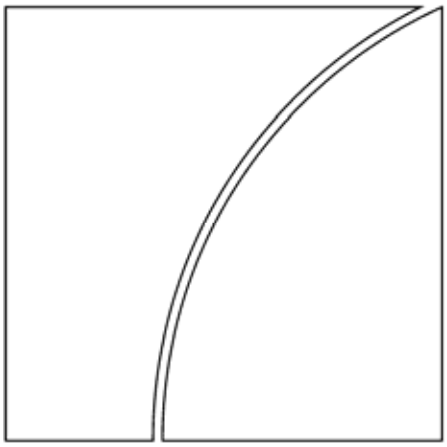
BANK FOR INTERNATIONAL SETTLEMENTS



BIS Working Papers

No 263

Determinants of house prices in nine Asia-Pacific economies

by Eloisa T Glindro, Tientip Subhanij, Jessica Szeto and Haibin Zhu

Monetary and Economic Department

October 2008

BIS Working Papers are written by members of the Monetary and Economic Department of the Bank for International Settlements, and from time to time by other economists, and are published by the Bank. The views expressed in them are those of their authors and not necessarily the views of the BIS.

Copies of publications are available from:

Bank for International Settlements
Press & Communications
CH-4002 Basel, Switzerland

E-mail: publications@bis.org

Fax: +41 61 280 9100 and +41 61 280 8100

This publication is available on the BIS website (www.bis.org).

ISSN 1020-0959 (print)

ISSN 1682-7678 (online)

Determinants of House Prices in Nine Asia-Pacific Economies *

Eloisa T Glindro†
Tientip Subhanij‡
Jessica Szeto§
Haibin Zhu¶

Abstract

The paper investigates the characteristics of house price dynamics and the role of institutional features 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.

JEL Classification Numbers: G12, R31
Keywords: Asia-Pacific economies; House price dynamics; Housing bubble; House price overvaluation; Mean reversion; Persistence parameter.

*This paper is a joint research project of the Bank for International Settlements, Bangko Sentral ng Pilipinas, the Bank of Thailand and the Hong Kong Monetary Authority under the auspices of the Asian Research Program of the Bank for International Settlements. The authors are particularly grateful to Eli Remolona for his initiation of this research project and for his insightful comments at various stages. The authors would like to thank Claudio Borio, Jacob Gyntelberg, Charles Leung, Frank Leung, Chu-Chia Lin, Patrick McGuire, Dubravko Mihaljek, Pichit Patrawimolpon, Marc Oliver Rieger, Niloka Tarashev, Kostas Tsatsaronis, Goetz von Peter and workshop participants at HKIMR, BSP, BOT, BIS, the 2008 Asian Finance Association annual meeting and the 2008 Asian Real Estate Society annual conference for helpful comments. Gert Schnabel provides valuable support for data compilation. The views expressed herein are those of the authors and do not necessarily reflect those of the authors' affiliated institutions.

†Center for Monetary and Financial Policy, Bangko Sentral ng Pilipinas, Manila, Philippines. E-mail: eglindro@bsp.gov.ph.

‡Economic Research Department, Bank of Thailand, Bangkok, Thailand. E-mail: tientips@bot.or.th.

§Economic Research, Hong Kong Monetary Authority. E-mail: jessica_wk_szeto@hkma.gov.hk.

¶Bank for International Settlements. E-mail: haibin.zhu@bis.org.

1 Introduction

There are good reasons why the public and policymakers should monitor house price developments closely. In most countries, housing is generally households' single largest investment and hence house price risk may be considered to be the major financial risk they face (Cocco, 2004; Yao and Zhang, 2005). Fluctuations in residential property prices tend to have a bigger wealth effect than those of financial assets.[1] In addition, because the purchase of a house is predominantly funded by mortgage loans originated by financial institutions, and real estate property is widely used as a major collateral asset for bank loans, there are strong linkages between the residential property cycle and the credit cycle, and by extension the banking sector and the macroeconomy.[2] Reflecting these, the Financial Sector Assessment Program (FSAP), which was introduced by the IMF and the World Bank in 1999, recommends including real estate prices in the encouraged set of financial soundness indicators (FSIs).

House price risk has attracted much attention in recent years. A number of industrialized economies, including the United States, the United Kingdom and Spain, have witnessed a protracted period of significant increases in house prices until recently. The perceived lower risk has encouraged more lax lending criteria in mortgage markets, which lie at the heart of the ongoing subprime crisis. By comparison, housing markets in most Asian economies have been relatively tranquil during the same period. However, the situation has started to change in the past several years. China, Hong Kong SAR and Korea have witnessed very strong house price inflation recently (see Figure 1). Given the not-so-distant experience of financial crises in this region (e.g. the 1997 Asian crisis and the so-called "lost decade" in Japan), in which booms and busts in real estate markets play a crucial role, there is a concern whether a new housing bubble could be formed. There are two opposite views. 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 as evidence of new speculative housing bubbles, and call for supervisors and central banks to take active 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 crisis, house prices were too low compared to

[1] On the one hand, booming housing markets can have a significant positive effect on household consumption, as shown by Girouard and Blöndal (2001) in a number of OECD countries and Campbell and Cocco (2007) in the United Kingdom. On the other hand, a sharp decline in house prices tends to have a much bigger impact on output growth than equity price busts, as suggested by Helbling and Terrones (2003) and Case et al (2005).

[2] The "financial accelerator" mechanism, developed by Bernanke et al, 1994; Bernanke and Gertler, 1995; Kiyotaki and Moore, 1997; Aoki et al, 2004 and Gan, 2007, provides the theoretical framework to analyze the inter-linkages between the housing market and the banking sector.

their fundamental values. Therefore, 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, have 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, including Australia, China, Hong Kong SAR, South Korea (Korea hereafter), Malaysia, New Zealand, the Philippines, Singapore and Thailand.[3] We examine the determinants of house price dynamics in two steps. In the first step, house price fundamentals are determined by country-specific demand and supply factors. In the second step, the characteristics of house price cycles are further explored by investigating evidence of serial correlation and mean reversion embedded in the short-term dynamics of house prices in each country. Not surprisingly, the patterns of national house price dynamics exhibit significant cross-country heterogeneity, which can be attributed to different stages of economic development, different institutional arrangements and market-specific conditions.

We also use the above results to discuss the question on whether there may be a bubble in real house prices. Importantly, throughout this paper we distinguish between house price overvaluation and a housing bubble. House price overvaluation refers to the fact that current house prices are substantially higher than their fundamental values. The overvaluation consists of two components. For one, imperfections in housing markets, such as lags in supply and credit market frictions, can cause house prices to exhibit fluctuations around their fundamental values in the short run. In this study, we consider this cyclical component of house price overvaluation as simply reflecting inherent frictions in the housing market. On the other hand, the residual component, i.e. the part of house price overvaluation that cannot be explained by serial correlation and mean reversion of house price dynamics, is most likely driven by overly optimistic expectations of future house price movements and hence treated as evidence of bubbles. Using this definition, we find little evidence of housing bubbles in the Asian economies, at least not at national levels.

The distinction between the cyclical and bubble components of house price overvaluation can be important for policy considerations. To mitigate house price overvaluation driven by cyclical movements related to market frictions, a policymaker should probably focus on measures that aim at reducing the magnitude and frequency of house price cycles, such as loosening land use regula-

[3] In this paper, we also loosely use the term "Asian" to represent the sample economies.

tion, improving information availability and transparency and enhancing property right protection. By contrast, to contain a bubble, the policymaker should instead adopt measures that control unwarranted high expectations of capital gains, or the "animal spirit" 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 elucidates on the salient features of the Asian housing markets structure and institutional settings. Section 4 explains the empirical method adopted in this study, and Section 5 describes the data and empirical results. Finally, Section 6 concludes and provides some policy perspectives.

2 Literature Review

Our study attempts to address the following questions: What determines the fundamental values and short-term dynamics of house prices? What are the implications of the institutional arrangements in housing markets (or more generally the business environment) on house price movements? How can one distinguish a speculative housing bubble from an increase in house price fundamentals or the cyclical component of house price overvaluation that is driven by frictions in the housing market? In this section, we first review the existing studies on these issues, and specify the new insights we provide in this exercise.

To monitor the housing market, the first issue is to understand the determinants of house prices. Housing is a special type of asset in that it 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, driven by some unique characteristics of the real estate market (such as asset heterogeneity, down-payment requirements, short-sale restrictions, lack of information, and supply lags). 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 shows that house price movements are closely related to a common set of macroeconomic variables and market-specific conditions. 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 highlighted by Herring and Wachter (1999), Hilbers et al (2001), Chen (2001) and Gerlach and Peng (2005). 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 et al (2005) find that house price dynamics differ across metropolitan areas with different degrees of supply elasticities.

Given the heavy reliance on mortgage financing in the housing market, housing finance system arrangements turn out to be another key factor to be considered in examining house price movements. There are recognizably significant time variation[4] and cross-country differences in terms of the prevalent contract type, the lending practice, the valuation method of collateral assets, the development of mortgage backed securities (MBSs), the flexibility in mortgage refinance and mortgage equity withdrawal. Such differences depend on the stage of economic development and the development of credit information systems and the strength of legal rights (Warnock and Warnock, 2007). There has been substantial evidence that institutional arrangements in housing finance systems have important implications on house price dynamics, both in time series (see Peek and Wilcox, 2006; Estrella, 2002; McCarthy and Peach, 2002) and cross country analyses (see Tsatsaronis and Zhu, 2004; *Égert* and Mihaljek, 2007).

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. Typically a bubble is identified if the current ratio is well above the historical average level. These measures, however, may be inadequate barometers for policy analysis because they have ignored 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 is to compare 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 Himmelbert et al, 2005; Ayuso and Restoy, 2006; Brunnermeier and Julliard, 2007).

[4]In the last several decades, housing finance systems have experienced remarkable changes in both industrialized economies (see Diamond and Lea, 1992; ECB, 2003; CGFS, 2006) and emerging market economies (see OECD, 2005; Hegedüs and Struyk, 2005). There is a general trend towards more market-based housing financing systems.

The second method is to compare observed house prices with fundamental values predicted based on the long-run relationship between house prices and macroeconomic factors (see, Abraham and Hendershott, 1996; Kalra et al, 2000; Capozza et al, 2002, 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.[5]

This paper examines the characteristics of house price dynamics in nine Asia-Pacific economies and 32 cities/market segments in these countries, discusses the role of distinctive institutional arrangements and explores the possible emergence of housing bubbles. The two closely related papers are Capozza et al (2002) and Tsatsaronis and Zhu (2004). Capozza et al (2002) characterize the dynamics of house price cycles in U.S. metropolitan areas by computing the serial correlation and mean reversion coefficients, the same two key parameters used in this study. Tsatsaronis and Zhu (2004) compare the features of national housing finance systems in 17 industrialized economies. Both papers find strong effects of institutional arrangements on house price dynamics, as we will illustrate in this study. However, our study differs substantially from those previous ones 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 area, 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 development of institutional arrangements, the reliance on bank lending and the role of government-sponsored agencies. In this regard, the results could provide complementary views to existing studies.

Second, we extend the studies by including a broader set of institutional factors, which provides a more robust message on the impact of house price dynamics and housing finance systems. Tsatsaronis and Zhu (2004) define the housing finance system as a combination of different aspects of institutional arrangements, including the mortgage rate adjustability, maximum loan-to-value ratios, valuation method and mortgage equity withdrawal. These measures are constant over time for each country, implying that the impact of housing finance innovations on each market has been ignored. In Capozza et al (2002), the role of housing finance systems is in effect barely touched because the authors examine house price dynamics in metropolitan areas within the *same* country.

[5]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.

In this study, we construct a measure of institutional factors on the basis of four different aspects of market developments, and this measure not only differs across countries but also varies over time. Therefore, we believe our results are more informative with respect to the role of institutional arrangements.

