Are Asia-Pacific Housing Prices Too High For Comfort? *

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

December 2007

Abstract

The paper investigates the characteristics of house price dynamics and the role of institutional features in nine Asia-Pacific economies. On average, house prices tend to be more volatile in markets with lower supply elasticity and 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. It, however, does not preclude the existence of bubbles in some market segments.

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

*This paper is a joint research project of the Bank for International Settlements, the Hong Kong Monetary Authority, Bangko Sentral ng Pilipinas and the Bank of Thailand 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 Jacob Gyntelberg, Charles Leung, Frank Leung, Pichit Patrawimolpon and workshop participants at HKIMR, BSP and BOT 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 BIS, BOT, BSP and HKMA.

†Center for Monetary and Financial Policy, Bangko Sentral ng Phlipinas, Manila, Phillippines. 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.

¶Research and Policy Analysis, Bank for International Settlements, Basel, Switzerland. E-mail: haibin.zhu@bis.org.

Are Asia-Pacific Housing Prices Too High For Comfort?

Abstract

The paper investigates the characteristics of house price dynamics and the role of institutional features in nine Asia-Pacific economies. On average, house prices tend to be more volatile in markets with lower supply elasticity and 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. It, however, does not preclude the existence of bubbles in some market segments.

JEL Classification Numbers: G12, R31

Keywords: Asia-Pacific economies; House price dynamics; Housing bubble; Housing financing system; Mean reversion; Persistence parameter.

1 Introduction

There are good reasons why the public and policymakers should monitor house price developments closely. In most countries, housing is generally the single largest investment made by households such that house price risk may be considered to be the major risk confronting them (Cocco, 2004; Yao and Zhang, 2005). A sharp fall in residential property prices can lead to serious problems of negative equity loans and higher risk of default, which have the potential to unleash systemic risks, unless promptly mitigated. Compared with financial assets, residential property tends to have a bigger wealth effect (Case et al, 2005). On the one hand, it has been generally agreed that 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) in a cross-country study. As a result, 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 the past ten years. The perceived lower risk has encouraged loosened lending criteria in mortgage market, which lies at the heart of the recent subprime crisis. By comparison, housing markets in most Asian economies have been tranquil during the same period. However, the situation started to change in the past several years. China, Hong Kong SAR, India 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 (the 1997 financial crisis and the lost decade in Japan), in which major downward corrections in house prices cause substantial distress to the real economy, there is a concern whether a new housing bubble is being formed, or whether this round of house price growth is sustainable. There are two divided views. The pessimists argue that house prices have been overvalued in many countries and will face downward corrections in the near future. To the extreme, some of them consider it as evidence of new speculative housing bubbles, and call for supervisors and central banks to take active measures to contain the bubbles. On the contrary, there is the optimistic view that this round of house price growth is a manifestation of recovery from the previous crisis episode. They argue that, in the aftermath of previous crisis, house prices were too low compared to 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 and housing financing systems, the increasing availability of mortgage products, the development of secondary mortgage markets and the introduction of real estate investment trusts (REITs), have arguably improved the market efficiency, stimulated demand and contributed to the house price growth.

The paper attempts to address the above question by examining the 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.[1] We first examine the determinants of housing prices since the 1990's, when many market-oriented reforms in the real estate sector were introduced in this region. We identify some pattern of commonalities and differences in the determinants of fundamental values of housing across the countries and relate these patterns to the institutional arrangements covering the entire gamut of housing regulatory framework (e.g. taxation policies, land administration system, property right protection), housing finance system, economic structure, and local conditions. In addition, we analyze the characteristics of house price cycles in these economies by providing 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 housing price dynamics exhibit significant cross-country heterogeneity, which can be attributable to the different stage of economic development, different institutional arrangements and market-specific conditions.

We also employ the above results to discuss on the "bubble" question. We propose to distinguish between house price overvaluation and house price bubbles. In particular, house price overvaluation refers to the fact that current house prices are substantially above their fundamental values. However, the overvaluation can be driven by two reasons. For one, it is well known that imperfections in housing markets, such as lags in supply, can cause house prices to exhibit fluctuations around their fundamental values in the short run. The degree of house price over/under valuation in the short run depends on the characteristics of housing markets, housing finance systems and other institutional arrangements. Importantly, an overvaluation driven by this short-term dynamics simply reflects inherent stickiness in the housing market. On the other hand, house price overvaluation can also be driven by overly optimistic expectation of future house price movements, which we dub as the true "bubble" component. In our analysis, this bubble component refers to the residual component that cannot be explained by serial correlation and mean reversion of house price dynamics. Our results suggest that house prices may be overvalued in Hong Kong SAR, Korea and Malaysia

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

in recent years, but there is no evidence of housing bubble, at least at the national level.

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 housing market and housing finance system arrangements on house price movements? How to distinguish a speculative housing bubble from fundamental-driven house price appreciation? In this section, we first review the existing studies on these issues, and specify the new insights we provide in this exercise.

Monitoring house price developments is very important, not only because housing is the single most important asset for the majority of households, but also because the strong implications of house price developments on financial stability and the real economy. Housing purchase is predominantly funded by mortgage loans originated by the banking system or the government housing finance system. At the same time, real estate property has been widely used as a major collateral asset for bank loans, due to the existence of asymmetric information between borrowers and lenders and costly enforcement of contracts (Bernanke and Gertler, 1995). This arrangement leads to a strong inter-linkage between the housing market and the banking sector (and the real economy), which is known as the "financial accelerator" mechanism (see Bernanke et al, 1994; Kiyotaki and Moore, 1997; Aoki et al, 2004). An increase in housing prices makes the banks less concerned about the default risk associated with the adverse selection problem. The lower finance premium and the improved credit availability for borrowers boost the demand for real estate assets and drive property prices even higher. By contrast, falling property prices may generate downward spiral movements in the value of real estate assets and the volume of bank loans as credit rationing intensifies. Unless households can easily substitute at zero cost bonds and commercial paper for loans, the changes in the supply of loans will affect the real economy and cause prolonged economic fluctuations.

To monitor housing market, the first issue to tackle is the determinants of house prices. Housing is a special type of asset in that it has a dual role of consumption and 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 it can provide, 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 requirement, short-sale restrictions, lack of information, and supply lags). For instance, Leung and Chen (2006) show that the land price can exhibit price cycles due to the role of intertemporal elasticity of substitution. Wheaton (1999) and Davis and Zhu (2006) develop a model in which there exists a lag in real estate supply 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 house price determination 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, house price tends to be local. 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 there are significant differences in supply elasticities across metropolitan areas in the United States and such differences stem from the differences in urban land use regulation. In particular, less-regulated, fast growth communities tend to exhibit high price 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 cross-country differences in terms of the prevalent contract type, the lending practice, the valuation method of collateral assets, the development of mortgage back securities (MBSs), the flexibility in mortgage refinance and mortgage equity withdrawal. Such differences can arise from the stage of economic development or from the development of credit information systems and the strength of legal rights (Warnock and Warnock, 2007). Tsatsaronis and Zhu (2004), based on a cross-country study in 17 industrialized economies, suggest that differences in housing finance systems have important implications on house price dynamics. House prices are more sensitive to short-term interest rates in those countries where floating rate mortgages are more widely used, and more aggressive lending practices are associated with stronger interaction between house prices and bank credit. Égert and Mihaljek (2007) compare the house

price determinants across eight Central and Eastern European and 19 OECD countries, and find that house prices in CEE countries are determined not only by the conventional macroeconomic factors, but also by institutional developments of national housing markets and housing finance systems. In addition, Campbell and Cocco (2003) show that the type of mortgage contract is an important choice for households who face borrowing constraints and income risk.

The characteristics of housing finance system do not only differ across countries, but also vary across time in the same market. 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, which implies that there might be structural breaks in house price determination in many countries. Accordingly, the linkages between house prices, banking lending and the real economy may also change.[2]

On the important issue of detecting house price bubbles, there are several approaches adopted in the literature. House bubble episodes are sometimes assessed by market analysts in terms of price-rent ratio or price-income ratio. These, however, may be inadequate barometers for policy analysis because they ignore the variation in fundamentals. As a result, these measures are not able to distinguish whether rising house prices are driven by strong economic fundamentals (e.g. income growth, low mortgage rates) or reflect speculative housing price bubbles. 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 interests and an additional risk premium (see Himmelbert et al, 2005; Ayuso and Restoy, 2006; Brunnermeier and Julliard, 2007). 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 (Abraham and Hendershott, 1996). In this paper, we adopt the second method because of data limitations. 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.

This paper examines the characteristics of house price dynamics in nine Asia-Pacific economies

[2]Peek and Wilcox (2006) argue that the development of the secondary mortgage market in the United States may have dampened the responses of residential investment to income and interest rates and, therefore, have contributed to the reduction in the volatility of the aggregate economy. Estrella (2002) shows that the effect of fed fund rate on mortgage rates is stronger with higher level of mortgage-backed securitization in the United States. Similarly, McCarthy and Peach (2002) show that innovations in housing finance systems affect the responses of mortgage rates and residential investment to monetary policy changes.

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. In addition, both of the two papers find strong effects of institutional arrangements on house price dynamics, as we will illustrate in this study. However, our study differs substantially from previous ones and, therefore, provides complementary insights to the literature.

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 unique 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 has been barely touched because the authors control for it by examining the house price dynamics in various metropolitan areas within the same country. In this study, we include a set of measures of institutional arrangements that not only differ across countries but also vary over time. Therefore, we believe our results are more suggestive regarding the role of institutional arrangements.

