	—	0.24	—	1.08	−0.031	0.98
Real Mortgage Rate	—	—	−0.051	−0.034	0.010	—	0.017	—	—
Land Supply Index	0.23	−3.51	—	−0.16	—	—	0.16	—	0.074
Real Construction Cost	—	0.25	—	—	—	—	—	0.78	—
REER	—	—	0.99	—	—	0.32	—	1.30	—
Equity Price Trend	−0.84	—	2.22	—	—	0.98	—	—	—
Adjusted R^2	0.99	0.77	0.87	0.51	0.82	0.98	0.41	0.65	0.88

Notes: The results are based on country-specific regression results, by either using national-level data (OLS) or pooled city-level and national-level data (panel). All equations are cointegrated at 1 percent level of significance except for China. Regressors are expressed in logs except for mortgage credit-to-GDP ratio and real mortgage rate. A general-to-specific approach is adopted so that the final model specification in each economy only includes those explanatory variables with statistically significant coefficients. To avoid simultaneity bias, regressors are instrumented with own lags.

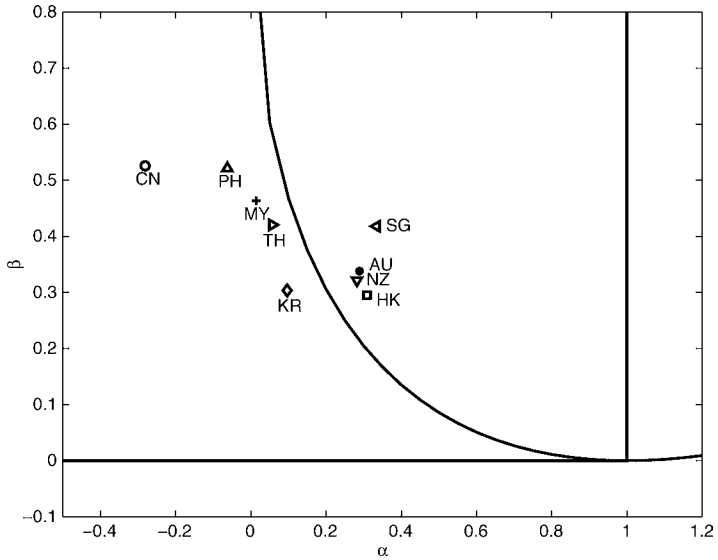
(continued)

Table 4. (Continued)

B. Short-Run House Price Dynamics (Dependent Variable: Real House Price Growth)		
	Coefficient	**t-value**
Persistence Parameter (α)	0.12	2.5
Mean-Reversion Parameter (β)	0.26	2.6
Contemporaneous Adjustment Parameter (γ)	0.68	10.9
α^* (Change in Land Supply Index)	-0.46	3.7
α^* (Change in Construction Cost)	-10.8	3.1
α^* Institutional Factor	0.20	4.1
β^* (Mortgage Rate)	0.018	1.8
β^* (Change in Land Supply Index)	-0.45	3.8
β^* Institutional Factor	-0.085	1.8
Adjusted R^2	0.51	

Notes: The regression is based on a panel data of the nine sample economies (with fixed effects). House price fundamentals are determined by the country-specific regression results as reported in table 4A. The institutional factor refers to the first principal component of four index variables: BFI, FFI, CI, and RPI as defined in table 1.

Figure 5. House Price Dynamics: Baseline Results



Note: The results are based on country-specific regressions on the determinants of house price fundamentals and a panel regression (with fixed effects) on the short-run dynamics.

residual terms in all markets except in China.[18] The evidence of cointegrating relationship justifies the validity of the error-correction specification in analyzing short-run dynamics.[19]

The third regression, instead, employs city-level data. As in the second regression, the fundamentals are determined on the basis of country-specific or market-specific analysis. The panel regression results of the endogenous adjustment equation, as reported in table 5, show significant and positive interactive effects of a dummy variable that defines the most important or high-end market segments in each economy, implying greater volatility in house price

[18]Similarly, in the first regression as described above, a panel unit-root test and the Kao residual cointegration test provide supporting evidence on the cointegration relationship among the variables included in table 3A.