Third, we extend the housing bubble literature by distinguishing between house price growth and house price overvaluation, and between cyclical and bubble components of house price overvaluation. 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, we consider that this cyclical component of house price overvaluation can be reflected by the serial correlation and mean reversion of house price dynamics, and define the unexplained part as the bubble component that is more likely to be driven by overly optimistic expectations in the housing market. Such a distinction is particularly important from a policymaker's perspective, because policy recommendations are quite different depending on what drives overvaluation of house prices.

3 Asian Housing Market Structure and Institutions

An understanding of the salient features of the Asian housing markets would provide the contextual background to the discussion of the empirical results that are obtained from the regressions. Culturally, there is a general trend towards encouraging home ownership 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. Property rights-related problems are most acute in China and the Philippines, which also rank the lowest in terms of business freedom and corruption among sample economies. A more detailed description of national housing markets is included in Appendix A.

3.1 Tenure system

In terms of tenure, both freehold and leasehold systems are available with the exception of Hong Kong SAR and China, where only the leasehold system applies. In both of the two economies, the government is effectively the sole owner of the land and the land market is essentially a market for land leases. A land rights use system is in place, whereby, the process of land allocation is governed by an auction system.

3.2 Foreign ownership restrictions

There are practically no foreign ownership restriction among the surveyed Asian economies, except in Thailand and the Philippines where private freehold is open only to citizens. Foreigners are only allowed to buy condominium units or lease land. In Thailand, however, foreigners with investments of at least 40 million baht in a Board of Investment (BOI)-approved project are allowed to purchase up to one rai (1,600 square meters) of land. In an effort to cool the property market, authorities in China have recently required that overseas individuals must have lived for at least one year in the country before they can buy a house for personal use.

3.3 Taxation policies

The acquisition and transfer of real estate are normally subject to the usual capital gains tax, notary fee and stamp duties, although there are huge variations across countries, including transaction turnaround time. The transaction cost is highest in Korea, which has a progressive real estate taxation policy. Turnaround is the longest in the Philippines. For medium-price housing, Thailand has full tax deductibility of interest payments on owner-occupied mortgage debt. In an effort to quell speculation on residential properties, China has imposed since 2005, along with other supply regulations, an idle land tax, a land appreciation tax and a business tax on properties held for less than five years.

3.4 Mortgage credit conditions

Most mortgage contracts are hybrid floating rate mortgages in the sample economies. Typically, loan-to-value ratios of 70 percent to 80 percent are the norm (see Table 1). In Hong Kong, the introduction of an insurance scheme for lenders allows banks to grant higher loan-to-value ratios, which can go as high as 95 percent. Loan maturity ranges from as low as three years to 35 years. Real estate investment trusts (REITs), in general, are still in their infancy, limiting the degree of asset substitutability.

Islamic house financing is a distinctive feature of the Malaysian banking system. Islamic house financing products generally share the same characteristics as normal housing loan products, but are based on the concept of Bai Bithaman Ajil (BBA) or Deferred Payment Sale. BBA refers to the sale of goods on a deferred payment basis at a price that includes a profit margin agreed upon by both the buyer and the seller. Islamic house financing is mostly fixed rate financing, but as of 2003, banks have begun to offer variable-rate Islamic house financing products.

3.5 Government housing finance system

Government-housing finance institutions play an equally important role in housing finance system in Asia. These institutions engage either in direct lending, mortgage securitization or both, with most of them carrying explicit or implicit government guarantees, except for Cagamas in Malaysia which is a purely private-sector institution. While the Hong Kong Mortgage Corporation (HKMC) does not have explicit government guarantee, it is largely perceived to carry an implicit government guarantee (Chan et al, 2006).

A conventional role of government housing finance institutions is to cater to mortgage financing needs of households, particularly low income households, and to promote home ownership. Malaysia, the Philippines and Thailand have a number of institutions that provide concessional residential loans. In Malaysia, there are a number of development finance institutions that provide financing for the purchase of residential properties. Thailand has the Government Housing Bank (GHB) and Government Savings Bank, which account for about half of the new mortgage loans. The Philippines has the Home Development Mutual Fund (HDMF), the Social Security System (SSS) and the Government Service Insurance System (GSIS). Despite the avowed goal of providing affordable financing to low-to-moderate income households, these government finance institutions typically also compete for the middle income segment. By contrast, in Singapore, the very comprehensive government housing finance benefits the majority of households. The government agency, the Housing Development Board (HDB), plans and develops public housing and sells it to eligible households at subsidized rates. As the majority of citizens are eligible for HDB flats, the public housing market constitutes over 80 percent of the housing stock. Another notable feature of the Singapore housing market is that both public and private property buyers can use their savings in the Central Provident Fund (CPF) – a mandatory social securities savings plan – to make down-payments and monthly mortgage repayments. With easy access to concessional finance, it is not surprising that Singapore has the highest home-ownership rate in the world.[6]

[6]China's Housing Provident Fund (HPF) scheme follows the Singapore model. In Australia, Hong Kong and New Zealand, there is no government institution that caters to mortgage financing needs of low income households.

Another major function of government housing finance institutions is to facilitate securitization. For instance, the Cagamas (Malaysia) and the HKMC undertake the function of securitization and do not engage in direct lending to households. In Korea, the Korean Housing Finance Corporation (KHFC) was established in 2004 to perform dual functions of lending to households and MBS issuance. In Thailand, the market for mortgage-back security (MBS) has not yet been developed but the Government Housing Bank (GHB) will soon have its first MBS issued in 2008 (Subhanij, 2007). By contrast, China's HPF, the Philippines' HDMF, Singapore's CPF do not perform the mortgage securitization function.

The involvement of government housing finance institutions in securitization is considered to have played a pivotal role in fostering the expansion of mortgage markets and encouraging greater participation of commercial banks in mortgage financing. In Malaysia, banks were less than eager to extend housing loans prior to the advent of securitization. Securitization allowed them to obtain competitively-priced funds, gain profits and diversify their housing loan products (Ng, 2006). The liquidity provided by securitization facilities has made it possible for financial institutions to overcome the liquidity mismatch problem and extend the term of housing loans. Higher liquidity also enhanced the capacity of households to take on greater debt and, thereby, increased demand for houses.

4 Methodology

In this section, we describe the empirical methodology used to characterize house price dynamics and to analyze the bubble component in house price overvaluation.

4.1 Characterizing house price dynamics

We follow the framework developed 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 determined by a mean reversion process to their fundamental values and by a serial correlation movement. The pattern of house price movements can be characterized by the mean reversion and serial correlation coefficients. In the third step, interactive terms are introduced to investigate the impact of institutional factors on house price dynamics.

Nonetheless, they provide public or social housing in the case of Australia and subsidized rental housing in the case of Hong Kong and New Zealand.

4.1.1 The fundamental value of housing

It is assumed that in each period, 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 of macroeconomic and institutional variables that determine house price fundamentals. We choose four blocks of explanatory variables based on theoretic reasoning or previous empirical work.

The first block of explanatory variables are demand-side factors, including real GDP, population, the real mortgage rate and the mortgage credit to GDP ratio. We posit that *higher income and higher population* tend to encourage greater demand for new housing and housing improvements. In addition, the *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 are supply-side factors, including the *land supply index* and the *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 are prices of other types of assets, including equity prices and exchange rates. It is well documented that house prices tend to comove with other asset prices. For instance, Sutton (2002) and Borio and McGuire (2004) find 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.[7] 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

[7] 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 on other assets.

purposes. In countries where foreign investments play an important role in the economy such as in Asia, an exchange rate appreciation is normally associated with housing booms.

Lastly, we also include 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: the business freedom index, the corruption index, the financial sector index and the property rights index. The institutional factor is designed to examine the impact of business, regulatory and financial conditions on the determination of house prices.

Several remarks are worth mentioning. First, we adopt a general-to-specific approach in assessing the determinants of house price fundamentals. That is, we start by including the whole list of possible explanatory factors to investigate their long-term relationship with house prices, using either single-equation ordinary least squares (OLS) or panel data techniques.[8] Only regressors found to be significant at the five percent level are retained.

Second, since the stochastic variables included in the long-run equation are mostly non-stationary, it is important to establish first the stationarity of the residuals of the cointegrating equation before proceeding to the second stage. Thus, residual tests were undertaken to ensure that the requisite statistical properties are satisfied.

Third, we use the trend series of mortgage credit to GDP ratios and equity prices in explaining the long-run house price fundamentals. A potential caveat of this approach to determining house price fundamentals is that some of the macro series may imbedded in themselves a non-fundamental component. 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 follow-up analysis.

4.1.2 Short-run dynamics

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:

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

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

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 ($0 < \gamma < 1$).

The above model specification allows for rich dynamics of house price movements, depending on the size of the coefficients α and β. To examine the dynamics, we first rewrite the equation 2 as a second-order difference equation (the subscript i omitted):

$$P_t - (1 + \alpha - \beta)P_{t-1} + \alpha P_{t-2} = \gamma P_t^* + (\beta - \gamma)P_{t-1}^*$$

We then proceeded to study the characteristic roots of the corresponding characteristic equation given by $b^2 - (1 + \alpha - \beta)b + \alpha = 0$, which determine the properties of house price dynamics (see Appendix C for details). In graphical form, house price dynamics can be depicted as in Figure 2.

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 $(1 + \alpha - \beta)^2 - 4\alpha \geq 0$ (see Region I in Figure 2), 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 $(1 + \alpha - \beta)^2 - 4\alpha > 0$ (see Region II in Figure 2), the transitory path in response to changes in equilibrium house price values exhibits a damped fluctuation around the equilibrium level. The magnitude of the two coefficients, again, decide on 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.

4.1.3 The role of institutional factors

Given the importance of mean reversion and serial correlation coefficients, the question to be asked is: what determines α and β? Following Capozza et al (2002), we posit that they are determined by

region-specific factors, including the stage of economic development, the elasticity of land supply and other institutional factors that reflect differences in business environment and housing finance system arrangements.

Formally, we introduce interactive terms in the mean reversion and serial correlation coefficients:

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

where Y_{ijt} is a list of region-specific economic and institutional factors that may affect the property of house price dynamics.[9] Introducing the interactive terms allow 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.

4.2 Detecting housing bubbles

We employ the above empirical results to investigate the issue of house price overvaluation, and to quantify two components of such overvaluation: a cyclical component that is attributable to the intrinsic house price cycles (related to macro and institutional factors and house market frictions) and a bubble component that cannot be explained by macro and institutional factors.

House price overvaluation is defined as the fact that observed house prices (P_t) are higher than predicted house price fundamentals (P^*_t) (see section 4.1.1, 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 house bubble is defined via component analysis of house price overvaluation. As 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 that this cyclical component of house price overvaluation can be reflected in our estimates of short-term dynamics. It is only the residual component that cannot be explained by the intrinsic adjustment process we define in this paper as the "bubble" component (also see Brunnermeier and Julliard, 2007). More specifically, for house price deviation from (predicted) fundamentals ($P_t - P^*_t$), the cyclical component that is driven by intrinsic house

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

price movements 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, and its deviation from the fundamental value P_t^* is attributable to the short-run cyclical movement of house prices. By comparison, the residual component, defined as house price overvaluation minus this cyclical component, is labeled as the "bubble" component in this study. Intuitively, 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 macro-financial variables or 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. For example, we use trend series of mortgage credit to GDP ratios and equity prices in examining the house price fundamentals. Moreover, whenever data are available, we adopt panel regressions to estimate house price fundamentals, in the hope to reveal the general relationship between house price fundamentals and macro-financial factors. Nevertheless, these refinements are by no means perfect.

The above empirical methodology also provides another complimentary 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 market under review.

5 Data description and empirical findings

In this section, we first briefly describe the data used in this study, then report the empirical results. The empirical results consist of three parts: the characteristics of house price dynamics, house price overvaluation and the bubble component analysis, and the determinants of house price fundamentals in each sample country.