Third, we extend the housing bubble literature by distinguishing between house price overvaluation and house bubbles. We define house price overvaluation as the situation that house prices are substantially higher than their fundamental values, following the method used in the literature. However, we argue that house price overvaluation is not necessarily equal to a housing bubble. House prices can rise above their fundamentals in the short run due to frictions in the housing market, which is a manifestation of housing market imperfections and the intrinsic house price cycles. Such overvaluation in the short term can be incorporated in the serial correlation and mean rever-

sion coefficients in the analysis, and it depends on the distinctive arrangements in national housing markets and housing financing systems. The residual component, which cannot be explained by the short-term dynamics, is labeled as the "bubble" component and is most likely driven by overly optimistic expectation of future house price movements (Brunnermeier and Julliard, 2007). We believe such distinction can be important for policy reasons. To mitigate house price overvaluation imbedded in house price cycles, the policymaker should probably adopt measures aimed at reducing the magnitude and frequency of house price cycles, such as loosening land use regulation, improving information availability and transparency and enhancing property right protection. To address the bubble issue, the policymaker should adopt measures that control unwarranted high expectation of capital gains in the housing market.

3 ASIAN HOUSING MARKET STRUCTURE AND INSTITUTIONS

An understanding of the salient features of the Asian housing markets would provide the contextual underpinnings to the analyses of the estimation results that are obtained from the regressions. Culturally, there appears to be greater propensity towards home ownership in Asia. The property sector is normally dominated by few major developers. The banking system alongside government housing finance system play important roles in meeting the demand for housing for 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. More detailed description of national housing markets is included in Appendix A.

3.1 Tenure system

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

3.2 Foreign ownership restrictions

There are practically no foreign ownership restrictions 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 efforts to cool the property market, authorities in China have 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

In terms of 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 far and between, including transaction turnaround time. Transaction cost is the highest in Korea, which imposes a cascading taxation policy. Turnaround time is noted to be the longest in the Philippines. Thailand has full tax deductibility of interest payments on owner-occupied mortgage debt. In an effort to quell speculation on residential properties, China has since 2005 imposed, along with other supply regulations, idle land tax, land appreciation tax and business tax on properties held for less than five years.

3.4 Mortgage credit conditions

Most mortgage contracts are hybrid floating rate mortgages, with the exception of New Zealand where mortgages with a fixed interest rate in the initial few years are popular (see Table 1). Typically, loan-to-value ratios of 70 percent to 80 percent are the norm. In Hong Kong, the introduction of insurance scheme for lenders allows banks to grant higher loan-to-value ratio, which could 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 relative infancy such that the degree of asset substitutability may be limited as well.

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). 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, 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 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 to 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 more than 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 them to eligible households at subsidized rates. As the majority of citizens are eligible for HDB flats, the public housing market constitutes over 80% 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.[3]

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 was noted to have played a pivotal role in fostering the expansion of mortgage markets and encouraging greater par-

[3]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. 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.

ticipation 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 methodology to be used in empirical studies, first to characterize house price dynamics and the second 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) framework to investigate the long-term and short-term determination 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 to their fundamental values and by a serial correlation movement. The two coefficients, mean reversion and serial correlation, characterize whether the stability and style of house price movements. In the third step, interactive terms are introduced to investigate the impact of institutional factors on house price dynamics.

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 real fundamental value of housing price in country i at time t, $f(\cdot)$ is a function and X_{it} is a vector of explanatory variables (macroeconomic and institutional factors), such as real GDP , population, mortgage credit-to-GDP ratio, real mortgage rate, real effective exchange rate, land supply index, building permit index, and regulatory indices/institutional variables.

The determination of house price fundamentals, or equilibrium house prices, can exhibit significant heterogeneous across countries, due to the differences in demand and supply factors. To start with, we include a list of macroeconomic and institutional factors that are likely to, either

by theoretical predictions or based on previous empirical work, affect the fundamental value of housing.

On the demand side, we include real GDP, population, real mortgage rate and mortgage credit to GDP ratio. We posit the that *higher income and higher population* tend to encourage greater demand for new housing and housing improvements. In addition, *mortgage rate* is expected to be negatively related to housing prices. 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.

On the supply side, we include 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 cost will be shared by purchasers and we expect a positive relationship between the real construction cost and equilibrium house prices.

In addition, 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 at opposite directions. Moreover, *real effective exchange rate appreciation* is expected to exert positive influence on property market prices, particularly in markets where there is substantial demand from non-residents for investment purposes. In countries where foreign investments play an important role in the economy such as in Asia, an exchange rate appreciation is normally associated with housing booms.

We also include several institutional factors that attempt to account for the impact of market arrangements on equilibrium house prices, including the business freedom index, the corruption index, the financial sector index and the property right index. Higher scores in *the business freedom index* and *the corruption index*, which reflect better regulatory conditions, are likely to be associated lower searching costs and lower transaction cost. Therefore they may have a positive effect on house price in equilibrium. *The financial sector index* reflects the depth and maturity of financial markets which allow greater intermediation function by the financial sector. Thus, it is also expected to facilitate greater credit transactions, thereby, pushing up prices in the long-run. *The property rights index*, on the other hand, measures the degree of flexibility in acquiring land and the legal protection to land/home owners. A lower score, or uncertainty in property rights may reduce the incentive and ability of builders to respond quickly to demand shocks, thus pushes up prices.

More formally, we investigate the long-term relationship between house prices and the list of

possible explanatory variables, using either single-equation ordinary least squares (OLS) and panel data technique, whenever appropriate. To avoid simultaneity bias, contemporaneous variables are instrumented with own lags. Only regressors found to be significant at five percent level were retained. Since the stochastic variables included in the long-run equation are mostly non-stationary, I(1), 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.

4.1.2 Short-run dynamics

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

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

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

If housing markets are efficient, prices will adjust instantaneously such that $\gamma = 1$, hence, $\alpha = 0$. Considering that the housing market is characterized by slow-clearing durable asset, it is reasonable to infer that current price changes are partly governed by previous changes in own price levels such that $\alpha > 0$ 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 coefficients α and β. To examine the dynamics, we first rewrite the above equation as (the subscript i omitted):

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

From the second-order linear difference equation above, we then proceeded to study the characteristic roots of the corresponding characteristic equation given by $b^2 - (1 + \alpha - \beta)b + \alpha = 0$. Appendix C provides the technical derivation of the properties of house price dynamics. In graphical form, housing 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 $\alpha <$ and $\beta > 0$. If satisfied, there are two possible types of house price movements. (i) if $(1 + \alpha - \beta)^2 - 4\alpha \geq 0$, house price will converge gradually to the equilibrium level. In this case, the transitory path itself does not generate house price cycles; in other words, house price cycles only come from cyclical

movements in their fundamental values. The speed of convergence depends on the magnitude of the two coefficients: it converges faster when α and β are smaller. (ii) if $(1+\alpha-\beta)^2-4\alpha>0$, the transitory path in response to changes in equilibrium house price values exhibits a dampened 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 either of two conditions, $\alpha <$ and $\beta > 0$, is violated, then the house price cycle is unstable. When a change in equilibrium house price occurs, the price either diverge away, or exhibits an amplified fluctuation and move away from the new equilibrium level.

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:

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

where Y_{ijt} is a list of regional-specific factors that may affect the property of house price dynamics. 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 also employ the above empirical results to investigate the issue of house price overvaluation, and whether there is a significant bubble component in such overvaluation. As mentioned above, in this paper we distinguish between the house price overvaluation and a housing bubble.

Intuitively, house price overvaluation can be defined as the difference between observed house prices (P_t) and predicted fundamental values (P^*_t) (see section 4.1.1, subscript i omitted).

Nevertheless, a significant house price overvaluation does not necessarily equal a housing bubble. As predicted by theoretical analysis and confirmed by many empirical findings, frictions in housing

markets, including lack of information, lags of supply and banks' reliance on current market price in loan extension, may cause intrinsic house price cycles. A temporary deviation of house prices above their fundamental values might be an intrinsic part of the transitory path towards the equilibrium levels. In other words, it is due to frictions in house price adjustment rather than overly optimistic expectation of future house price movements, which we define here as the "bubble" component (also see Brunnermeier and Julliard, 2007).

The analysis of short-run dynamics of house prices allows us to quantify the component that is driven by intrinsic house price movements in the short run, which can be explained by local conditions and institutional factors. In particular, this component at each point in time is defined 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 components is the predicted house price based on short-term dynamics, its deviation from the fundamental value P_t^* is attributable to the short-run cyclical movement of house prices. By comparison, the residual component, defined as house price overvaluation minus this short-run cyclical component, is labelled as the "bubble" component in this study. Depending on the contribution of the residual component, we can examine whether a house price overvaluation is bubble-driven or not.[4]

5 Data description and empirical findings

In this section, we first briefly describe the data to be 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 countries.

5.1 Data description

Quarterly data for residential property sector in nine countries and 32 cities/market segment in Asia were used in the analysis. Where data are available, quarterly series spanning the period 1993-2006 were used. The sample includes Australia, China, Hong Kong SAR, Korea, Malaysia, New Zealand, Philippines, Singapore and Thailand. 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

[4] Another strong evidence of housing bubble is that the house price cycle turns out to be unstable. For instance, if $\alpha > 0$ and $\beta = 0$, the house price inflation simply follows an autoregressive process and has nothing to do with changes in fundamental values. Nonetheless, we do not detect any unstable house price cycle, including the above example, in this study, hence we only focus on the composition analysis as stated above.

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 – in the average market and in the luxury market – respectively.

At the onset, it may be worth mentioning that there are some subtle variations in the definition of housing prices used in the estimation. While some series are derived using 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.