[19]This is in contrast to the results in Gallin (2006), who reports little evidence of cointegration relationship in the U.S. market. The longer list of explanatory variables used in this study may contribute to the different findings.

Table 5. City-Level Endogenous Adjustment Panel Regression Results

	Coefficient	t-value
Persistence Parameter (α)	−0.14	5.7
Mean-Reversion Parameter (β)	0.54	11.8
Contemporaneous Adjustment Parameter (γ)	0.91	29.4
α^* (Change in Land Supply Index)	0.068	2.4
α^* (Dummy for Major Cities)	0.22	2.4
β^* (Change in Mortgage Rate)	0.084	2.6
β^* Institutional Factor	−0.086	3.0
β^* (Dummy for Major Cities)	0.084	2.6
Adjusted R^2	0.32	

Notes: The regression is based on a panel data of thirty-two cities (markets) in seven Asia-Pacific economies (Australia and New Zealand excluded), using the panel regression with fixed effects. House price fundamentals are determined by the country-specific panel regressions or market-specific regressions, which are not reported here. The institutional factor refers to the first principal component of four index variables: BRI, FFI, CI, and RPI as defined in table 1. The dummy for major cities (markets) equals one for the following cities (markets): Kuala Lumpur luxury, Bangkok luxury, Manila luxury, Hong Kong luxury, Singapore private, Beijing, Shanghai, and Seoul.

movements.[20] In addition, the negative (positive) interactive effect between the institutional factor (mortgage rate adjustment) and the mean-reversion parameter remains robust. However, the interactive effects of supply and construction cost indices are washed out.

The results suggest that the high-end markets or the leading markets are more likely to be associated with lower response of supply to market demand, which causes them to be more likely to face a higher volatility of house price movements. The low supply elasticity in these markets could be attributed to limited supply as well as high volatility in housing demand. The demand for new housing or house improvement tends to increase the most in the largest

[20]It equals to one for high-end markets (in Bangkok, Hong Kong, Kuala Lumpur, and Manila), the Singapore private housing market, and major commercial cities in the country (Beijing and Shanghai in China and Seoul in Korea).

cities during the urbanization process, and demand for investment purpose is often the most volatile in high-end markets.

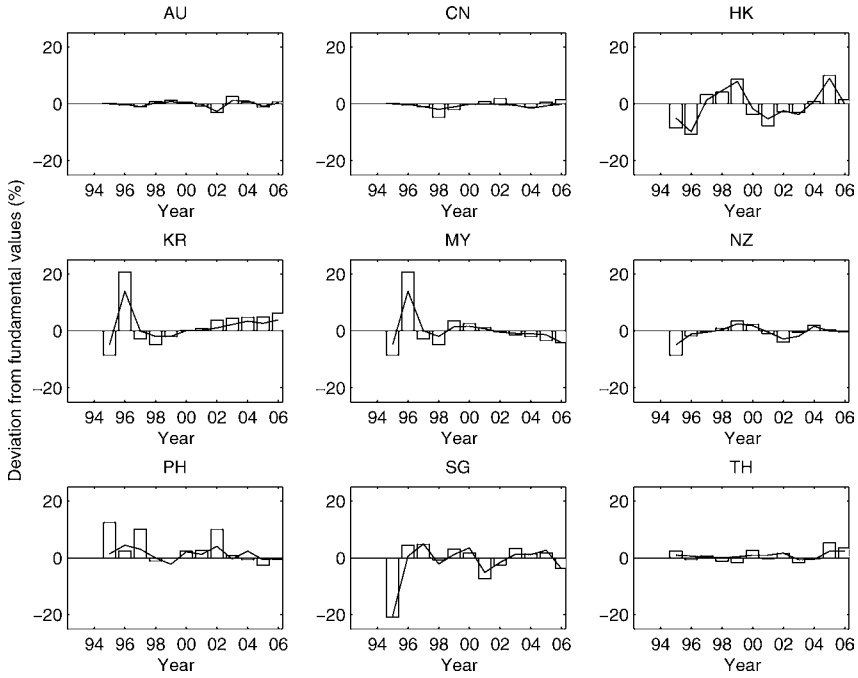
4.2 Detecting Housing Bubbles

Following the methodology described in section 3.3, we try to address the question of whether house prices in selected Asia-Pacific economies are overvalued and, if so, whether there is evidence of some bubble being formed in this region.