5.1 Data description

Quarterly data for residential property sector in nine economies and 32 cities/market segments in Asia[10] 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. While some series are derived using a hedonic pricing method, some are simply based on floor area prices collected by authorized 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 SAR, 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 house finance systems (see Section 3 and Appendix A), which has arguably led to discontinuities in the dynamics.

Apart from residential property price index, 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 four institutional indices: the business freedom index, the financial freedom index, corruption index and the property rights index. Appendix B provides definitions of these variables and the data sources, and Table 2 reports summary statistics of key variables used in this study, for each country and for the whole sample.

A key explanatory variable used in this study is the institutional factor, which is defined as the first principal component of the four institutional indices as mentioned above. It is constructed so that we can investigate the role of institutional factors in determining long-run and short-run dynamics of house prices in a parsimonious way. It turns out that the first principal component has approximately equal weights of the four indices, and can account for about 80% 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 and a higher degree of flexibility in acquiring land and the legal protection to land/home owners. Therefore, a higher institutional factor score tends to reduce the searching and transaction cost, facilitate credit transactions and allow investors to respond more quickly to changes in the housing market. As shown in Figure 3, the institutional factor exhibits substantial

[10] At 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; Caloocan, Makati, Manila, Pasay, Pasig and Quezon are included in 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.

time variation and cross-country differences. The nine economies can be easily divided into two groups: Australia, Hong Kong, New Zealand and Singapore as more business-friendly and the other five economies less so. Overtime, Australia and New Zealand experienced major improvements, while Malaysia and Thailand witnessed deterioration in their business environment during the period under review.

5.2 Characterizing house price dynamics

To investigate the characteristics of house price dynamics, we follow the Capozza et al (2002) approach as described in Section 4.1. We run three different regressions.

The first regression relies on a panel data technique to estimate the determinants of fundamental house prices (Equation 1) and the short-run dynamics (Equation 3), with the results reported in Table 3. 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. In stage 1, the determination of house price fundamentals yields results that are largely consistent with the theoretical predictions (Table 3.A). First, higher income, prospects of higher capital gains from real effective exchange rate appreciation and greater credit availability (mortgage credit-to-GDP) 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 with 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 of house prices. Lastly, equity prices are negatively related to house prices, suggesting that the substitution effect dominates the wealth effect during the sample period.

Results on the short-term dynamics, using house price fundamentals predicted in the panel regression results, are reported in Table 3.B. 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, Philippines, and Thailand

observe a convergence to the fundamental values.[11] Particularly in China and Philippines, the speed of convergence is the lowest, suggesting that the price discovery function is the weakest in the two markets.

The differences in national house price dynamics can be explained by differences in market arrangements, such as the supply elasticity, mortgage rate adjustability and the institutional factor (Table 3.B).[12] First, the land supply index has a negative interactive effect on the persistence coefficient. As expected, increases in the land supply index and the construction cost index, proxies for higher supply elasticity, temper the magnitude of house price cycles. Second, changes in mortgage rates have a positive interactive effect on the mean reversion coefficient. This is probably because larger changes in mortgage rates may reflect a more liberalized mortgage market or higher flexibility in mortgage rate adjustment, which is often associated with a 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. This is quite surprising as it indicates that a more flexible market is associated with more significant house price fluctuations.[13] There might be two reasons. For one, housing is a unique type of asset in that there are many frictions in the housing market. By introducing more flexible housing finance systems and improving the business environment, the role of housing as an investment good expands and the price-discovery function in the housing markets strengthens. This probably explains the higher volatility when housing markets become more market-oriented. On the other hand, the less volatile house prices in those economies with a lower score in business freedom index is probably attributable to more extensive government support and finance-linked subsidies in these economies.

The second regression (Table 4) is similar to the first one, except that country-specific regressions are used to identify the determination of house price fundamentals.[14] It is commonly known that housing is a local product and the determination of house prices tend to be market-specific. To reflect this we allow the house price fundamentals to be determined in each country-specific analysis, and use the country-specific predicted fundamental values in the analysis on the short-run dynamics.

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

[12] Notice that we do not have the time series of housing finance variables, such as loan to value ratios and real estate taxes. Instead, we use the changes in the nominal mortgage rate to proxy for mortgage rate adjustability and the institutional factor to proxy for the flexibility of housing markets and housing finance systems.

[13] 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 a number of other Asian economies.

[14] 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.A. 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 4.B. The sign and significance of all coefficients, including the interactive terms, are retained. The cross-country differences in term of the average persistence and mean-reversion coefficients, do not change in the regression that allow for country-specific fundamentals (Figure 5 versus Figure 4).

The third regression (Table 5), 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 shown in Table 5, show significant and positive interactive effects of a dummy variable that defines the most important market segments in each country.[15] By contrast, the interactive effects of supply and construction cost indices are washed out. This suggests 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 more likely to face a higher volatility of house price movements. By contrast, the negative (positive) interactive between the institutional factor (mortgage rate adjustment) and the mean-reversion parameter remains robust.

5.3 Detecting housing bubbles

Following the methodology described in Section 4.2, 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. At the national level, the evidence of house price overvaluation in recent years is rather weak. Except for Hong Kong SAR (where the house price was 10% higher than predicted fundamentals in year 2005), the deviation of house prices from fundamental values is quite small. The result contrasts sharply before the Asian-crisis, where house prices are about 20% higher than their fundamental values in Korea and Malaysia. It appears that the recent strong house price growth (eg in Australia, China, Korea and Hong Kong, see Figure 1) is mainly attributable to strong macroeconomic fundamentals.

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

A further breakdown quantify the cyclical and bubble components of house price deviation from their fundamental values. The red bars in Figure 6 plot the cyclical component 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, ie 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 to the findings before the Asian financial crisis, when the bubble component explains 7 percentage point of house price overvaluation in Korea and Malaysia and a double-digit bubble component in Philippines. Therefore, a general conclusion is that, at least at the national level, there is little evidence of substantial house price overvaluation nor house price bubbles in the selected economies in recent years.

Given that city-level (or market-level) house prices are available, it is natural to extend the analysis to the city-level. Figure 7 plots the results for each country, by comparing 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, in almost all countries (except Malaysia), a more remarkable overvaluation has been detected in the leading market compared to 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 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.

6 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 current run-up in house prices reflects mainly an adjustment to more buoyant fundamentals than speculative housing bubbles. However, national average house prices mask the volatility in house price movements in leading cities/markets.

Despite the relatively benign housing market environment in Asia, it remains crucial for regulators to understand the potential risks embedded in the new 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 satisfactory. Further exploration calls for improvement in data compilation and a better understanding on 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. Reliable information on city level or across market segments is crucial to the understanding of possible local/ market segment bubbles.

References

[1] Abraham, J and P Hendershott (1996): "Bubbles in Metropolitan Housing Markets", *Journal of Housing Research*, vol 7, pp 191-207.

[2] Aoki, K, J Proudman and G Vlieghe (2004): "House Prices, Consumption and Monetary Policy: A Financial Accelerator Approach", *Journal of Financial Intermediation*, vol 13, issue 4, pp 414-35.

[3] Ayuso, J and F Restoy (2006): "House Prices and Rents: An Equilibrium Asset Pricing Approach", *Journal of Empirical Finance*, vol 13, pp 371-88.

[4] Ballesteros, M (2002): "Rethinking Institutional Reforms in the Philippine Housing Sector", *PIDS Discussion Paper* no 2002-16. Philippine Institute for Development Studies, Makati City, Philippines.

[5] Bernanke, B and M Gertler (1995): "Inside the Black Box: The Credit Channel of Monetary Policy", *Journal of Economic Perspectives*, vol 9, no 4, pp 27-48.

[6] Bernanke, B, M Gertler and S Gilchrist (1994): "The Financial Accelerator and the Flight to Quality", *Review of Economics and Statistics*, vol 78, pp 1-15.

[7] Borio, C and P McGuire (2004): "Twin Peaks in Equity and Housing Prices?" *BIS Quarterly Review*, March, pp 79-93.

[8] Brunnermeier, M and C Julliard (2007): "Money Illusion and Housing Frenzies", *Review of Financial Studies*, forthcoming.

[9] Campbell, J and J Cocco (2007): "How do House Prices Affect Consumption? Evidence from Micro Data", *Journal of Monetary Economics*, vol 54, pp 591-621.

[10] Capozza, D, P Hendershott, C Mack and C Mayer (2002): "Determinants of Real House Price Dynamics", *NBER Working Paper* no 9262, October.

[11] Case, K, J Quigley, and R Shiller (2005): "Comparing Wealth Effects: The Stock Market versus the Housing Market", *Institute of Business and Economic Research Working Papers*, no W01-004.

[12] CGFS (2006): "Housing Finance in the Global Financial Market", Committee for Global Financial System Publications, No 26, Basel.

[13] Chan, E, M Davies and J Gyntelberg (2006): "The Role of Government-Supported Housing Finance Agencies in Asia", *BIS Quarterly Review*, December, 71-83.

[14] Chen, N K (2001): "Bank Net Worth, Asset Prices and Economic Activity", *Journal of Monetary Economics*, vol 48, pp 415-36.

[15] Chiquier, L (2006): "Housing Finance in East Asia", in S Ghosh (ed), *East Asian Finance Flagship Book*, World Bank.

[16] Cocco, J (2004): "Portfolio Choice in the Presence of Housing", *Review of Financial studies*, vol 18, no 2, pp 535-67.

[17] Coleman, A (2007). "Credit Constraints and Housing Markets in New Zealand", *RBNZ Discussion Paper* no 2007/11.

[18] Cruz, P C (2006). "Inflation, Politics and Government Intervention: How Asian Residential Markets Have Suffered", *Global Property Guide*, November 8.

[19] Davis, E P and H Zhu (2004): "Bank Lending and Commercial Property Cycles: Some Cross-Country Evidence", *BIS Working Papers*, no 150.

[20] Diamond, D and M Lea (1992): "Housing Finance in Developed Countries: An International Comparison of Efficiency", *Journal of Housing Research*, vol 3, issue 1, pp 1-260.

[21] ECB (2003): "Structural Factors in the EU Housing Markets", European Central Bank, March.

[22] Égert, B and D Mihaljek (2007): "Determinants of House Prices in Central and Eastern Europe", *BIS Working Papers*, no 236.

[23] Ellis, L (2006). "Housing and Housing Finance: The View from Australia and Beyond", *RBA Research Discussion Paper* no 2006-12.

[24] Estrella, A (2002): "Securitization and The Efficacy of Monetary Policy", *FRBNY Economic Policy Review*, May, pp 243-55.

[25] Gan, J (2007): "Collateral, Debt Capacity, and Corporate Investment: Evidence from a Natural Experiment", *Journal of Financial Economics*, forthcoming.

[26] Garmaise, M and T Moskowitz (2004): "Confronting Information Asymmetries: Evidence from Real Estate Markets", *Review of Financial Studies*, vol 17, no 2, pp 405-37.

[27] Gerlach, S and W Peng (2005): "Bank Lending and Property Prices in Hong Kong", *Journal of Banking and Finance*, vol 29, pp 461-81.

[28] Girouard, N and S Blöndal (2001): "House Prices and Economic Activity", *OECD Economics Department Working Papers*, no 279.

[29] Green, R, S Malpezzi and S Mayo (2005): "Metropolitan-Specific Estimates of the Price Elasticity of Supply of Housing, and Their Sources", *American Economic Review Papers and Proceedings*, vol 95, no 2, pp 334-39.

[30] Hegedüs, J and R Struyk (2005): *Housing Finance: New and Old Models in Central Europe, Russia, and Kazakhstan*, Published by Local Government and Public Service Reform Initiative, Open Society Institute-Budapest.