Another data limitation is the relative short time frame of house price data. Except for Hong Kong SAR and Singapore, Thailand and Korea, quarterly house price data cover the post-Asian crisis period only. On a second thought, longer time series of house price data may not necessarily improve the results, in the sense that many Asian economies have experienced a regime-shifting in housing markets and house finance systems (see Section 3 and Appendix A), and taking it into account would add another layer of complexity in the empirical exercise.

Apart from residential property price index, other series used in this study include GDP, population, construction cost, land supply index, mortgage credit, mortgage rate, real effective exchange rate, stock price index, and four institutional factors: the business freedom index, the financial freedom index, corruption index and the property rights index. All variables are in real terms except stock price index and the ratio of mortgage credit to GDP. Except for the mortgage rate, all variables are transformed into a log form. Appendix II 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.

5.2 Characterizing house price dynamics

To investigate the characteristics of house price dynamics, we follow the Capozza et al approach as described in Section 4.1. We run three different regressions. In each regression, we follow the "from-general-to-specific" approach, i.e. to start with a list of explanatory variables and then only retain the significant ones in the final specification.

The first regression, as reported in Table 3, adopts the panel data technique in estimating the determinants of fundamental housing prices (Equation 1) an the short-run dynamics (Equation 3). The regression attempts to capture the common picture, if any, of house price cycles of the nine economies during the sample period, i.e. 1996-2006. In stage 1, the determination of house price fundamentals yields results that are largely consistent with 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) push up residential property prices in Asia-

Pacific economies. Second, increases in real mortgage rates have a dampening effect on housing prices by raising the amortization requirements, but the magnitude is relatively small. Third, the coefficient of land supply index is negative, which contradicts with the theoretical prediction that increases in land supply have a dampening effect on house prices in the long run. On a second thought, this may reflect an impact in the reverse directly, i.e. higher house prices provide an incentive for developers to build up new residential property projects. Fourth, transparency in business regulations, proxied by higher business freedom index and corruption index, facilitates greater transactions and likewise exerts positive impact of housing prices. Lastly, equity prices are negatively related to house prices, suggesting that the substitutional effect dominates the wealth effect during the sample period.

Results on the short-term dynamics, using house price fundamentals as predicted in the panel regression results, are reported in Table 3.B. Figure 3 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. Hong Kong, Singapore, New Zealand, Malaysia and Australia typically observe dampened oscillation of house prices if the fundamental values change, whereas China, Philippines, Korea and Thailand observe a convergence to the fundamental values. Comfortably, no country is in the zone of unstable divergence or amplified oscillation. To this extent, there appears to be no imminent danger of unsustainable house price developments in our sample economies.

The differences in national house price dynamics can be explained by differences in institutional factors, such as the supply elasticity, mortgage rate adjustability and the degree of business freedom.[5] First, the land supply index has a negative interactive effect on the persistence coefficient. Expectedly, increases in the land supply, a proxy for higher supply elasticity, temper the magnitude of house price cycles. Second, changes in mortgage rates, a proxy of mortgage rate adjustability, strengthen the mean reversion process of house prices. Lastly, the degree of business freedom has an important effect. An improvement in the business environment tends to increase the amplitude but lower the frequency of house price cycles. This is quite surprising, as it indicates that more flexible market is associated with more significant house price fluctuations.[6] There might be two reasons. For one, housing is a unique type of asset in that there are many frictions in the housing market.

[5]Notice that we do not have the time series of housing finance variables, such loan to value ratios and real estate taxes, we use the changes in nominal mortgage rate to proxy for mortgage rate adjustability and the four regulatory indices (the business freedom index, the financial freedom index, the corruption index and the property right index) to proxy for the flexibility of housing markets and housing finance systems.

[6]Actually this finding is not new. Zhu (2006) also suggest 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.

By introducing more flexible housing finance systems and improving the business environment, the role of housing as an investment good expands the 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 housing 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. While many of the housing programs target the lower class where demand pressures are not as high, these programs were noted to have benefited more the middle-class because access to credit is governed by qualification requirements that the middle class can comply with. Under such conditions, house price pressures are expectedly more subdued.

The second regression is similar to the first one, except that the determination of house price fundamentals is country-specific[7] rather than following a common pattern. It is commonly known that housing is a local product and the determination of housing prices tend to be market-specific. To overcome potential bias due to this heterogeneity, we allow the house price fundamentals to be determined in each country-specific analysis, and use the country-specific predicted fundamental values in determining the short-run dynamics. The results are shown in Table 4.

Table 4.A. confirms that the driving factors of house price fundamentals are market-specific (see Section 5.4 for detailed discussion), therefore it is important to incorporate this heterogeneity in the analysis. Nevertheless, the results of short-run house price dynamics are quiet robust, as reported in Table 4.B and Figure 4.

Compared with the previous regression, the major difference is that the interactive terms of the mean-reversion coefficient become insignificant. On the interactive terms of the persistence parameter, both land supply condition and business freedom index have a significant interactive impact and the sign remains the same (the magnitude differs slightly). More importantly, by looking the average persistence and mean-reversion coefficients (Figure 4), the characteristics of house price movements in each country, particularly in term of cross-country distinctions, do not change in the regression that allow for country-specific fundamentals.

The third regression, instead, employs city-level data. As in the second regression, the fundamentals are determined on the basis of country-specific or market-specific analysis. The panel regression results of endogenous adjustment equation, as shown in Table 5, confirm the importance of institutional factors in determining house price dynamics. That, is a more liberalized business environment is associated with a more volatile (higher amplitude, lower frequency) house price

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

cycle. Nevertheless, the regression also suggests some new results. For instance, increases in real construction cost tend to amplify the amplitude of house price cycles. Higher GDP growth tends to slow down the convergence process or reduce the frequency of house price cycles, probably because the higher demand for housing takes more time for the market to absorb. More interesting, the dummy variable that measures the importance of particular markets,[8] has a positive interactive effect on the mean reversion parameter, suggesting that the luxury markets or the leading markets are more likely to observe a long period of deviation of house prices from the fundamental values.

5.3 House price overvaluation vs. bubble

Following the methodology described in Section 4.2, we try to address the question whether house prices in selected Asia-Pacific economies have been overvalued, and if so, how much of them can be contributed to a bubble component.

The baseline results are calculated based on the second regression as reported above, which treats the determination of house price fundamentals as country-specific and use a panel data regression to analyze the patterns of short-run dynamics. In Figure 5, we first plot the deviation of house prices from predicted fundamentals. At national level, Hong Kong SAR, Korea and Malaysia observed house price overvaluation in recent years, but not in a dangerous zone as observed in the pre-crisis period. In the other countries, there is no obvious house price overvaluation: it appears that the recent strong house price growth (eg in Australia, China, New Zealand, see Figure 6) is mainly attributable to strong macroeconomic fundamentals.

A further breakdown analysis suggests that even the modest house price overvaluation in these economies is not evidence of a house "bubble", but is more likely to be driven by short-term cyclical movements that are related to house market frictions rather than overly optimistic market expectations. The cyclical component, or house price deviation that can be attributed to short-run transition towards new fundamental values, explain the bulk of the house price overvaluation. At least at the national level, there is little evidence of housing bubbles in the selected economies.

Given that the 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 between the luxury market (or a leading market) and the average market. There are two interesting findings. First, in almost all countries (except Malaysia), significant overvaluation has been detected in the leading market. By contrast, for the average market there is no obvious house price overvaluation. In other word, the house price overvaluation that is observed at the national

[8] It equals to one for luxury 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).

level is comes mainly from the leading market segment. This supports the conventional view that the leading market behaves very differently from the average market. Second, the breakdown analysis suggests that the housing bubble may exist at particular market segments, for instance, the luxury market in Manila. From policy perspective, it is important for policymakers to implement market-specific diagnosis and to find the right policy instruments that ideally can distinguish between the bubble and non-bubble component.

5.4 Determinants of housing prices in selected Asian countries

Not surprisingly, the patterns of house price determination (both long-term and short-run) exhibit significant cross-country heterogeneity. This can be attributable to the different stage of economic development, different institutional arrangements and market-specific conditions. In this section, we provide some detailed perspectives regarding the determinants of country-specific fundamental housing prices, as reported in Table 4.A.

5.4.1 Australia

Migration pressures as shown in the strong impact of population and more flexible credit conditions give rise to demand pressures. The disinflation and fall in nominal interest rates brought about by greater competition from specialized mortgage lenders since the mid-1990s have also allowed households to service large mortgages. Favorable demand conditions seem to encourage the development of residential projects.

5.4.2 China

The estimation period (1998-2006) coincides with the era of market-oriented reforms in the housing markets and greater financial deregulation. The confluence of rising household disposable income, rapid pace of urbanization, entry of private developers and more market-oriented pricing policy could have triggered the high response rate of developers to ever increasing demand for housing. In addition to demand for housing as a consumption good, it is also becoming a lucrative investment opportunity due to lack of alternative options (Chiquier, 2006; Lung, 2005).

The fundamental value of housing is largely explained by rising real per capita income and construction cost index. Expectedly, higher real income growth induces higher demand for housing. Higher real construction costs reflect higher frictions in the supply side and they are eventually passed on to home-purchasers. Hence both of them have a positive impact on house price fundamentals.

The rapid pace of income growth, irrespective of the income distribution issue, appears to be outweighing the impact of credit availability and mortgage rate. This is not surprising because for an economy as big as China, the mortgage credit-to-GDP ratio is way below the ratios for Hong Kong SAR, Singapore and even Malaysia. In fact, in the early stages of mortgage market development in China, mortgage loans have been supplemented by other sources of funds such as financial support by family members. Pre-payment of residential mortgage loans was prevalent in practice, e.g. a 30-year loan is normally pre-terminated within five years. Another important facet of China's mortgage market is that while the PBoC liberalized mortgage rates in 2005, banks were still noted to be not pricing loans according to costs and risks but rather compete through volumes by applying the floor level set by PBoC before applying the 10 percent discount. These new mortgage rates do not reflect any premium on additional market risk (Chiquier, 2006).