The analysis is based on the second regression described above, which treats the determination of house price fundamentals as country specific and relies on a panel data regression to analyze the patterns of short-run dynamics. In figure 6, we first plot the deviation of house prices from predicted fundamentals, represented in bars. At the national level, the evidence of house price overvaluation in recent years is rather weak. Except for Hong Kong (where the house price was 10 precent higher than predicted fundamentals in year 2005), the deviation of house prices from fundamental values is quite small. The result contrasts sharply with results before the Asian crisis, where house prices are about 20 percent higher than their fundamental values in Korea and Malaysia. It appears that the recent strong house price growth (e.g., in Australia, China, Hong Kong, and Korea; see figure 1) is mainly attributable to strong macroeconomic fundamentals.

When the cyclical component, depicted by lines in figure 6, is plotted against total house price overvaluation, the evidence of a house price bubble is even weaker. In Hong Kong, the modest house price overvaluation in year 2005 was mainly driven by the cyclical component, i.e., intrinsic house price adjustment due to house price frictions and other market factors. Only in Korea and Thailand is the bubble component positive, but at very low levels. Again, this contrasts with the findings before the Asian financial crisis, when the bubble component explains 7 percentage points of house price overvaluation in Korea and Malaysia and a double-digit bubble component in the Philippines. Therefore, a general conclusion is that, at least at the national level, there is little evidence of substantial house price overvaluation or house price bubbles in the selected economies in recent years.

Figure 6. Deviation of Country-Level House Prices from Fundamental Values



Notes: The bars represent the average annual deviation of observed house prices from their fundamental values, and the lines represent the cyclical component of this average annual deviation, i.e., the component that can be explained by the short-term dynamics. The results are based on country-specific regressions on the determinants of house price fundamentals and a panel regression (with fixed effects) on the short-term dynamics (see table 4).

The analysis also extends to city-level (or market-level) house price dynamics. Figure 7 plots, in each economy, the house price deviation from fundamentals in the high-end market (or a leading market) versus the average market. There are two interesting findings. First, except for Malaysia, a more remarkable overvaluation has been detected in the leading market compared with the other markets in the current run-up of house prices. In other words, the house price overvaluation that is observed at the national level comes mainly from the leading market segment. Moreover, over the