[31] Helbling, T and M Terrones (2003): "When Bubbles Burst", in *World Economy Outlook*, International Monetary Fund, pp 61-94.

[32] Herring, R and S Wachter (1999): "Real Estate Booms and Banking Busts: An International Perspective", Center for Financial Institutions Working Papers, no 99-27, University of Pennsylvania.

[33] Hilbers, P, Q Lei and L Zacho (2001): "Real Estate Market Developments and Financial Sector Soundness", *IMF Working Paper*, no WP/01/129.

[34] Himmelberg, C, C Mayer and T Sinai (2005): "Assessing High House Prices: Bubbles, Fundamentals and Misperceptions", *Journal of Economic Perspectives*, vol 19, no 4, pp 67-92.

[35] Hofmann, B (2004): "Bank Lending and Property Prices: Some International Evidence", Working Paper.

[36] Kalra, S, D Mihaljek and C Duenwald (2000): "Property Prices and Speculative Bubbles: Evidence from Hong Kong SAR", *IMF Working Paper WP/00/2*.

[37] Kiyotaki, N and J Moore (1997): "Credit Cycles", *Journal of Political Economy*, vol 105, issue 2, pp 211-48.

[38] Krainer, J, M Spiegel and N Yamori (2005). "Asset-Price Decline and Real Estate Market Illiquidity: Evidence from Japanese Land Values", *Federal Reserve Bank of San Francisco Working Paper* no 2004-16, Center for Pacific Basin Studies.

[40] Lee, C M and S H Choi (2007): "Three Dimensional Interpretation of the Korean Housing Market: Structural Relationship among Sales, Chonsei, and Monthly Rent Markets", paper presented at the 12th Asian Real Estate Society Annual Conference, July 9-12, Macau, China.

[40] Leung, C and N K Chen (2006): "Intrinsic Cycles of Land Price: A Simple Model", *Journal of Real Estate Research*, vol 28, no 3, 293-320.

[41] Leung, C, G Lau and Y Leong (2002): "Testing Alternative Theories of the Property Price-Trading Volume Correlation", *Journal of Real Estate Research*, vol 23, no 3, pp 253-64.

[42] McCarthy, J and R Peach (2002): "Monetary policy transmission to residential investment", FRBNY Economic Policy Review, May, 139-158.

[43] Medium-Term Philippine Development Plan, 2004-2010 (2005). National Economic and Development Authority (NEDA), Pasig City, Philippines.

[44] Ng, A (2006): "Housing and Mortgage Markets in Malaysia", in B Kusmiarso (ed), *Housing and Mortgage Markets in the SEACEN Countries*, SEACEN.

[45] OECD (2005): *Housing Finance Market in Transition Economies: Trends and Challenges*, OECD publication, ISBN-92-64-010165.

[46] Peek, J and J Wilcox (2006): "Housing, Credit Constraints, and Macro Stability: The Secondary Mortgage Market and Reduced Cyclicality of Residential Investment", *American Economic Review Papers and Proceedings*, May, pp 135-40.

[47] Sing, T F and S E Ong (2004): "Residential Mortgage-Backed Securitization in Asia: The Singapore Experience", *Journal of Real Estate Literature*, vol 12, no 2.

[48] Subhanij, T (2007): "Some Lessons from Securitisation Crisis", *Bangkok Post*, Business news, 13 July 2007.

[49] Sutton, G (2002): "Explaining changes in house prices", *BIS Quarterly Review*, September, pp 46-55.

[50] Tsatsaronis, K and H Zhu (2004): "What Drives Housing Price Dynamics: Cross-Country Evidence", *BIS Quarterly Review*, March, pp 65-78.

[51] Warnock, V and F Warnock (2007): "Markets and Housing Finance", mimeo.

[52] Wheaton, W (1999): "Real Estate 'Cycles': Some Fundamentals", *Real Estate Economics*, vol 27, pp 209-30.

[53] Wong Partnership (2007): "Land Appreciation Tax to be Strictly Enforced", *China Watch*, January 31.

[54] Yao, R and H Zhang (2005): "Optimal Consumption and Portfolio Choices with Risky Housing and Borrowing Constraints", *Review of Financial Studies*, vol 18, no 1, pp 197-239.

[55] Zhu, H (2006): "The Structure of Housing Finance Markets and House Prices in Asia", *BIS Quarterly Review*, December, pp 55-69.

Appendix

A Housing market structure and institutional framework in Asia

Australia

Land tenure in Australia is predominantly freehold with the exception of Canberra which is largely leasehold. Freehold titling is governed by three primary systems, the old system, the Torrens title and strata title. The Torrens title evidenced by a Certificate of Title is the most common form of freehold title while strata title applies to multi-unit housing.

In purchasing land or property, foreign corporations and individuals require the approval of the foreign Investment Review Board of the Federal Treasury. Applications for commercial real estate and new residential developments are normally approved but applications for second-hand residential properties are normally refused. Variable rate with longer term credit is the norm and the degree of securitization is most advanced among surveyed countries. This has been spurred by the rise of specialist lenders beginning mid-1990s which resulted in heightened competition, product innovation and reduction in the spread between mortgage interest rate and cash rate. These new breed of lenders have been largely responsible for the substantial market for securitized mortgage debt.

The Australian housing market is characterized by high rate of home ownership and government policies were noted to have favored such. Imputed rental income and capital gains on sale of owner-occupied property are tax exempt. However, interest payments on owner-occupied mortgage debt is not tax-deductible, thus, creating an incentive for households to pay down mortgage debt quickly. In addition, the run-up in house prices has been associated with rising housing debt, a trend that has been ascribed to the disinflation and fall in nominal interest rates over the 1990s. This has allowed households to service larger mortgages in the process.

China

While all lands in China remain government-owned, transfer of land use rights for value was implemented in 1988. The maximum leasehold periods for residential, industrial/mixed-use, and commercial properties were 70, 50, and 40 years, respectively. This milestone reform event eventually set the pace and direction of housing market reforms in China. In 1991, the city of Shanghai pioneered the Housing Provident Fund (HPF) scheme, from which the nationwide HPF, implemented in 1994, was patterned after.

In 1998, the welfare housing system for public sector employees was abolished. In lieu of housing allocation, one-time housing subsidy was provided to facilitate acquisition of existing public housing stock. It was reported that as of January 2001, 80 percent of allocated public housing had already been sold to the workers. This was followed by a number of regulatory reforms. Private sector developers were permitted to engage in new residential projects. The People's Bank of China

(PBoC) released the rules on residential mortgage lending, which were initially participated in by developers. Private sector housing market grew remarkably since then. By 2005, the subsidized segment of the private housing market was mere 10 percent as majority were already traded in market prices (Zhu, 2006).

To contain unabated price appreciation and speculation in the real estate market, new country-level regulations were issued beginning 2003. On that year, the sale of additional land to developers for villa use was restricted to ensure that lands for which mortgage loans were availed of are really developed for intended purpose. Shanghai went as far as reducing floor area ratios. In 2004, the use of loans to purchase land was banned, thereby, effectively requiring developers to put up cash upfront to acquire land. In 2005, the People's Bank of China (PBoC) put an end to preferential mortgage rates. New taxes were imposed, i.e., capital gains tax on properties held for less that two years and idle land tax. In addition, mortgage transfer was prohibited such that borrowers were required to pay off the entire loan before selling the property. On December 28, 2006, China's State Administration of Taxation set out new requirements and procedures for the strict enforcement of land appreciation tax, which ranges between 30 to 60 percent (Wong Partnership, 2007).

Hong Kong SAR

The land use rights system in Hong Kong is similar to China's but with a lower leasehold period of 50 years. The housing market is relatively active. The number of primary and secondary market transactions as a proportion of the outstanding housing stock was 7.7 percent in 2006. The use of the services of real estate agents is common, particularly in the secondary market. Property transactions are not subject to a capital gains tax.

Residential mortgage loans account for a sizeable portion of the banking sector's loan portfolio. Most homebuyers of private residential property obtain finance from commercial banks, which provide mortgages at variable, market-determined rates. The limit on the loan-to-value ratio is 70 percent.

The Hong Kong SAR government's involvement in the housing market is seen to mainly to come through two channels: the provision of subsidized rental housing to lower-income households, and the provision of land for private residential development. Land sales are conducted through the Application List system, under which each year the government announces a land bank containing sites available for sale in the next financial year (the application list). Developers can make an offer on a listed site to the government, and if the offer is above the government's undisclosed reserve price, the government arranges an auction for the site. The Application List system was introduced following the Asian financial crisis in place of scheduled public auctions, in efforts to make the supply of land a more market-driven process. In 1985, land supply restrictions were introduced but were later abolished during the handover in July 1997.

Hong Kong's residential housing market underwent considerable volatility in the decade since the Asian financial crisis. House price fell over 60 percent from its peak in 1997 to a trough in 2003, which then turned around and climbed 70 percent from the low base as the economy rebounded.

The high-end of the market saw an even more robust recovery in prices.

Korea

Three types of property tenure/ownership exist, namely, free simple or freehold title, strata title and leasehold but mostly for short-term. Rapid urbanization and industrialization resulted in a surge in demand for urban land as most of the population live in towns and cities. This makes housing very expensive in Korean cities, especially in Seoul. The market was noted to have heated up dramatically at least three times during the past 30 years: the late 1970s, early 1990s and early 2000s.

The high cost of residential housing has largely been traced to supply shortage combined with a high population density. The shortage had its roots in the wartime destruction of a large part of the existing stock as well as the north-to-south migration of over a million people during and after the Korean War. The initial gap between housing units and households was made larger by high population growth in the 1960s, rural to urban migration and changes in the family structure in the 1970s and 1980s. In addition, most of Korean land is privately owned. The state has less than 20 percent of the land and is considered quite low compared with other countries. Public land is used mostly for infrastructure and is not marketable.

The environment of housing shortages, high inflation, and financial repression led to an informal housing finance system known as the *chonsei*. Chonsei is a unique rental contract in the Korean housing market, in which the tenant pays an upfront deposit in the beginning of the contract period with no requirement for paying the monthly rent. The deposit is fully refundable at the end of the contract period. The income from the deposit during the contract period is equivalent to rental income that accrues to the landlord. Chonsei has become less important as a financing mechanism in recent years as monthly rental contracts and mortgage financing have become more popular (Lee and Choi, 2007).

Prior to the deregulation, public housing finance accounted for more than 80 percent of Korean housing finance market. Mortgage loans are mostly extended on short-term basis. Implicit financing through pre-sales was also provided by home builders. Most new apartments are pre-sold with a twenty percent down payment and the rest is paid installments over a roughly two year period during which time the apartments get built. The primary mortgage market used to be dominated by the National Housing Fund (NHF) that provided below-market loans to low to moderate-income households and the Korea Housing Bank (KHB) which catered to higher income customers. Gradually, housing finance was deregulated. In 1996, commercial banks were allowed to provide long-term mortgages. In 1997, KHB was privatized.

As in most of Asia, residential real estate prices in Korea fell substantially after the Asian crisis. Consequently, chonsei deposit also dropped and developers providing implicit finance went into bankruptcy. Since many houses purchased for investment purposes were financed through chonsei deposit, the declining deposit was equivalent to reduced mortgage financing, which further depressed demand for home purchases. After the crisis, most government controls over the housing

market were relaxed, the most important of which was the phasing out of the housing price control system in February 1998. This, however, did not lead to increased competition and lower price because the Korean housing market remains dominated by a few property developers.

With the recovery of the housing market since 2000, housing finance also expanded but was dominated by short-term loans with floating rates. In 2004, the Korean Housing Finance Corporation (KHFC) was established to provide more liquidity and allow for the lengthening of the maturity of mortgage loans. KHFC purchases long-term fixed rate mortgages from commercial banks and packages them into mortgage-backed securities (MBS).