5.4.3 Hong Kong SAR

Economic growth and housing market activities are relatively volatile in the estimation period. The real GDP variable reflects households' ability to afford housing as well as the general economic condition. Following the Asian financial crisis, households in Hong Kong experienced slower or negative income growth and higher jobless rates. This, combined with pessimistic house price expectations, is likely to have curbed housing demand.

As Hong Kong is a relatively open economy, an appreciation of the real effective exchange rate is expected to be associated with rising house prices, as overseas demand is likely to be boosted on expectations of higher capital gains from changes in the exchange rate.

5.4.4 Korea

Rapid urban migration and fast urbanization push up demand for urban housing. This is reflected in the significance of population and building permit index. However, supply could not respond quickly enough to demand pressures due to land supply limitations, dominance by few property developers, cascading taxation policies on housing and stringent loan qualification requirements such as lower loan-to-value and debt-to-income ratios. Thus, it was noted that there was not enough competition in the market even if most government controls were relaxed after the 1997 financial crisis.

The growing importance of the financial system in explaining fundamental house prices is highlighted by the significance of the indicator of depth of financial system. Two landmark developments characterized the estimation period, namely, the deregulation of housing finance and establishment of KHFC to provide additional liquidity and longer-term loans.

The preponderance of informal housing arrangement known as the chonsei system (as described in Appendix A) and short-term mortgage loans with flexible mortgage rate may partly explain why mortgage rate is turning out to be positive.

5.4.5 Malaysia

The results suggest that prospects of the housing industry in Malaysia remain relatively stable given the prevailing conducive financing conditions and continued income growth. In fact, income explains a large part of house price movement.

Mortgage interest rate is also positively related to house prices, albeit small in magnitude, which may be a response to greater demand. The demand impetus may have risen due to a number of important contemporaneous development in the housing and mortgage market. First, in the period of 2000-2004, interest rates were on a declining trend due to low inflation and competition for loans among banking institutions even as real income continued to increase. Secondly, the securitization facilities provided by Cagamas were able to reduce the funding mismatch among banking institutions, thus, allowing them to extend more credit with longer repayment period. These factors may have rendered interest cost a less important consideration in the decision to purchase a house.

5.4.6 New Zealand

Population pressures partly arising from immigration appear to be putting pressure on housing prices. Construction cost is also positively related to housing price. The estimation period captures the era of financial deregulation in which 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 30 percent more than they previously could. Unlike Australia, mortgage securitization is limited.

5.4.7 Philippines

Real housing prices in six major cities in the National Capital Region (Caloocan, Makati, Manila, Pasay, Pasig and Quezon City) have been, in general, on a downward trend during the sample period. As the Philippine population continues to grow rapidly, so does the need for quality housing. Government resources are, however, limited and most public programs tend to produce complete shelter packages largely unaffordable to the poor (MTPDP, 2004-2010).

Housing price fundamentals for the average housing market are explained by financing conditions such as mortgage rate and mortgage credit, with the latter as the principal determining factor. With modest income growth, it is not surprising that access to credit is very crucial in the decision to purchase a house.

Mortgage rate is turning out to be positive for the average housing market. This may be because the middle-income earners in formal employment also enjoy access to the government housing finance system that has finance-linked subsidies. Eligibility in these subsidy programs normally require a target group with sufficient level and stability of income as well as good financial prospects. Thus, the underserved households, which are the original target beneficiaries of subsidy programs, are effectively excluded. As a result, the banking system cannot compete effectively with this sector of the market and hence, unable to develop systems to move down markets (Hoek-Smit, 2003; Llanto and Ballesteros, 1999; Ballesteros, 2002). Hence, when commercial mortgage rates rise in response to demand pressures from their regular middle-to-high income client base, the middle-income segment that may have otherwise been discouraged by the higher commercial mortgage rate can readily shift to the government housing finance system, thereby, exerting demand pressure, although the estimated magnitude is miniscule.

5.4.8 Singapore

Singapore's average housing market, represented by the HDB resale market, is driven by real mortgage rate, real construction costs, and real effective exchange rate. The real mortgage rate was found to be significant and of the expected sign but of a small magnitude, likely because the rate does not apply to all HDB flat buyers, but only those who obtain finance from banks. HDB-flat buyers who satisfy certain income ceiling are eligible for HDB loans, where they pay a concessionary interest rate. Mortgage credit was found insignificant, a finding that could be attributed to the extensive public housing finance system.

While HDB flats are only available to Singapore citizens, the real effective exchange rate might have captured the general economic condition and thus found to be positively related to HDB resale prices.

5.4.9 Thailand

The period of estimation coincides with the process of financial liberalization policy in Thailand where ceilings on both deposit and loan rates were lifted (Subhanij and Waraurai, 2001). Surprisingly, the real mortgage interest rate is found to be positively related to housing prices and the impact is small. The reason may be due to the fact that demand for loan tends to be high during

upward economic cycles, resulting in higher mortgage rate and house price, and vice versa. In addition, most Thai borrowers buy houses with large downpayment and could deduct from their personal income tax the portion of mortgage interest payment. The ceiling for mortgage interest allowance for personal income tax deduction increased from 50,000 baht per year in 2000 to 100,000 baht per year in 2007. For an owner of lower and lower-middle price property the entire mortgage interest payment may be fully deductible, i.e. fully subsidized.

Income and real effective exchange rate are strongly significant in the determination of house prices. Exchange rate has a significant impact on house price in Thailand. In particular, currency appreciation (against the US dollar) is associated with housing price booms and vice versa. It can be partly explained by the important role of foreign investors, who invested heavily in Thai property during the boom, boosting property prices and the baht but retreated after the Asian crisis, putting downward pressure on the already weak currency and property markets.

Interestingly, mortgage credit is not significant to housing price determination. This finding could reflect the fact that mortgage credit is not as important to housing prices in Thailand as previously thought. The reason, as discussed earlier, is that most Thai customers buy houses with large downpayment, rather than relying fully on mortgage credit. This together with the strong result of income factor reflects different institutional characteristic in Thailand that people usually buy houses when they are able to afford it, rather than taking out large mortgage loans. When Thai homebuyers could not yet afford to buy houses, they normally decide to reside with their own family. It is not surprising, therefore, that compared to other countries such as Hong Kong, Korea and Singapore, Thailand is one of the countries with the lowest ratio of mortgage debt outstanding to GDP (Zhu, 2006).

As with most results, land supply appears to be responding to more buoyant demand.

6 Conclusion

The study has documented evidence of serial correlation and mean reversion in nine Asia-Pacific economies and analyzed the patterns of housing price dynamics in relation to distinct institutional features. Notwithstanding the nuances in each market, the regression results validate the hypothesis that the current run-up in house prices mainly reflects adjustment to more robust fundamentals rather than evidence of speculative housing bubbles. However, national average house prices mask the volatility in house price movements in leading cities/markets.

Notwithstanding the relatively benign housing market environment in Asia, there is no room for complacency as there would always be new sources of volatility as markets mature. It is during

placid times that reforms are best thought of. Given existing rigidities in the housing regulatory framework, it is deemed important to introduce reforms that would facilitate greater transactions and to enhance the role of housing as a tradable investment asset. Institutional reforms in the areas of land registration property rights systems are important in mitigating extreme house price fluctuations. As the role of mortgage financing expands, it has become increasingly important for regulators to understand the potential risks embedded in the new housing market structure. It would, thus, be prudent for both financial stability and monetary policy objectives of central banks to include house price movements in the regular macroeconomic surveillance. Regular monitoring and analysis of asset price movements is essential so that pre-emptive policy responses could be coordinated with concerned government agencies.

Information is also critical as markets develop. The US sub-prime woes have been hampered by information deficit on the amount and distribution of losses. As the price discovery mechanism is marred by information asymmetries, the ensuing overly cautious stance can aggravate the situation even for the prime mortgage market. Improvement in the data capture, credit rating and risk assessment is imperative. The risk assessment system relied on by regulators and investors must be robust and imbued with integrity. For most of Asia, there appears to be a pressing need to improve the quality and timely availability of housing price data if these are to aid in better analysis for policy decision-making purpose. Reliable information on city level prices 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 (2001): "Benefits (and Losses) from Rent Control in the Philippines: An Empirical study of Metro Manila", *Discussion Paper Series* no 2001-23. Philippine Institute for Development Studies, Philippines.

[5] 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.

[6] Banerjee, A, J D Dolado, J W Galbraith and D F Hendry (1993): *Cointegration, Error-Correction and the Econometric Analysis of Non-Stationary Data*, Oxford University Press, New York , U.S.A.

[7] Bardhan, A D, R Datta, R H Edelstein and L S Kim (2003): "A Tale of Two Sectors: Upward Mobility and the Private Housing Market in Singapore", Journal of Housing Economics, vol 12, pp 83-105.

[8] 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.

[9] 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.

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

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

[12] Campbell, J and J Cocco (2003): "Household Risk Management and Optimal Mortgage Choice", *Quarterly Journal of Economics*, vol. 118, issue 4, pp 1449-94.

[13] 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.

[14] Cao, A and R Keivani (2007): "Market Failure or Institutional Failure: Why the Chinese Urbanites Find Housing Increasingly Unaffordable", Working Paper presented at the 12th Asian Real Estate Conference, 9-12 July, Macau, China.