Figure 7. Deviation of City-Level House Prices from Their Fundamentals

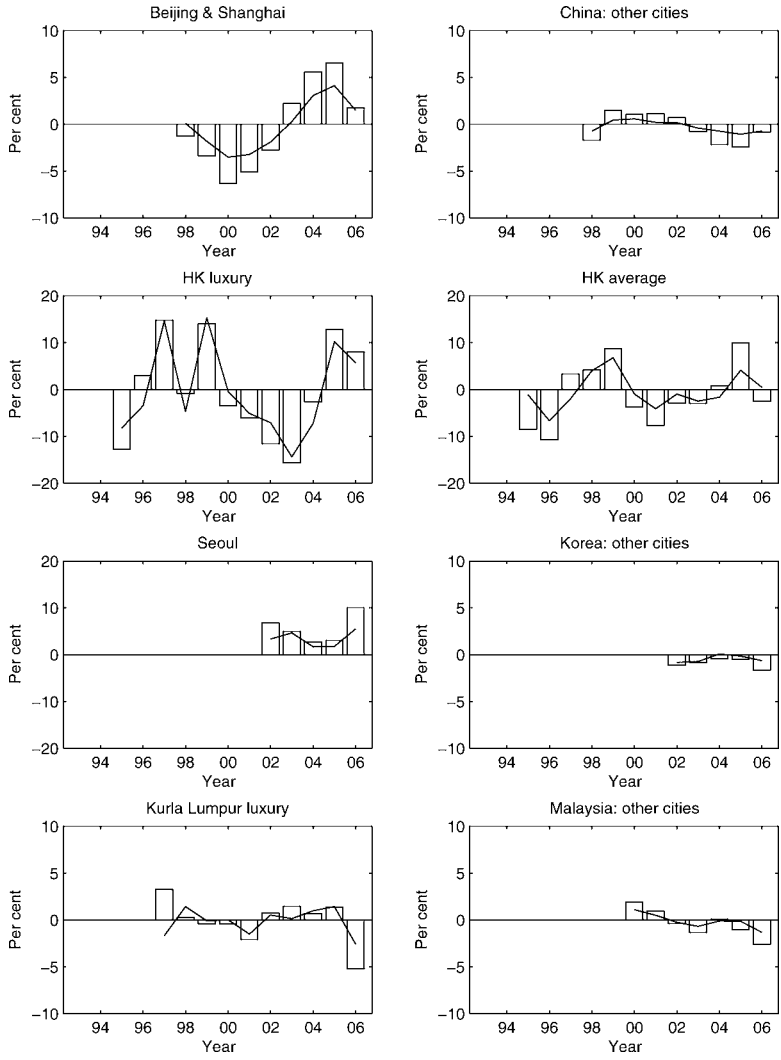


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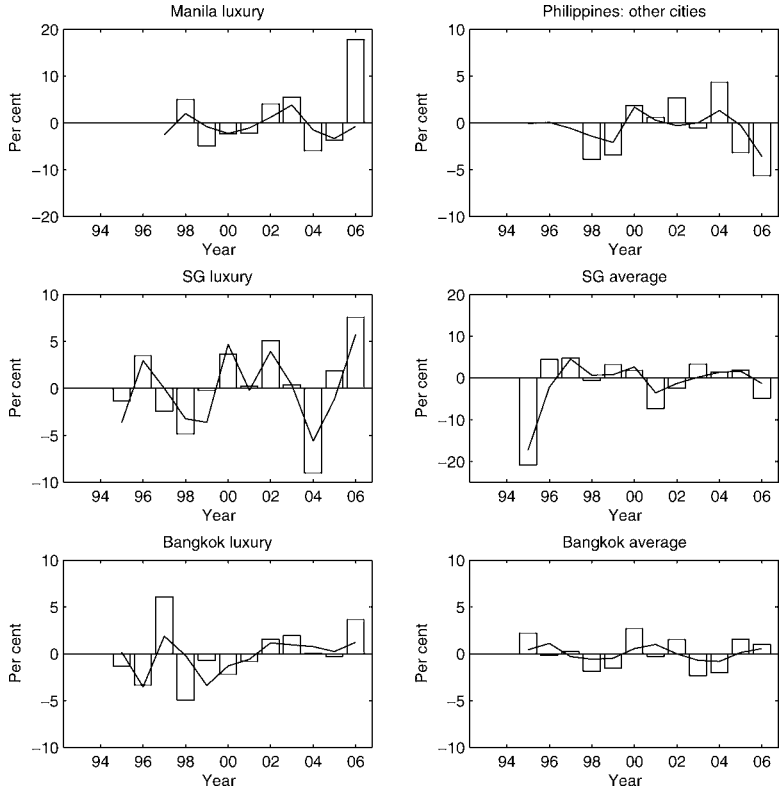
Figure 7. (Continued)



Notes: The bars represent the average annual deviation of observed house prices from their fundamental values, and the lines represent the cyclical component of this average annual deviation, i.e., the component that can be explained by the short-term dynamics. The results are based on a city-level analysis. In China, "other cities" refers to the average of Chongqing, Guangzhou, Shenzhen, and Tianjin. In Korea, "other cities" refers to the average of Busan, Daegu, Daejon, Gwangju, Incheon, and Ulsan. In Malaysia, "other cities" refers to the average of Johor, Kuala Lumpur average market, Pahang, Perak, and Pinang. In the Philippines, "other cities" refers to the average of Caloocan, Makati, Manila average market, Pasay, Pasig, and Quezon.

whole sample period, house prices in the leading market are more likely to deviate substantially from their fundamental values. These results are consistent with the conventional view that the leading market is more volatile than the average market. Second, the

breakdown analysis suggests that speculative housing bubbles may exist at particular market segments—for instance, the luxury market in Manila and to a lesser degree in Bangkok, Seoul, Beijing, and Shanghai. From a policy perspective, it is important for policymakers to implement market-specific diagnoses and to find the right policy instruments that can ideally distinguish between cyclical and bubble components.