The recent rapid house price growth was believed to have fed speculative demand for housing that relied on expectation of future price increases. Against this backdrop, to further quell speculation, the capital-gains taxes on people who own two houses was raised from nine and 36 percent previously to a flat rate of 50 percent. Those with three or more homes in designated Speculation Zones may have to pay up to 82 percent in capital gains taxes, an increase from the 60 percent. The plan was to be implemented in 2007, after a 1–2 year grace period to encourage the owners to dispose of their extra homes. Furthermore, the government toughened lending policies by lowering loan-to-value (LTV) and debt-to-income (DTI) ratios, making it more difficult for people to obtain loans to buy homes.

Malaysia

Freehold and leasehold (30, 60 and 99 years) are the two types of tenure. Since the 1990s, residential property transactions have accounted for a sizeable portion of total real estate transactions, both in volume and value (Ng, 2006). This trend has been aided by the Malaysia Government's thrust towards promoting access to comfortable living and affordable housing especially for the lower-income group. Significant portion of development spending was allocated to housing development in successive five-year Malaysia Plans since 1971. Financial support as well as incentives have been provided under various programs. Malaysia has the lowest house-price-to-income ratio in Asia.

While the recent run-up in house prices is driven by strong demand for luxury properties, more subdued price increases in the mass market have been attributed to oversupply and the government's attempt to make housing more affordable. By end-2006, property overhang in the residential market increased by about 68 percent. It was observed that the average sales performance of new launches of residential property had been on a downward trend since 2002 and only started to pick up in the third quarter of 2006.

In terms of housing finance, banking institutions (commercial banks, finance companies, Islamic banks and merchant banks) are by far the biggest primary market lenders in providing financing for the purchase of residential properties. Apart from banking institutions, development finance institutions such as the National Savings Bank, Cooperative Bank, Malaysian Building Society Berhad and Borneo Housing Finance Berhad; and a number of insurance companies also provide financing for the purchase of residential properties. The Treasury Housing Loan Division (THLD)

of the Ministry of Finance is also involved in the housing loan market by providing end-financing to public-sector employees.

Typically, banking institutions in Malaysia would offer two types of mortgage loans: conventional housing loans and Islamic house financing. Islamic house financing products generally share the same characteristics as normal housing loan products but are based on the concept of Bai Bithaman Ajil (BBA). BBA or Deferred Payment Sale refers to the sale of goods on a deferred payment basis at a price that includes a profit margin agreed upon by both the buyer and the seller. Islamic house financing is mostly fixed rate financing, but as of 2003, banking institutions have begun to offer variable-rate Islamic house financing products.

Mortgage securitization has been the domain of the National Mortgage Corporation (Cagamas), which was set up in 1988. Cagamas is the main issuer of mortgage-backed securities backed up by housing loans purchased from banking institutions. Cagamas not only catalyzed the expansion of the Malaysian mortgage market but also encouraged the increased participation of banking institutions in the market. Prior to the advent of securitization, banks were less than eager to extend housing loans. Securitization allowed them to obtain competitively-priced funds, gain profits and diversify their housing loan products and lengthen the term of housing loans from 15 years to 25 or 30 years (Ng, 2006).

New Zealand

The Torrens title is the predominant method of land titling in New Zealand. Migration and credit were noted to have played a strong role in house price developments in New Zealand. Only limited land and property tax applies. Government support in the housing market mainly through the management and provision of rental housing for low income families at subsidized rates. Public and social housing comprise about six percent of housing stock.

Prior to 1984, the New Zealand mortgage market was heavily regulated and access to bank mortgage finance was limited. These mortgages were subject to fairly stringent terms and conditions such as limit on loan-to-value ratio and the mortgage-repayment-to-income ratio (the ratio of the mortgage repayment obligation to gross income). After the sector was deregulated during the 1980s, new types of mortgages such as revolving credit mortgages with more flexible terms were introduced. In the 1990s commercial banks further relaxed the terms of their mortgages in an effort to increase their client base in the residential mortgage market, thus, enabling some classes of borrowers to substantially increase the amount they could borrow to approximately thirty percent more than they previously could (Coleman, 2007). Unlike Australia, mortgage securitization is limited.

Philippines

There are two types of tenure in the Philippines, namely, the freehold tenure and leasehold system. The private freehold is open only to Filipino citizens or corporations with at least 60 percent equity held by Filipinos. Foreigners are not permitted to own land except through hereditary succession.

They are allowed, however, to purchase condominium units (subject to the Condominium Act) or lease land for a maximum of 75 years. To date, rent controls are still in effect. The latest version of the law allows an increase of no more than 10 percent per year during the three-year extension period (ending in December 2007).

The institutional set-up for housing development revolves around the provision of housing assistance to the low and low-middle income households. The government housing finance system consists of various government agencies with finance-linked subsidies such as those by the Home Development Mutual Fund (HDMF), Government Service Insurance System (GSIS) and the Social Security System (SSS), which are intended to benefit the low income classes. Many studies have noted that the eligibility requirements for availing of a mortgage loan have tended to benefit more the non-poor (Ballesteros, 2002; Chiquier, 2006; MTPDP, 2004-2010). In the aftermath of the Asian crisis, a regulatory limit of no more than 20 percent of total loan portfolio can be extended to the real property sector.

In the aftermath of the Asian crisis, the Bangko Sentral ng Pilipinas (BSP) imposed statutory limit of 30 percent on the share of real estate loans to the total loan portfolio. Maximum loan-to-value ratio was set at 60 percent but 70 percent was allowed for real estate loans less than Php 3.5 million and housing loans guaranteed under the government's National Shelter Program. In an effort to clean up non-performing assets of financial institutions, the Special Purpose Vehicle Act was enacted in 2002.

Singapore

About 90 percent of land in Singapore is owned by the government and its statutory boards. Land is mainly sold on leasehold interests up to 99 years. In terms of the mechanism of land sale, there is both a reserve list and a confirmed list. Under the reserve list, the government will only release a site for sale if an interested party submits an application for the site to be put up for tender with an offer of a minimum purchase price that is acceptable to the government. Sites under the confirmed list are released for tender at a pre-determined date, without the need for the sale to be triggered by an application.

Singapore has an extensive public housing finance system that caters to all income classes. A notable feature of the Singapore housing market is that both public and private property buyers can use their savings in the Central Provident Fund (CPF) – a mandatory social security savings plan – to make downpayments and monthly mortgage repayments. A majority of the homeowners fund their home purchases through the Central Provident Fund. For the purchase of private housing units, commercial banks also provide mortgages at market rates. The loan period is typically 25 – 30 years and loan amount up to seven times the household annual income.

The Housing Development Board (HDB) oversees the entire gamut of housing-related programs from planning and development to housing management and housing finance. Subsidized loans are granted to first-time buyers or to second-time homebuyers who upgrade to another HDB flat. With easy access to concessional financing, it is not surprising that Singapore has the highest home

ownership rate at 93 percent (2000 Census). As the majority of citizens are eligible for government-provided housing (also called HDB flats for the Housing Development Board), the public housing market constitutes over 80 percent of the housing stock. There is an authorized resale market for public housing units, through which households could trade their public houses after fulfilling a five-year minimum occupancy requirement. The market is active and prices are market determined.

Notwithstanding the dominance of public housing, the Singapore government has taken measures to encourage the development of private housing since the 1990s and the share of private housing has increased steadily. Capital gains made by households in the public housing market are often a source of down payments for the purchase of private houses.

Thailand

Ownership, possession and use of land in Thailand come under two types of tenure: Freehold and leasehold. Foreigners are not allowed to purchase land, except when they invest at least 40 million baht in a Board of Investment (BOI)-approved project. The Bank of Thailand also prohibits mortgage lending to foreigners. They are, however, allowed to buy condominium units provided that they do not make up more than 40 percent of the condominium's unit-owners. In addition, under the law on property leasing (May 1999), foreigners doing business in Thailand were allowed to lease real property primarily for commercial or industrial purposes as well as to lease land for at least 30 years but not exceeding 50 years, renewable for another 50 years. If a lease involves more than 100 rai (40 acres), prior approval is needed from the Land Department.

The Thai primary mortgage market is dominated by domestic commercial banks, with current market share of 51.4 percent followed by the Government Housing Bank (GHB), with market share of 39.4 percent and the Government Savings Bank (GSB), with market share of around nine percent. Commercial banks usually compete for middle and high income segments (many mortgage loans in the range of 1-5 million baht), whereas GHB has been serving rather moderate income households. After the 1997 crisis, the GHB experienced higher housing loan growth than domestic commercial banks. This is largely due to the low GHB's lending rates and the rapid expansion of its branch network. The market share of GHB is even higher for the newly originated credits in 2006, around 47 percent. The combined market shares of both GHB and GSB represent 48 percent of the outstanding mortgage debt and 56 percent of the new mortgage loans.

Thai banks generally tend to favor new housing due to their commercial relationship with developers. Resale housing transactions are financed by banks with tighter loan-to-value ratios (70% to 80% ceilings). Most mortgage contracts are hybrid floating rate mortgages, which entail fixed interest rates up to the first 3 years and floating rates afterwards. Typically, the maximum length of the mortgage contract is 25-35 years, subject to the condition that the contract length plus the borrower's age must not exceed 60-65 years.

Developers pre-finance lending is mostly provided by commercial banks. This level of outstanding debt has remained constant at just below 200 billion baht for the last three years as commercial banks lend mostly to the largest and reputable developers, who have also been issuing limited

volume of debentures through bond markets. The industry is concentrated with the largest five property developers, representing 60 percent of the business of all listed developers.

The residential property market is also helped by a number of direct and indirect government subsidies for housing. Direct subsidies are those that come through the budgetary system, of which the government's large-scale housing project 'Baan Eau-Athorn' is the most important. Indirect subsidies are those that come through the tax system as income tax deductions and exemptions and various forms of tax relief in the acquisition and transfer of real estate.

B Data sources and definitions

1. HOUSE PRICES

Country	Series definition	Sources	Remarks
Australia	Residential property price index	national source	Weighted average of 8 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 SAR	(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) Top 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.
Malaysia	(i) Residential house price index; (ii) Capital value of luxury residential property in Kuala Lumpur	(i) National source; (ii) CEIC	(i) Nationwide, all dwellings (per sq.m) 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) Top 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 the total current valuations of the relevant local authorities combined and used to calculate the current average valuation for each quarter. These current valuations are then used to calculate the price index using sales price
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) Top capital value for a prime quality residential property in the best location in Manila, Makati and Ortigas Center.
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) Top capital value achievable 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 douse and town house, including land (hedonic method); (ii) Top capital value achievable for a prime quality residential property in the best location in Bangkok

2. CONSTRUCTION COST

Country	Series definition	Sources	Remarks
Australia	Residential construction, input prices, materials	national source	
China			not available
Hong Kong SAR	Gross construction output, deflator	CEIC	
Korea	Producer price index; Raw & intermediate materials for construction	Datastream	
Malaysia	Construction cost, buildings, 2-4 Storey, Flat Roof	CEIC	Same source: city-level (Johor, Kuala Lumpur, Pahang, Perak and Pinang) information is also available.
New Zealand	Producer price index (output) for construction	National source	
Philippines	CPI Construction materials	NSO	
Singapore	Building materials	CEIC	
Thailand	Construction Material; price index	BOT	

3. LAND SUPPLY INDEX (MOSTLY BUILDING PERMIT)

Country	Series definition	Sources	Remarks
Australia	Construction, new dwellings started, units; seasonally adjusted	national source	
China	Building Construction: area completed: total (thousands of sq m)	CEIC	Same source: city level (Beijing, Chongqing, Guangzhou, Shanghai, Shenzhen and Tianjin) information is also available.
Hong Kong SAR	Private residential buildings authorized to commence work; gross area	CEIC	
Korea	Buildings authorized for construction, total; units (seasonally adjusted)	CEIC	Same source: city level (Busan, Daegu, Daejon, Gwangju, Incheon, Seoul and Ulsan) information is also available.
Malaysia	Housing approvals for construction, private developers; units	CEIC	
New Zealand	Residential construction permits issued (value) deflated by construction cost	national source	
Philippines	Building permits (number)	NSO	Building permits (values) also available
Singapore	Land sales (sq m); quarterly interpolated	HKMA	Annual data
Thailand	Land development licences nationwide (unit)	BOT	Nationwide series backdated using Bangkok data (also available for residential land development only)

4. MORTGAGE RATES

Country	Series definition	Sources
Australia	Variable mortgage rate, housing loans	national source
China	1-year short term lending rate	HKMA
Hong Kong SAR	Weighted average of mortgage rates	HKMA
Korea	Housing loan (replaced now with loans to households which has very similar value but longer series) rates	CEIC
Malaysia	Lending rate: weighted average, commercial banks	CEIC
New Zealand	Variable mortgage rate, housing loans	RBNZ
Philippines	Average lending rate	BSP
Singapore	Rate for 15-year housing loans	HKMA; CEIC
Thailand	Minimum lending rate, prime rate	BOT

5. MORTGAGE CREDIT

It refers to "Housing loans extended from commercial banks to household".
Provided by national sources or CEIC.