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

[16] 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.

[17] Case, K and R Shiller (1989): "The Efficiency of the Market for Single-Family Homes", *American Economic Review*, vol 79, no 1, pp 125-37.

[18] Case, K and R Shiller (2003): "Is There a Bubble in the Housing Market?" *Brookings Papers on Economic Activity*, vol 2003, no 2, pp 299-342.

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

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

[21] Chang, Y, S Dasgupta and J Gan (2007): "Property Market Bubbles, Toeholds, and the Winners' Curse: Evidence from Hong Kong Land Auctions", paper presented at the 12th Asian Real Estate Conference, 9-12 July, Macau, China.

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

[23] Chen, N K (2001b): "Asset Price Fluctuations in Taiwan: Evidence from Stock and Real Estate Prices 1973 to 1992", *Journal of Asian Economics*, vol 12, pp 215-32.

[24] Chen, N K and H J Wang (2007): "The Procyclical Leverage Effect of Collateral Value on Bank Loans – Evidence from the Transition Data of Taiwan", *Economic Inquiry*, vol 45, no 2, pp 395-406.

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

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

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

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

[29] Deng, Y and P Liu (2007): "Mortgage Prepayment and Default Behavior with Embedded Forward Contract Risks in China's Housing Market", Working Paper.

[30] 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.

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

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

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

[34] Frankel, A (2006): "Prime or Not so Prime? An Exploration of US Housing Finance in the New Century", *BIS Quarterly Review*, March, 67-78.

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

[36] 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.

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

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

[39] Gochoco-Bautista, S (2007): "Asset Prices and Monetary Policy: Booms and Fat Tails in East Asia", *BIS Working Papers.*

[40] 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.

[41] Grimes, A, A Aitken. and S Kerr (2004): "House Price Efficiency: Expectations, Sales, Symmetry", *Working Paper* 04-02. Motu Economic and Public Policy Research, New Zealand.

[42] Gurkaynak, R (2005): "Econometric Tests of Asset Price Bubbles: Taking Stock", *Finance and Economics Discussion Series* 2005-04, Board of Governors of the Federal Reserve System.

[43] 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.

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

[45] 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.

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

[47] 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.

[48] Hoek-Smit, M (2003): "The Design and Implementation of Subsidies for Housing Finance", paper presented at the World Bank Seminar on Housing Finance, March.

[49] Hoesli, M, P Fraser and L McAlevey (2006): "House Prices and Bubbles in New Zealand", *Swiss Finance Institute Research Paper* no 06-20.

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

[51] Hong Kong Monetary Authority (2005): "An Empirical Analysis of the Fair Value of Hong Kong's Residential Property Prices", HKMA internal document, November.

[52] Hordahl, P and F Paker (2007): "Understanding asset prices: an overview", *BIS Papers*, no 34 , March.

[53] Jones Lang Lasalle (2006a): "Asia Pacific Property Investment Guide 05/06", mimeo.

[54] Jones Lang Lasalle (2006b): "Real estate transparency index", mimeo.

[55] Kan, K, S Kwong and C Leung (2004): "The Dynamics and Volatility of Commercial and Residential Property Prices: Theory and Evidence", *Journal of Regional Science*, vol 44, no 1, pp 95-123.

[56] Kao, C (1999): "Spurious Regression and Residual-Based Tests for Cointegration in Panel Data", *Journal of Econometrics*, vol 90, pp 1-44.

[57] Kim, K H (2004): "Housing and the Korean economy", *Journal of Housing Economics*, no 13, pp 321-341.

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

[59] Krainer, J (2003): "House Price Bubbles", *Economic Letter* 2003-6, Federal Reserve Bank of San Francisco, 7 March.

[60] Lee, J K and K H Ahn (2004): "Categorization and Effectiveness of Korean Housing Policy – An Analysis of Effectiveness of Price Impact", presented at the 9th AsRES conference,.

[61] Leung, C (2004): "Macroeconomics and Housing: A Review of the Literature", *Journal of Housing Economics*, vol 13, pp 249-67.

[62] Leung, C (2007): "Equilibrium Correlations of Asset Price and Return", *Journal of Real Estate Finance and Economics*, vol 34, pp 233-56.

[63] 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.

[64] 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.

[65] Lung, R (2005): "China: An Evolving Housing Market", *Asia Focus*, Federal Reserve Bank of San Francisco, June.

[66] Valuation and Property Services Department (2006): *Malaysia property market 2006*, Malaysia.

[67] Malpezzi, S (1999): "A Simple Error Correction Model of House Prices", *Journal of Housing Economics*, vol 8, pp 27-62.

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

[69] McCarthy, J and R Peach (2004): "Are Home Prices the Next 'Bubble'?", *FRBNY Economic Policy Review*, vol 10, no 3, pp 1-17.

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

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

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

[73] Ortalo-Magné, F and S Rady (2004): "Housing Transactions and Macroeconomic Fluctuations: A Case Study of England and Wales", *Journal of Housing Economics*, vol 13, pp 287-303.

[74] Peek, J and E S Rosengren (1992): "Crunching the Recovery: Bank Capital and the Role of Bank Credit", In L E Brown and E S Rosengren (eds), *Real Estate and the Credit Crunch*, Federal Reserve Bank of Boston, Conference Series No 36.

[75] 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.

[76] Peng, P (2007): "Paradigm Shifts in Residential Mortgage Market in the Past Decade", mimeo.

[77] Ruckphaopant, R, J Wanitthanankun and Y Thaicharoen (2006): "Housing and mortgage markets in Thailand", in B Kusmiarso (ed), *Housing and Mortgage Markets in the SEACEN Countries*, SEACEN.

[78] Schiller, T (2006): "Housing: Boom or Bubble?", *Business Review*, Federal Reserve Bank of Philadelphia.

[79] Sinai, T and N Souleles (2005): "Owner-Occupied Housing As a Hedge Against Rent Risk", *Quarterly Journal of Economics*, pp 763-89.

[80] 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.

[81] Sing, T F , I C Tsai and M C Chen (2006): "Price Dynamics in Public and Private Housing Markets in Singapore", *Journal of Housing Economics*, vol 15, pp 305-20.

[82] Smith, M H and G Smith (2006): "Bubble, Bubble, Where's the Housing Bubble", *Brookings Papers on Economic Activity*, vol 2006, no 1, pp 1-50.

[83] Stein, J (1995): "Prices and Trading Volume in the Housing Market: A Model with Down-Payment Effects", *Quarterly Journal of Economics*, vol 110, no 2, pp 379-406.

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

[85] Subhanij, T and R Waraurai (2001): "Financial Liberalization Policy: Towards a new Paradigm", *BOT Symposium Paper*, Bank of Thailand.

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

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

[88] Valuation and Property Services Department, *Property Status Report*, various issues, Malaysia.

[89] Valuation and Property Services Department, *Property Stock Market Report*, various issues, Malaysia.

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

[91] Wheaton, W (1990): "Vacancy, Search, and Prices in a Housing Market Matching Model", *Journal of Political Economy*, vol 98, no 6, pp 1270-92.

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

[93] 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.

[94] 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 housing 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 housing 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 housing 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; 2004-2010 MTPDP). 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. It required immediate provisioning of 5 to 100 percent for non-performing loans other than assets obtained by foreclosure or dacion en pago (real and other property owned or acquired or ROPOAs). Provisioning for ROPOAs, on the other hand, was capped at 10 percent per annum from the 6th to 10th year since date of acquisition. Due to the relatively lower maintenance costs of ROPOAs, banks were not inclined to dispose of them (Pasadilla, 2005).

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 outstand-

ing 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 housing 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 housing 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 housing 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:

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

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). The speed of convergence is faster if the magnitude of the root is smaller, i.e. if α is smaller or if β is higher. If otherwise $\alpha - \beta \geq 1$, the system becomes unstable and the dynamics of house price exhibits divergence from the equilibrium. The speed of divergence increases in α and decreases in β.

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 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	of the cycle	of the cycle
	3A. $\alpha < 1$	Dampened fluctuation		

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 (max 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	fixed	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 (max 30)	GHB	82.0 (2000)

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

[1] China and the Philippines have provident fund scheme, 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 as reported in Global Property Guide (2006), Krainer et al (2005); and Sing and Ong (2004). China's ownership rate pertains to homeownership in urban areas.

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	32.37
	82.1	40.6	1.7	34.5	7.6	15.1	37.5	5.9	31.3	3.3
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	205.29
	57.9	27.8	21.2	17.8	32.3	22.7	16.7	41.8	16.0	109.2
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. 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	0.10	2.01
Real mortgage rate	-0.02	-3.62
Mortgage credit-to-GDP	0.35	16.30
Land supply index	0.12	9.40
Real effective exchange rate	0.38	5.08
Stock price index	-0.09	4.64
Business freedom index (BFI)	0.17	4.74
Corruption index (CI)	0.10	5.27
Adjusted R^2	0.82	

Notes: The regression is based on a panel data of the nine sample economies (with fixed effects). All explanatory variables, except for mortgage rate and mortgage credit-to-GDP, 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.

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

	Regression 1		Regression 2	
	coefficient	t-value	coefficient	t-value
Persistence parameter (α)	0.35	4.33	0.34	6.35
Mean reversion parameter (β)	0.10	4.25	0.15	5.98
Contemporaneous adjustment parameter (γ)	0.13	3.06	0.13	2.52
α*(change in land supply index)			-0.46	1.90
α*(BFI-$\overline{BFI}$)			0.94	5.48
β*(change in mortgage interest rate)			0.11	3.02
β*(BFI-$\overline{BFI}$)			-0.18	3.34
Adjusted R^2	0.21		0.44	

Notes: The regression is based on a panel data of the nine sample economies (with fixed effects). House price fundamentals are determined by the panel regression results as reported in Table 3.A. "BFI" refers to the business freedom index and $\overline{BFI}$ refers to its sample average.