5. Conclusion

The study documents evidence of serial correlation and mean reversion in nine Asia-Pacific economies and analyzes the patterns of house price dynamics in relation to local institutional features. Notwithstanding the nuances in each market, the regression results validate the hypothesis that the run-up in house prices up to 2006 reflects mainly an adjustment to more buoyant fundamentals rather than speculative housing bubbles. Looking back, it appears that property market developments in Asia and the Pacific were in line with our assessment of house price risk. Despite the spillover effect that hit the real economy, housing markets have only experienced mild adjustment in most Asia-Pacific economies without causing damage to the banking system.

Despite the relatively benign housing market environment in Asia, it remains crucial for regulators to understand the potential risks embedded in the evolving housing market structure. Whereas our study tries to investigate the determination of house price dynamics and evidence of house price bubbles, the answers are far from complete. Further exploration calls for improvement in data compilation and a better understanding of the mechanism of house price determination. For most of Asia, there appears to be a pressing need to improve the quality and timely availability of house price data if these are to aid in better analysis for policy decision-making purpose. Moreover, national average house prices mask the volatility in house price movements in leading cities/markets. Therefore, reliable information on the city level or across market segments is crucial to the understanding of possible local/market segment bubbles.

Appendix.

Table 6. House Prices: Definitions and Data Sources

Country	Series Definition	Sources	Remarks
Australia	Residential property price index	National source	Weighted average of eight capital cities in Australia, namely Sydney, Melbourne, Brisbane, Adelaide, Perth, Hobart, Darwin, and Canberra.
China	Property price index (both residential and commercial)	CEIC	Same source: city-level information is also available. Beijing, Chongqing, Guangzhou, Shanghai, Shenzhen, and Tianjin are included in this study.
Hong Kong	(i) Residential property price index (repeat sales); (ii) Capital value of luxury residential property	(i) CEIC; (ii) Jones Lang LaSalle (JLL)	(i) A composite index for all classes of private domestic, the most common official figures for property price measurement; (ii) Capital value for a prime-quality residential property in the best location.
Korea	Residential overall house price index (including detached house and apartment prices)	CEIC	Same source: city-level information is also available. Busan, Daegu, Daejon, Gwangju, Incheon, Seoul, and Ulsan are included in this study.

(continued)

Table 6. (Continued)

Country	Series Definition	Sources	Remarks
Malaysia	(i) Residential house price index; (ii) Capital value of luxury residential property in Kuala Lumpur	(i) National source; (ii) CEIC	(i) Nationwide house price index is from national source. City-level/state-level residential house prices are from CEIC, using hedonic method. Johor, Kuala Lumpur, Pahang, Perak, and Pinang are included in this study; (ii) Capital value for a prime-quality residential property in the best location in Kuala Lumpur.
New Zealand	Residential property price index	National source	Total New Zealand index is from current valuations of the relevant local authorities. These current valuations are used to calculate the average valuation and the price index in each quarter.
Philippines	(i) Residential property price index; (ii) Capital value of luxury residential property	(i) NSO; (ii) JLL/Colliers International	(i) Constructed from available value of building permits and corresponding floor area. City-level information is available for the national capital region (represented by Caloocan, Makati, Manila, Pasig, Pasay, and Quezon; 2000 = 100); (ii) Capital value for a prime-quality residential property in the best location in Manila, Makati, and Ortigas Center.

(continued)

Table 6. (Continued)

Country	Series Definition	Sources	Remarks
Singapore	(i) Residential property price index; (ii) Capital value of luxury residential property	(i) CEIC; (ii) JLL	(i) HDB resale price index, which is calculated from the quarterly average resale price of HDB flats by date of registration; (ii) Capital value for a prime-quality residential property in the best location.
Thailand	(i) Residential property price index; (ii) Capital value of luxury residential property in Bangkok	(i) BOT; (ii) JLL	(i) Bangkok and vicinities, single detached house and town house, including land (hedonic method); (ii) Capital value for a prime-quality residential property in the best location in Bangkok.

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