6. POPULATION

Country	Sources	Remarks
Australia	CEIC	
China	CEIC	Same source: city level information is also available. Beijing, Chongqing, Guangzhou, Shanghai, Shenzhen and Tianjin are included in this study.
Hong Kong SAR	CEIC	
Korea	CEIC	Same source: city level information is also available. Busan, Daegu, Daejon, Gwangju, Incheon, Seoul and Ulsan are included in this study.
Malaysia	CEIC	Same source: city-level/state-level information is also available. Johor, Kuala Lumpur, Pahang, Perak and Pinang are included in this study.
New Zealand	CEIC	
Philippines	CEIC	
Singapore	CEIC	
Thailand	BOT	Same source: Bangkok and vicinities information is also available and included in this study.

7. GROSS DOMESTIC PRODUCT (GDP)

It refers to "real GDP". Provided by national sources or CEIC.

8. REGULATORY INDICES (ALL COUNTRIES)

Country	Sources	Remarks
Business freedom index	Heritage Foundation	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.
Financial freedom index	Heritage Foundation	Measure of banking security as well as independence from government control.
Corruption Index	Heritage Foundation	Measure of the perception of corruption in the business environment, including levels of governmental legal, judicial, and administrative corruption.
Property Rights Index	Heritage Foundation	Measure of the ability of individuals to accumulate private property, secured by clear laws that are fully enforced by the state.

C Characteristics of house price dynamics

Following Capozza et al (2002), we assume that the adjustment equation of house prices follows:

$$\Delta P_t = \alpha \Delta P_{t-1} + \beta(P^*_{t-1} - P_{t-1}) + \gamma \Delta P^*_t$$

This model specification allows for a rich dynamics of house price movements depending on the size of coefficients α and β. To examine it, we first rewrite the above equation as:

$$P_t - (1 + \alpha - \beta)P_{t-1} + \alpha P_{t-2} = \gamma P^*_t + (\beta - \gamma)P^*_{t-1}$$

Analyzing the corresponding characteristics equation of the second-order difference equation, $b^2 - (1 + \alpha - \beta)b + \alpha = 0$, yields the following results:

1. Case 1: if $\delta \equiv (1 + \alpha - \beta)^2 - 4\alpha > 0$

The characteristics equation has two real and distinct solutions, $b_1, b_2 = \frac{1+\alpha-\beta \pm \sqrt{\delta}}{2}$. In this case, the complementary function of the solution can be written as a linear combination of expressions b_1^t and b_2^t. By assuming $1 + \alpha - \beta > 0$, b_1 is always the dominant root and is always positive. There are three possible outcomes:

(1.A) $\alpha - \beta \geq 1$

In this case, it is obvious that the dominant root $b_1 \geq 1$. Therefore, the house price dynamics is unstable and exhibits divergence from the equilibrium level. The speed of divergence is faster if b_1 is higher, that is, if α is higher or if β is smaller.

(1.B) $\alpha - \beta < 1$ and $\beta \leq 0$

In this case, it can be easily shown that the dominant root b_1 is greater than one. Therefore the system is unstable and exhibits divergence from the equilibrium level. Similarly, the speed of convergence depends on the size of the dominant root, i.e. is faster if α is higher or if β is smaller.

(1.C) $\alpha - \beta < 1$ and $\beta > 0$

In this case, the dominant root b_1 is positive and less than one. Therefore, the dynamics of house price is stable and gradually converges towards the equilibrium level. The speed of convergence is faster if the dominant root b_1 is smaller, i.e. if α is higher or if β is higher.

2. Case 2: if $\delta \equiv (1 + \alpha - \beta)^2 - 4\alpha = 0$

In this case, there are two real and identical roots of the characteristics equation, $b_1 = b_2 = \frac{1+\alpha-\beta}{2}$. There are two possible scenarios. If $\alpha - \beta < 1$, the size of the root is smaller than 1 and the dynamics of house price is stable and exhibits convergence to the equilibrium level (no cycle). If otherwise $\alpha - \beta \geq 1$, the system becomes unstable and the dynamics of house price exhibits divergence from the equilibrium.

3. Case 3: if $\delta \equiv (1 + \alpha - \beta)^2 - 4\alpha < 0$

In this case, the two characteristics roots are conjugate complex, $\frac{1+\alpha-\beta}{2} \pm \frac{\sqrt{-\delta}}{2}$. The complementary function of the solution can be transformed as $R^t[C_1 \cos(\theta t) + C_2 \sin(\theta t)]$, where C_1 and C_2

are two arbitrary constants and $R = \sqrt{\alpha}$ and $\cos\theta = \frac{1+\alpha-\beta}{2\sqrt{\alpha}}$. The dynamics of house price exhibit cyclical fluctuations, but the amplitude of the cycle and the convergence property depend on the value of R (in this case, α). If $\alpha > 1$, R is larger than one and the house price movement exhibits an explosive stepped fluctuation; If $\alpha = 1$, the resulting path displays a symmetric fluctuation around the equilibrium level; If $\alpha < 1$, the fluctuation is mitigated over time and it exhibits a damped stepped fluctuation. On the other hand, the frequency of house price cycles depends on the size of θ, which decreases in α and increases in β.

Case	Sub-case	Time path of house prices	Impact of higher α	Impact of higher β
1. $(1+\alpha-\beta)^2$	1A. $\alpha-\beta \geq 1$	Unstable/divergence	faster divergence	slower divergence
$-4\alpha > 0$	1B. $\alpha-\beta < 1, \beta \leq 0$	Unstable/divergence	faster divergence	slower divergence
	1C. $\alpha-\beta < 1, \beta > 0$	Convergence, no cycle	faster convergence	faster convergence
2. $(1+\alpha-\beta)^2$	2A. $\alpha-\beta < 1$	Convergence, no cycle	slower convergence	faster convergence
$-4\alpha = 0$	2B. $\alpha-\beta \geq 1$	Unstabel/divergence	faster divergence	slower divergence
3. $(1+\alpha-\beta)^2$	3A. $\alpha > 1$	Explosive fluctuation	Higher amplitude,	Higher frequency
$-4\alpha < 0$	3A. $\alpha = 1$	Symmetric fluctuation	lower frequency	of the cycle
	3A. $\alpha < 1$	Damped fluctuation	of the cycle	

Table 1: **House market conditions in selected Asia-Pacific economies**

Country	LTV ratio	Mortgage credit		Government housing finance corporation[1]	Homeownership rates[2]
		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 SAR	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)

Sources: Global Property Guide (2007); Zhu (2006); national sources.

Notes: [1] China and the Philippines have provident fund schemes, with housing loan facility made available to members. Shanghai pioneered the Housing Provident Fund (HPF) scheme in 1991, which became the model for national housing provident scheme introduced in 1994. The Philippines has HDMF, SSS and GSIS (see Appendix A). [2] Various survey years reported in Cruz (2006) for Southeast Asian and East Asian countries and Ellis (2006) for Australia and New Zealand.

Table 2: **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
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. RHR: 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.

Table 3: **Panel regression results**

3.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	

3.B. Short-run house price dynamics
Dependent variable: real house price inflation

	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, and the institutional factor refers to the first principal component of four institutional variables: BFI, FFI, CI and RPI as defined in Table 2. In panel A, all variables (except for 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.

Table 4: **Panel regression based on a country-specific model of house price fundamentals**

4.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[1] 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[2]	-	-	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 a pooled city-level and national level data (panel). All equations are cointegrated at one percent level of significance. Regressors are expressed in logs except for mortgage credit-to-GDP ratio and real mortgage rate. Insignificant explanatory variables are dropped out in the model specification. To avoid simultaneity bias, regressors are instrumented with own lags. [1]Mortgage credit-to-GDP ratio. [2] Real effective exchange rate.

4.B. Short-run house price dynamics
Dependent variable: real house price inflation

	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* INSTITUTION	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	

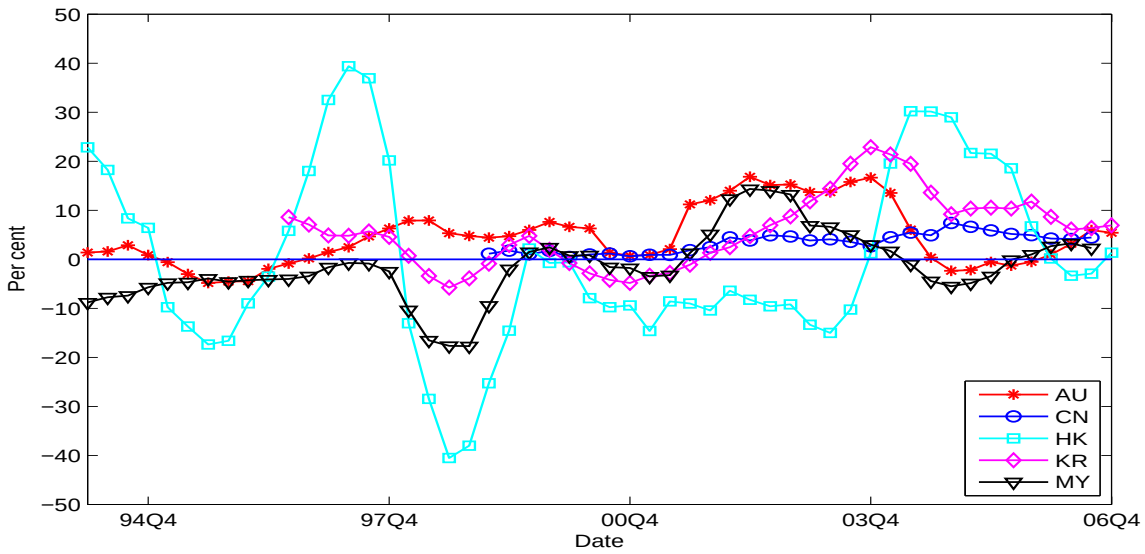
Notes: The regression is based on a panel data of the nine sample economies (with fixed effects). House price fundamentals are determined by the country-specific regression results as reported in Table 4.A. The institutional factor refers to the first principal component of four institutional variables: BFI, FFI, CI and RPI as defined in Table 2.

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 32 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 institutional variables: BFI, FFI, CI and RPI as defined in Table 2. The dummy for major cities (markets) equals one for the following cities (markets): Kuala Lumpur luxury, Bangkok luxury, Manila luxury, HK SAR luxury, Singapore private, Beijing, Shanghai and Seoul.