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 (panel)
Real GDP	-1.085	0.139	0.249	-	0.779	-	-	-	0.253
Population	4.530	-	-	0.667	-0.418	3.626	-	-	
Mort/GDP[1]	0.509	-	-	-	-	-	0.965	-	
Real mortgage rate	-0.013	-	-	0.705	0.016	-0.033	0.019	-0.033	0.012
Land supply index	0.324	0.058	-	0.158	-	0.097	-	-	0.050
Real construction cost	-	0.472	-	-	-	2.101	-	0.735	
REER[2]	-	-	0.766	-	-	-	-	1.300	0.293
Stock price index	-0.248	-	-	-	-	-	-	-	
Business freedom index	-	0.054	-	-	-	-	-	-	
Corruption index	-	-	-	-	-	-	-	-	
Property rights index	-	-	-	-0.290	-	-	-	-	
Financial freedom index	-	-	-	0.644	-	-	-	-	
Adjusted R^2	0.986	0.879	0.68	0.50	0.55	0.983	0.481	0.65	0.791

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)	0.31	6.13
Mean reversion parameter (β)	0.23	8.67
Contemporaneous adjustment parameter (γ)	0.27	6.83
α*(change in land supply index)	-0.44	2.04
α*(BFI-$\overline{BFI}$)	0.88	6.09
Adjusted R^2	0.51	

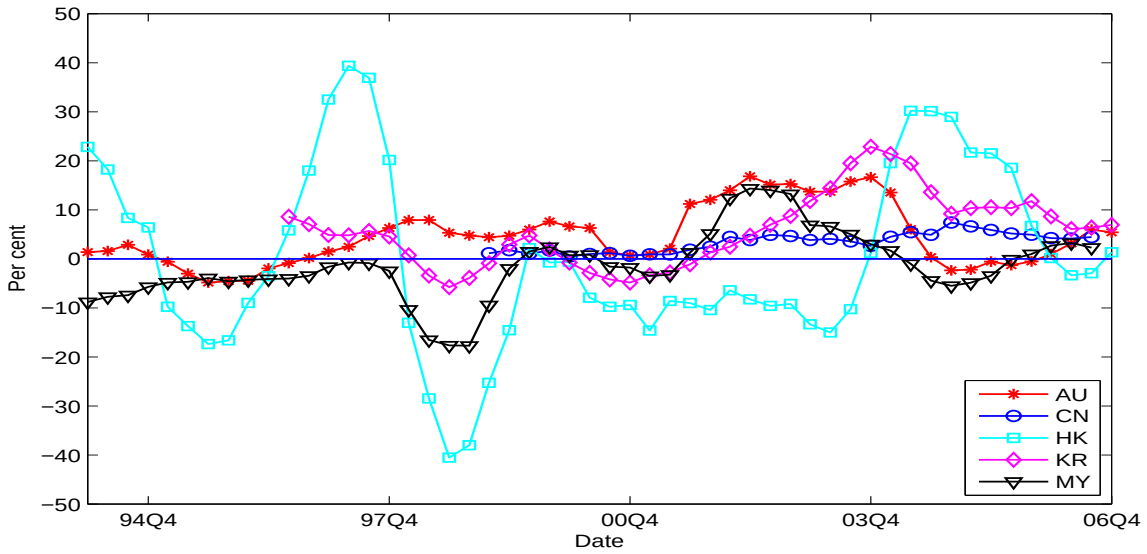
Notes: The regression is based on a panel data of the nine sample economies (with fixed effects). House price fundamentals are determined by the country-specific regression results as reported in Table 4.A. "BFI" refers to the business freedom index and $\overline{BFI}$ refers to its sample average.

Table 5: **City-level endogenous adjustment panel regression results**

	coefficient	t-value
Persistence parameter (α)	0.11	4.01
Mean reversion parameter (β)	0.29	12.59
Contemporaneous adjustment parameter (γ)	0.22	8.69
α* (change in real construction cost)	4.77	2.89
α* (BFI-$\overline{BFI}$)	0.77	11.42
β* (dummy for major cities)	-0.14	5.07
β* (change in real GDP)	-2.32	3.19
β* (BFI-$\overline{BFI}$)	-0.09	2.23
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. "BFI" refers to the business freedom index and $\overline{BFI}$ refers to its sample average. 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**



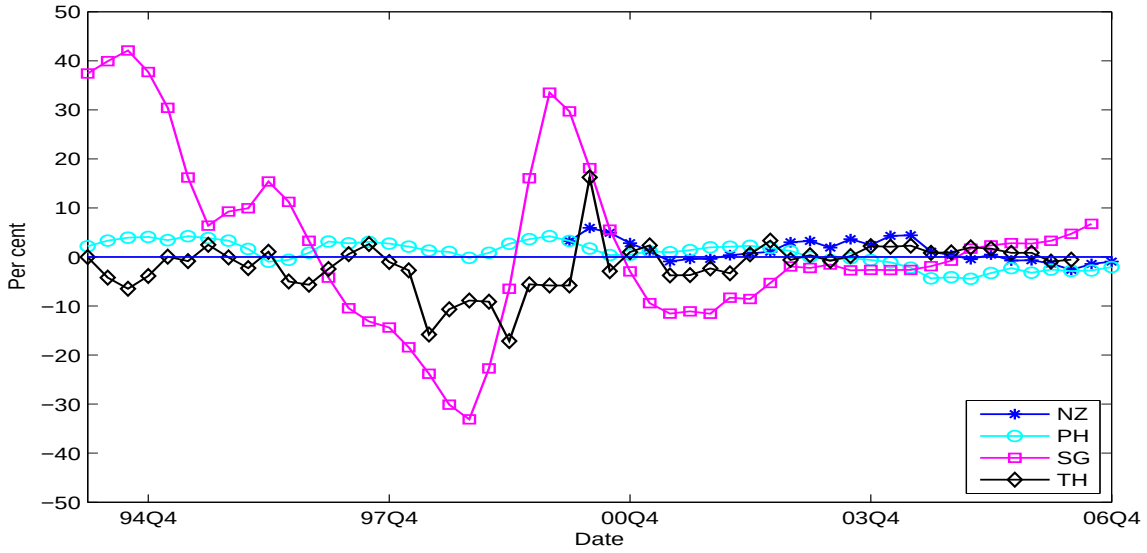
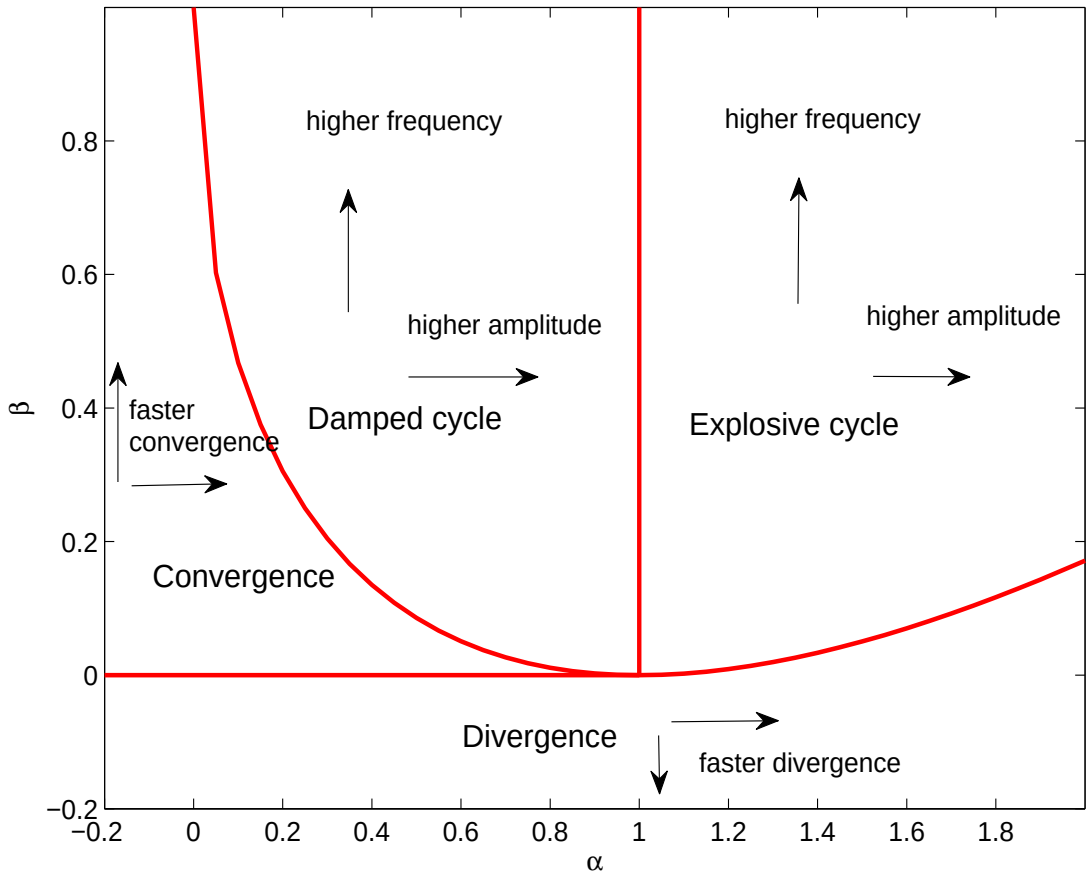
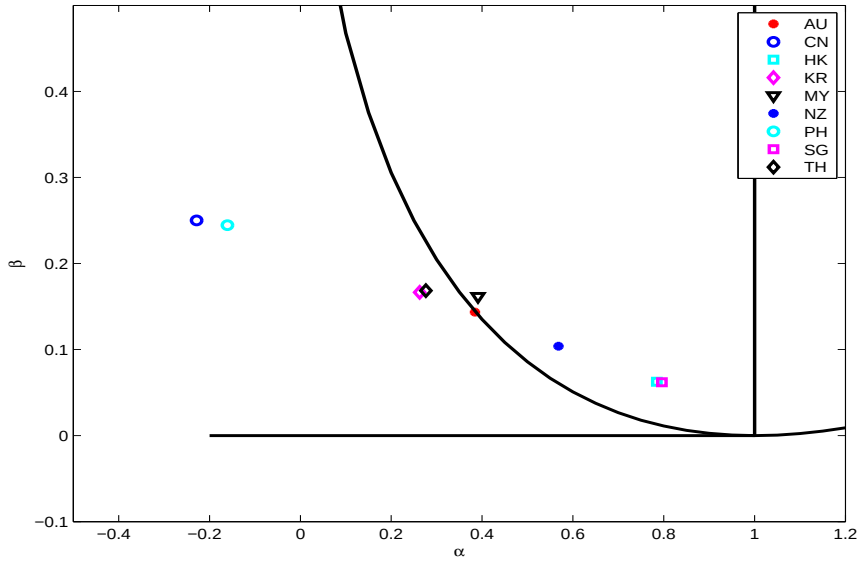