Figure 1: **House price inflation (yoy) in average residential markets, 1994-2006**



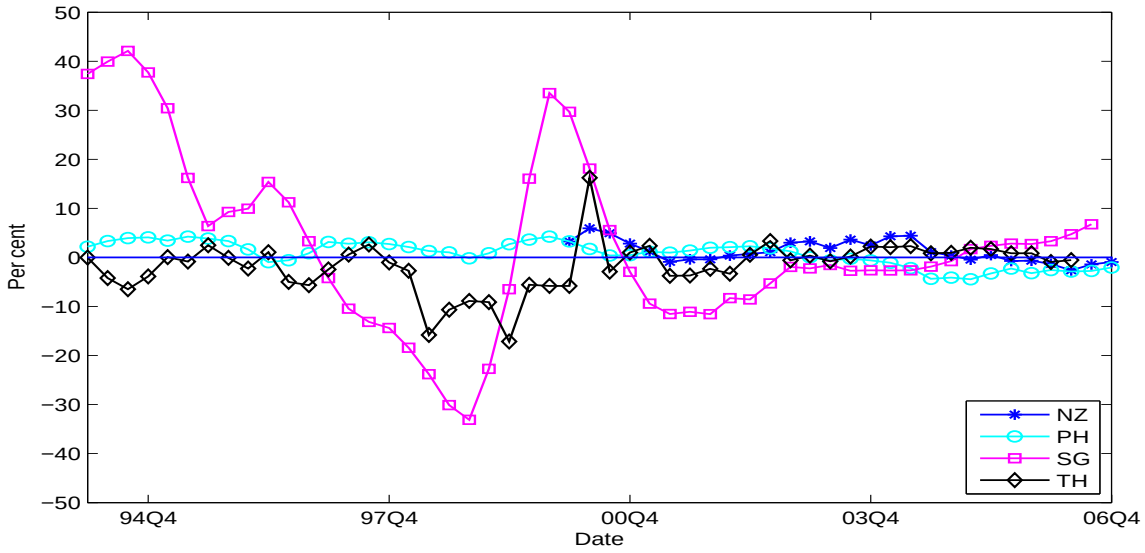
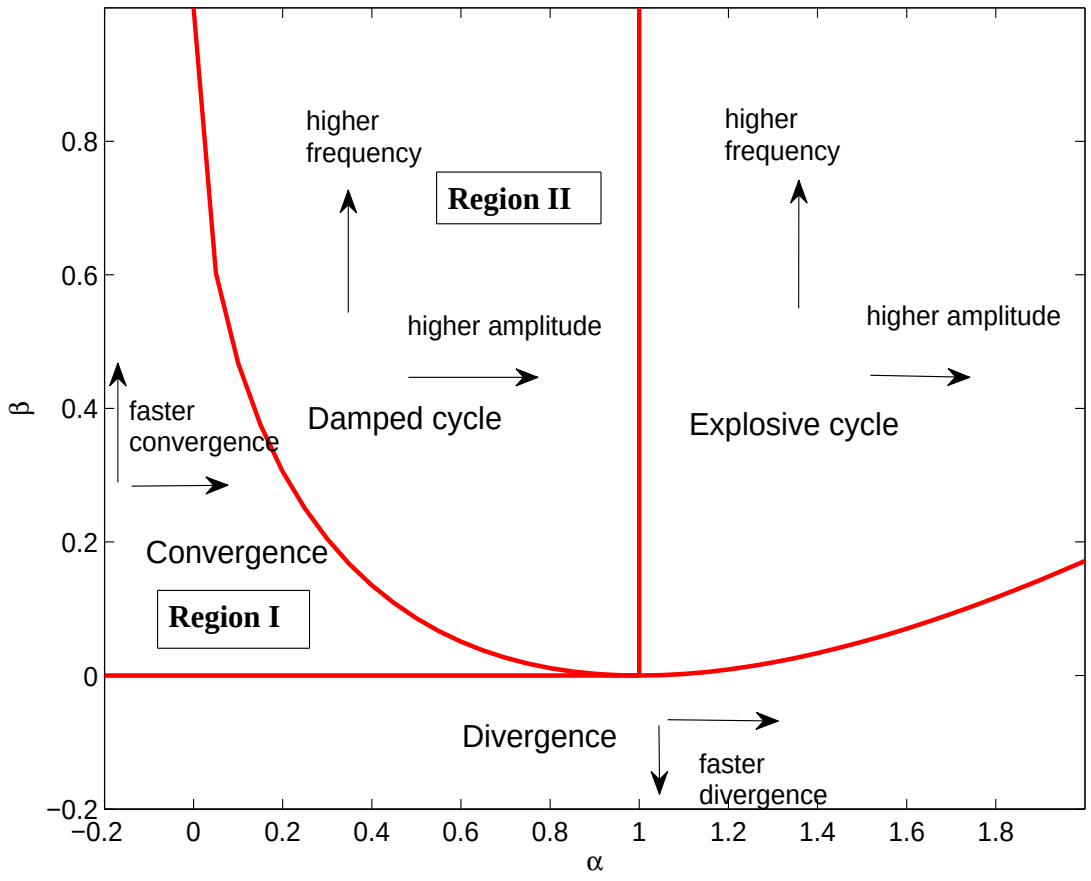
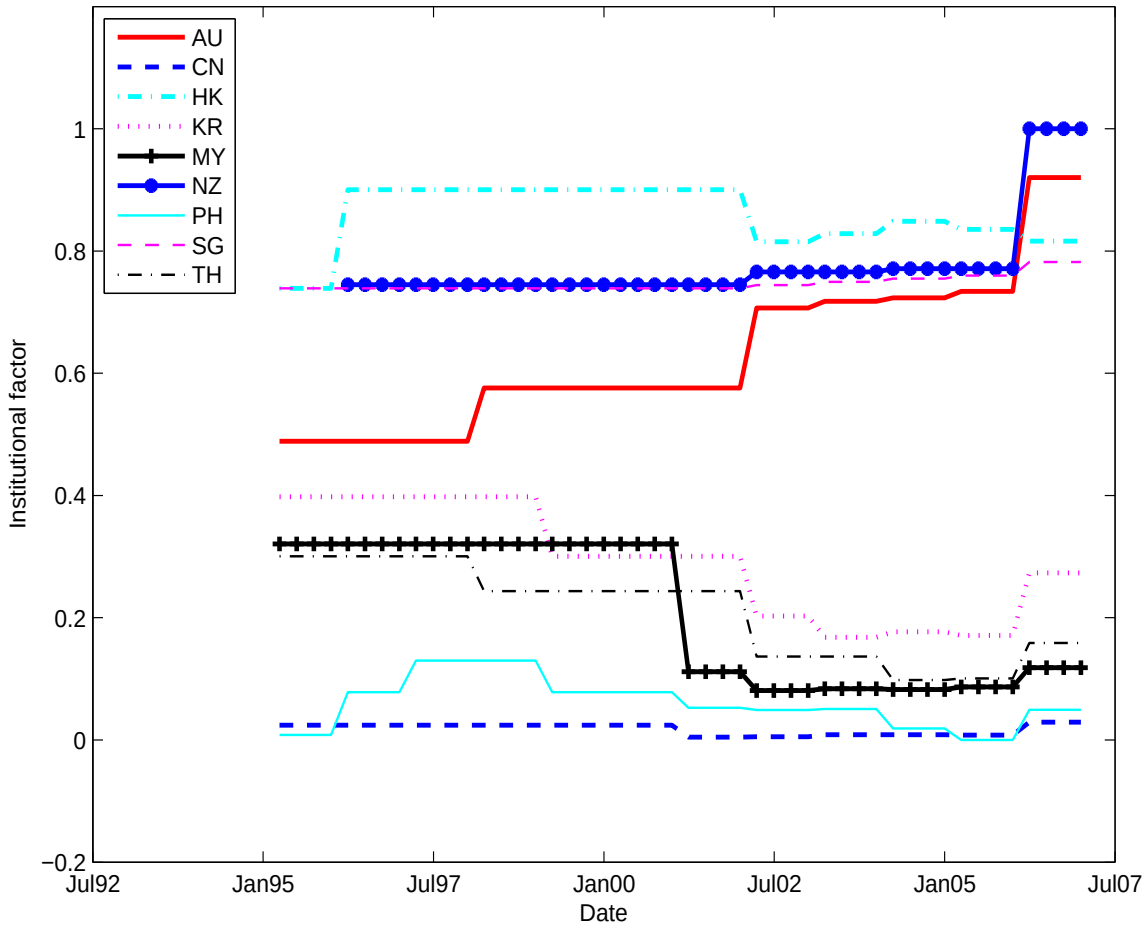


Figure 2: **Characteristics of house price dynamics: Illustration**



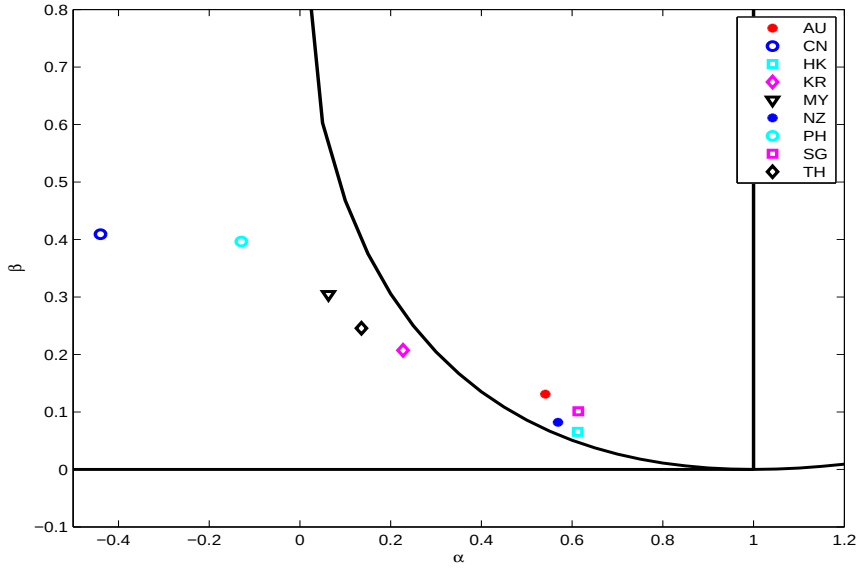
Notes: The figure plots the characteristics of house price dynamics for different combination of persistence (α) and mean-reversion (β) parameters.

Figure 3: **Characteristics of house price dynamics: Illustration**



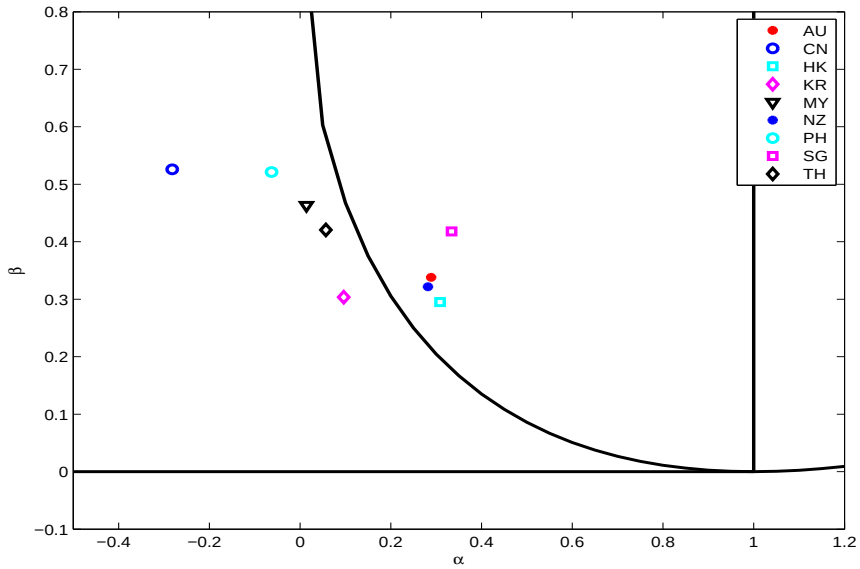
Notes: The figure plots the time series of the institutional factor in each of the nine economies under review. The institutional factor is defined as the first principal component of four index series: the business freedom index, the financial freedom index, corruption index and the property right index.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

Figure 4: **House price dynamics: Panel regression results**



Notes: 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).