Figure 2: **Characteristics of house price dynamics: Illustration**



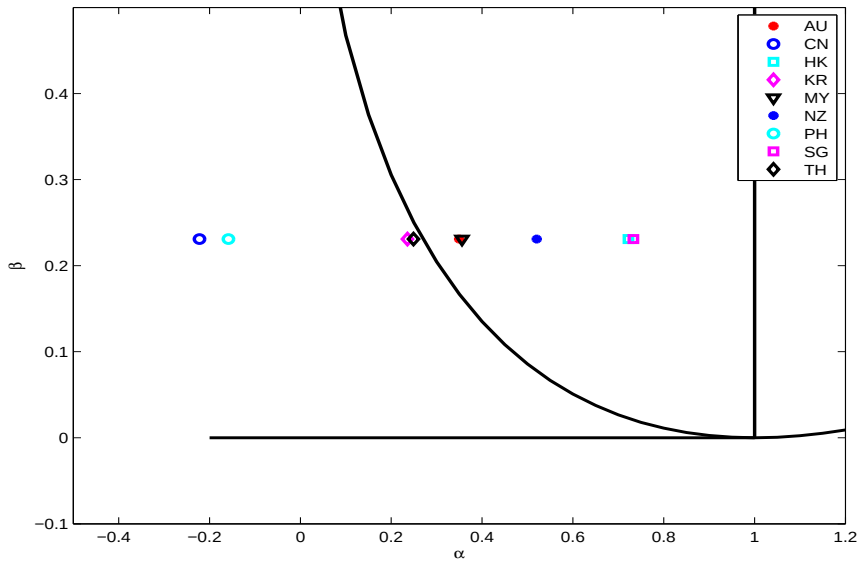
Notes: The figure plots the characteristics of house price dynamics for different combination of persistence (α) and mean-reversion (β) parameters.

Figure 3: **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 4: **Housing 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.

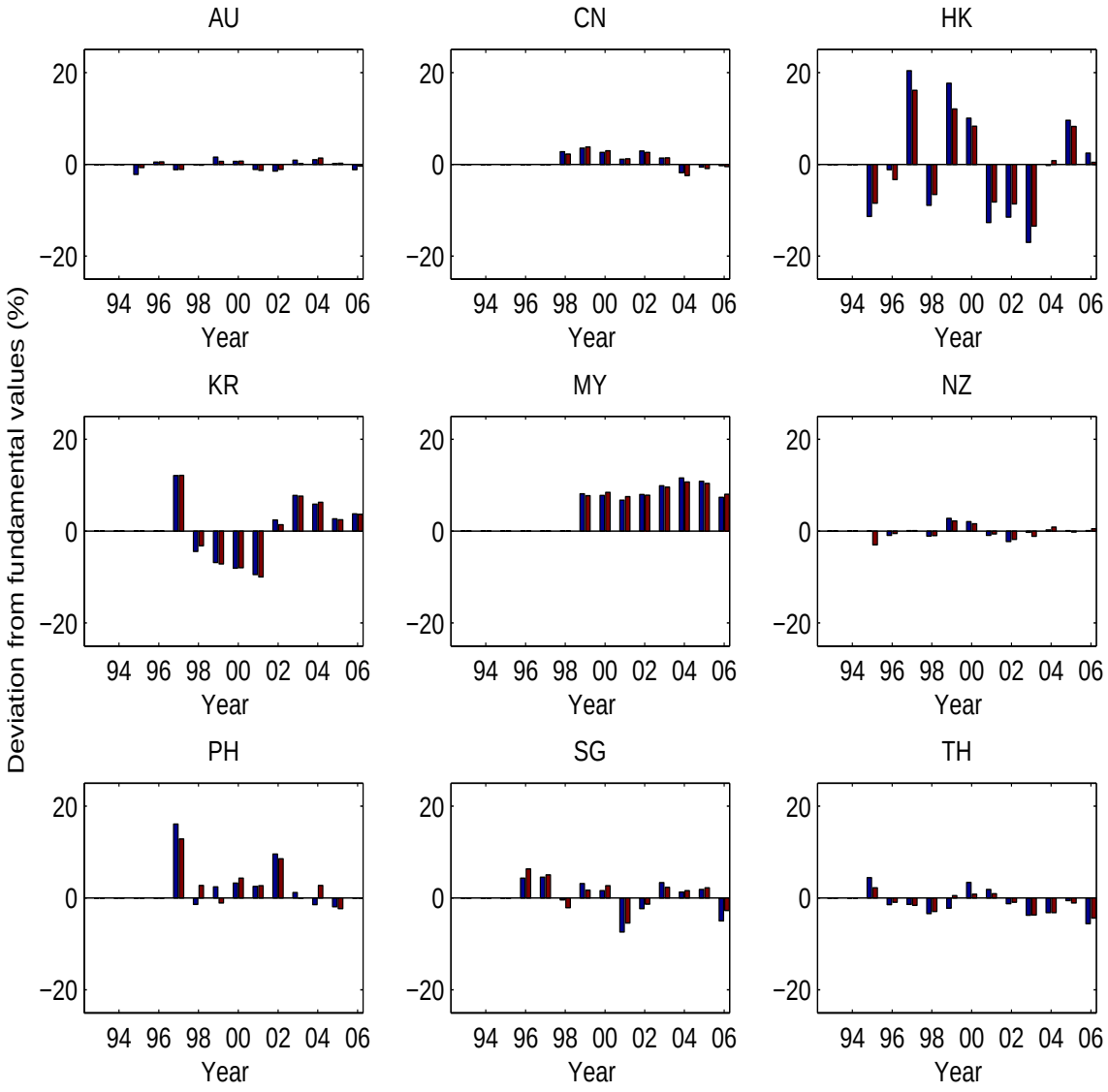


Figure 5: Deviation of country-level house prices from fundamental values

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.