Figure 5: **House price dynamics: Baseline results**



Notes: 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.

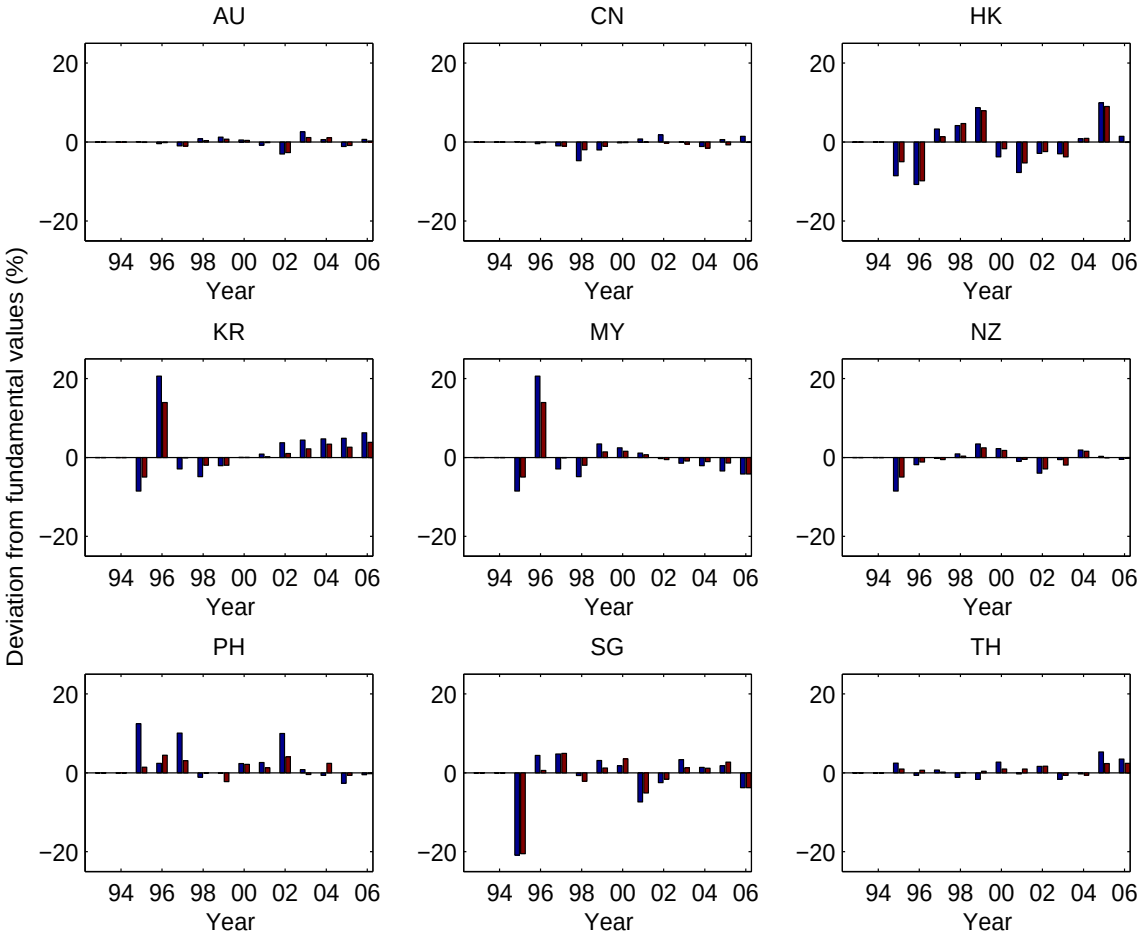


Figure 6: Deviation of country-level house prices from fundamental values

Note: The blue bars represent the average annual deviation of observed house prices from their fundamental values, and the red bars 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.

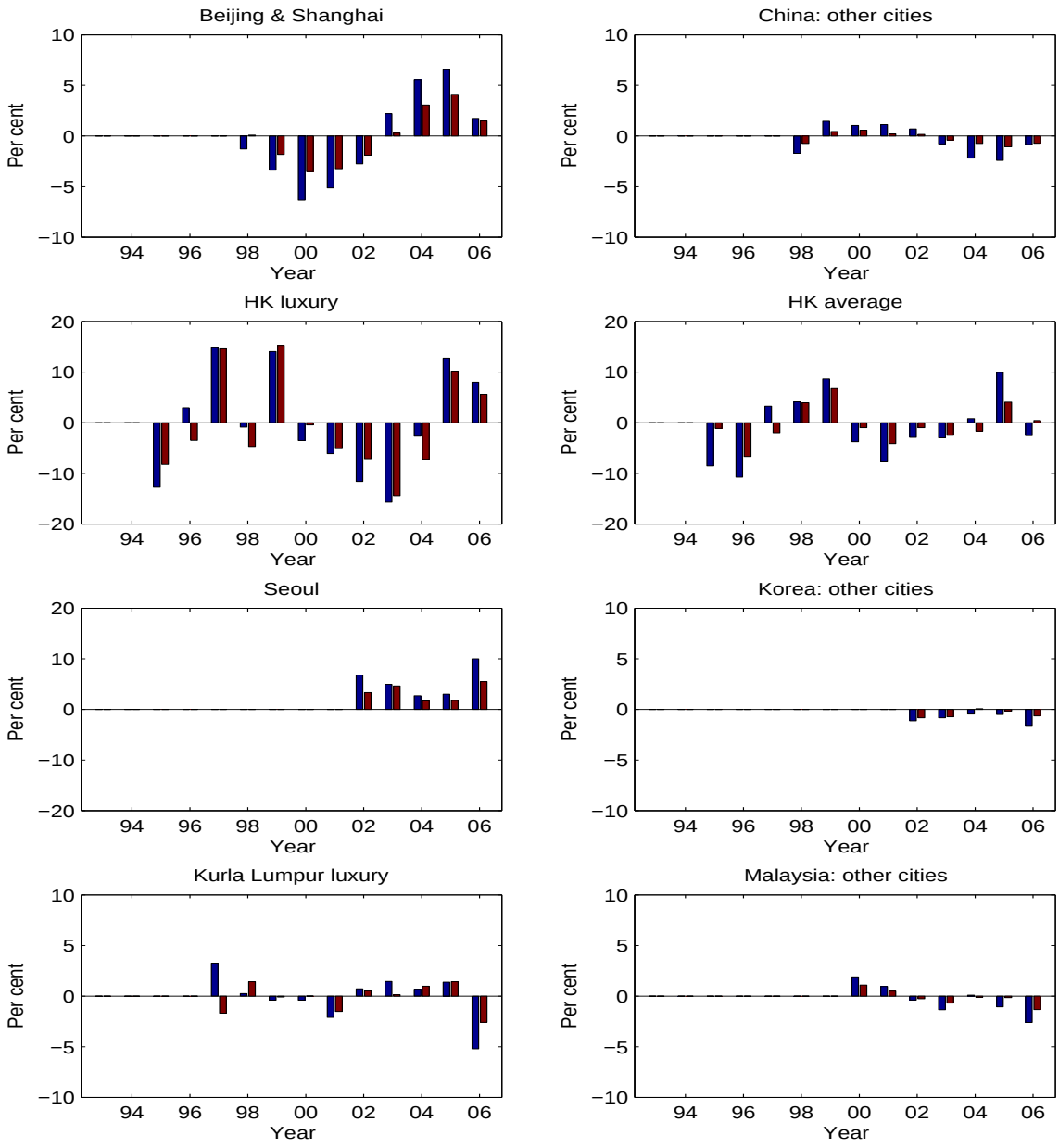


Figure 7: Deviation of city-level house prices from their fundamentals

Note: The blue bars represent the average annual deviation of observed house prices from their fundamental values, and the red bars 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" refer to the average of Chongqing, Guangzhou, Shenzhen and Tianjin. In Korea, "other cities" refer to the average of Busan, Daegu, Daejon, Gwangju, Incheon and Ulsan. In Malaysia, "other cities" refer to the average of Johor, Kuala Lumpur average market, Pahang, Perak and Pinang. In Philippines, "other cities" refer to the average of Caloocan, Makati, Manila average market, Pasay, Pasig and Quezon.

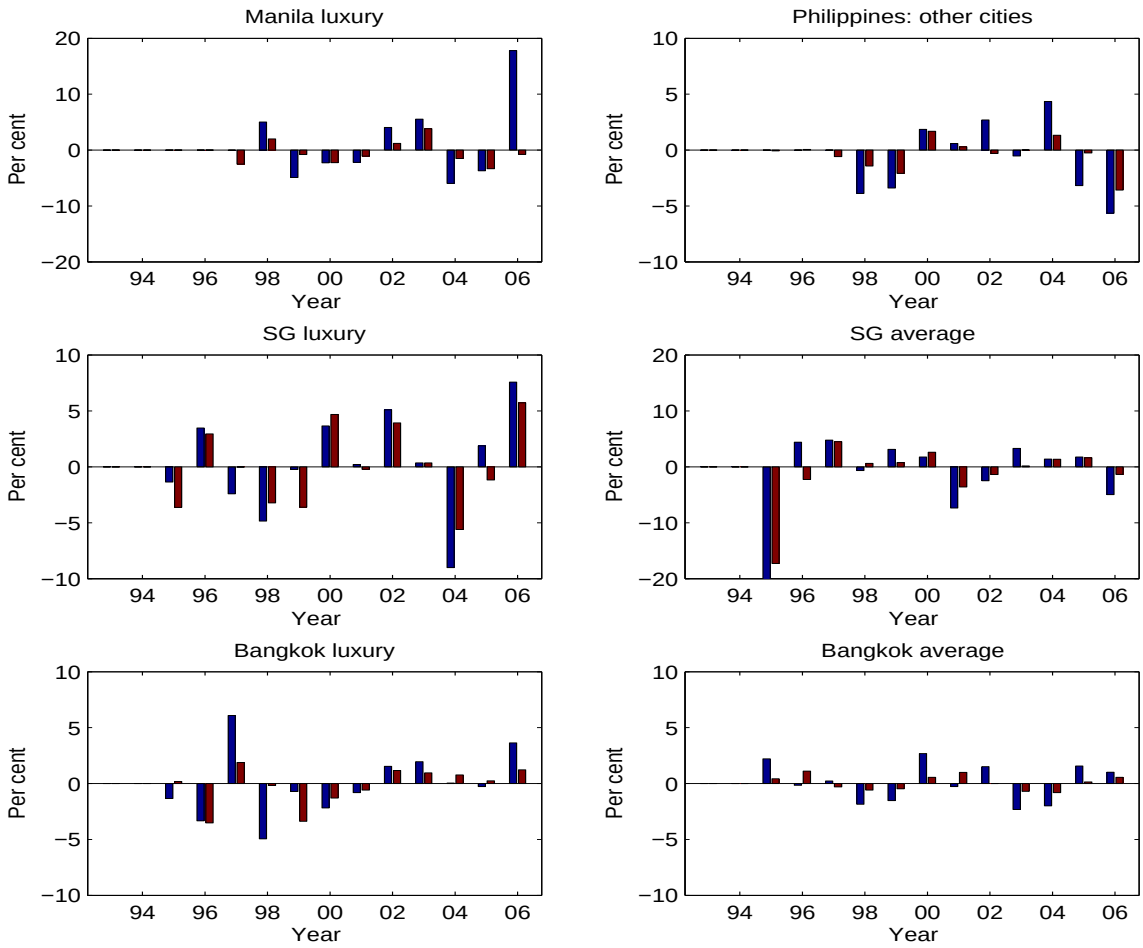


Figure 7: Deviation of city-level house prices from their fundamentals (continued)