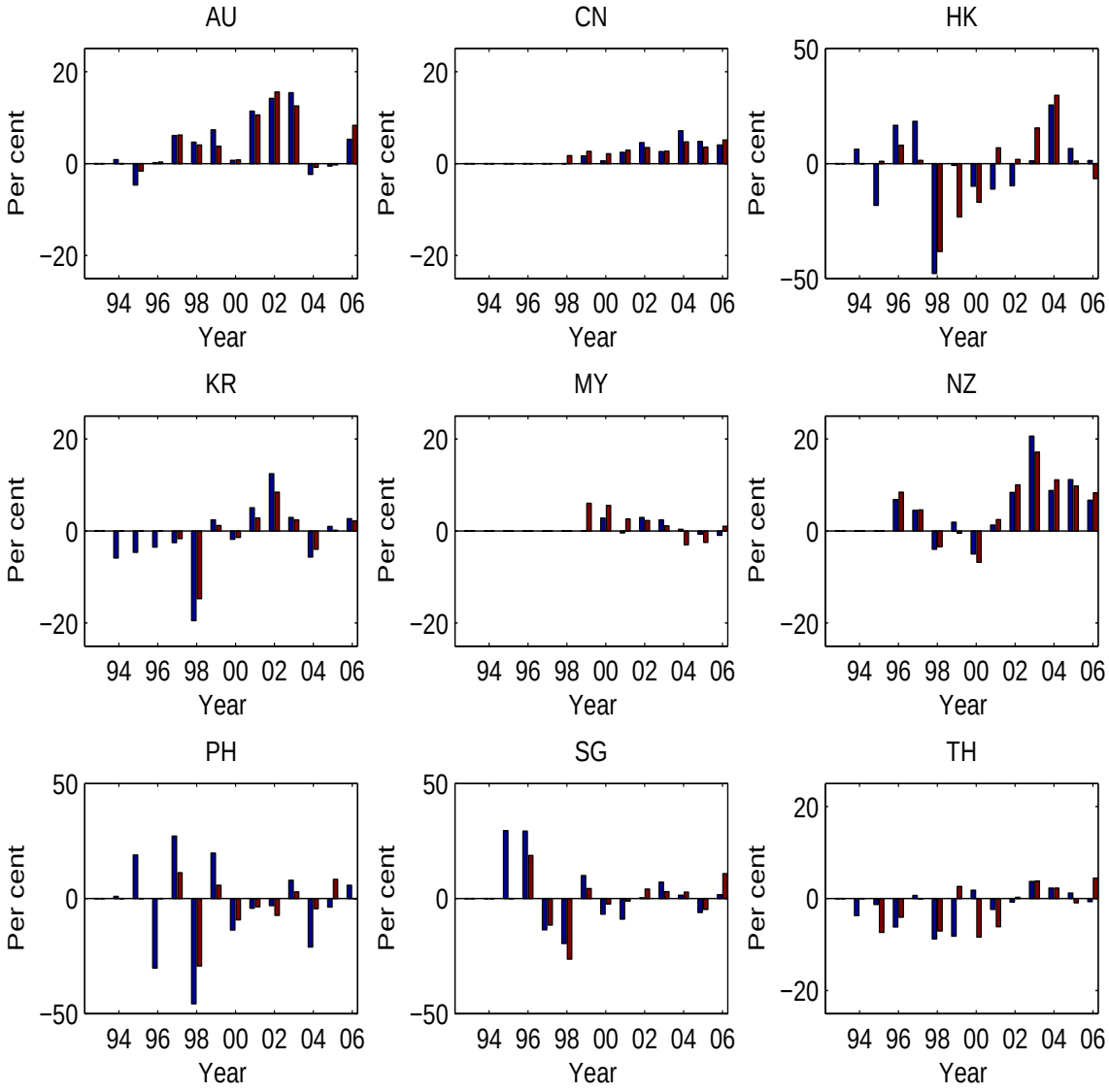


Figure 6: Annual house price growth

Note: The blue bars represent observed annual house price growth, and the red bars represent the house price growth predicted by the house price dynamics regression. 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.

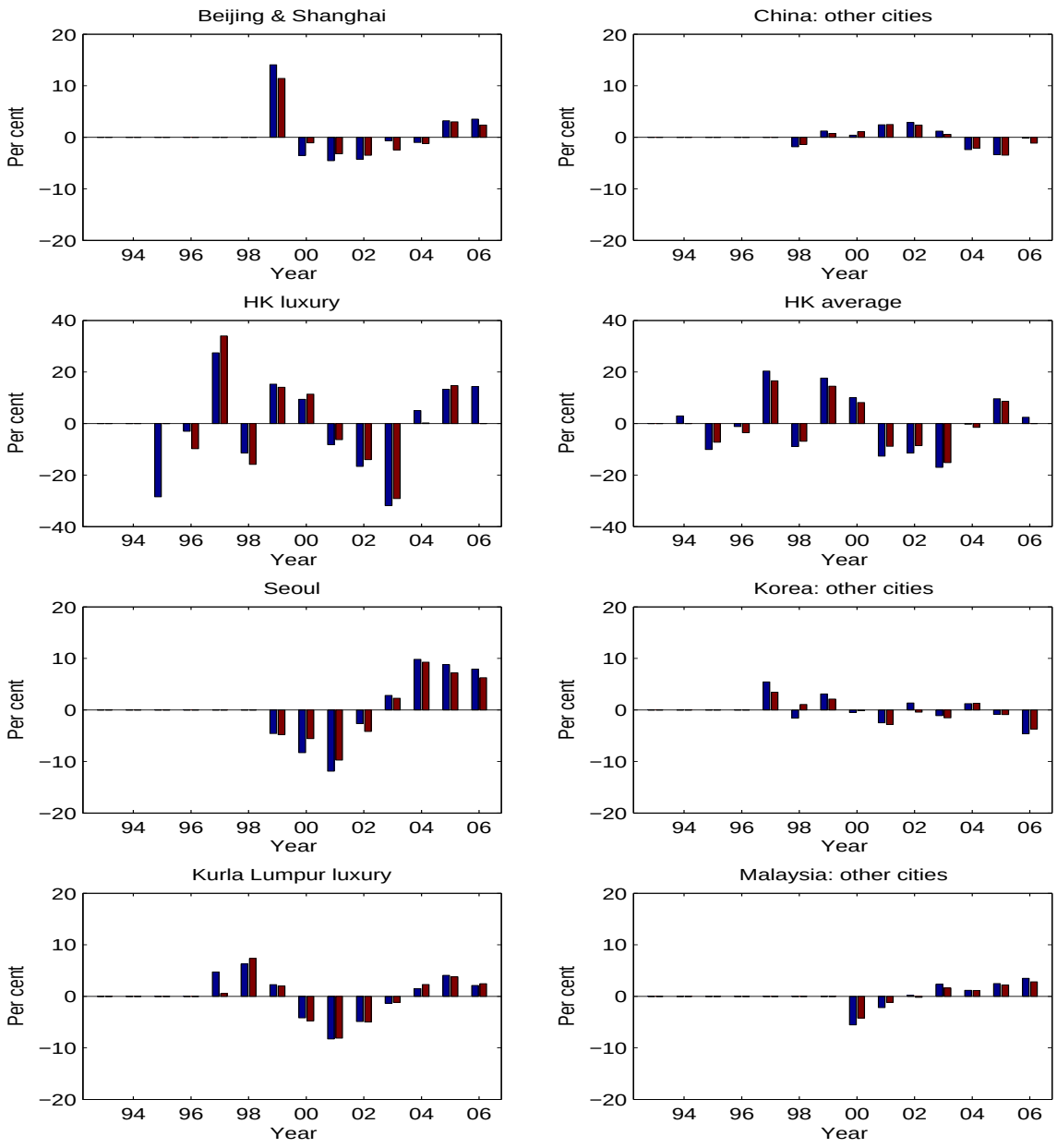


Figure 7: Deviation of city-level house prices from their fundamentals

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.

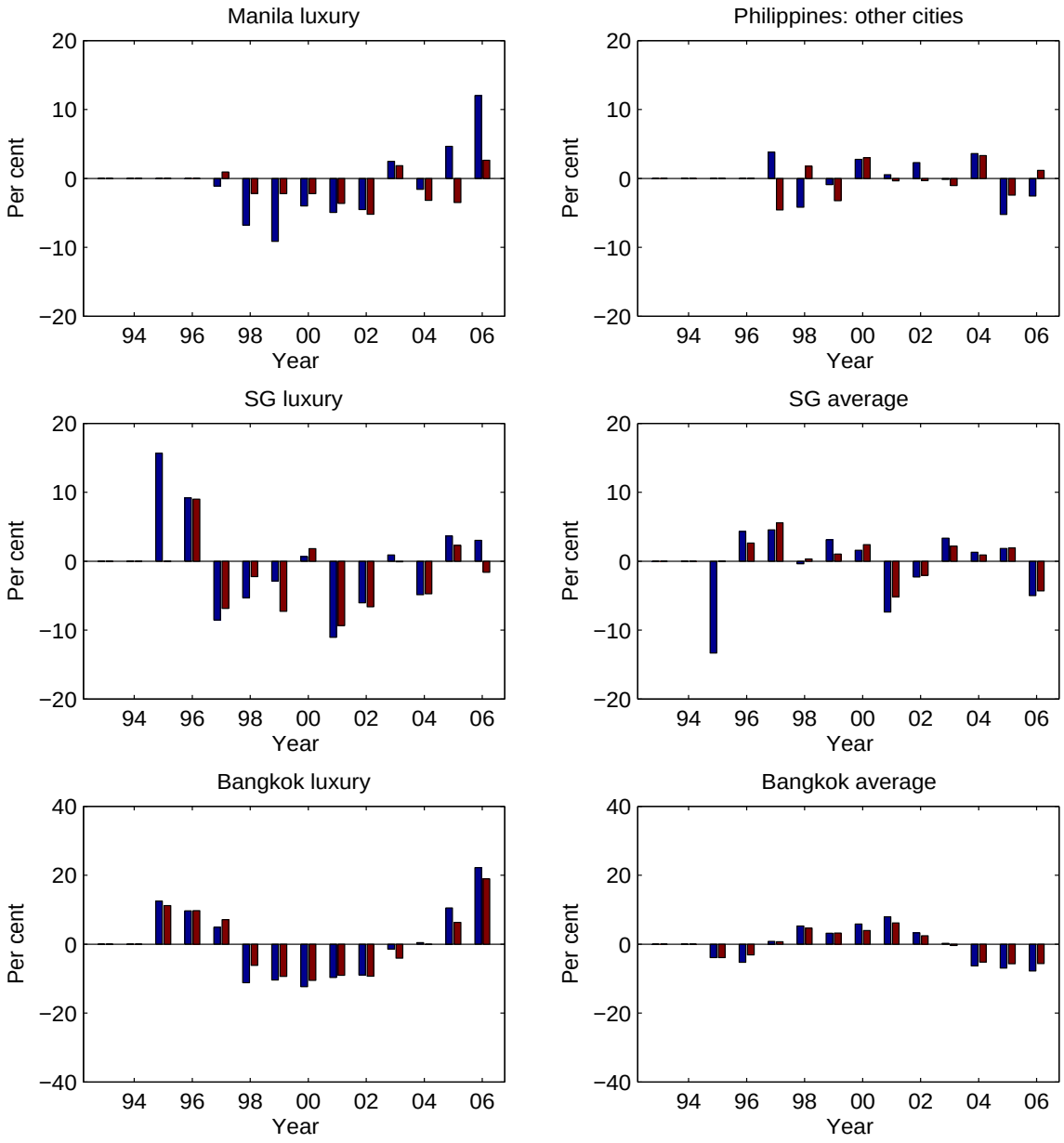


Figure 7: Deviation of city-level house prices from their fundamentals (continued)