Determinants of house prices in nine Asia-Pacific economies[1]

Eloisa T Glindro[2], Tientip Subhanij[3], Jessica Szeto[4] and Haibin Zhu[5]

1 Introduction

There are good reasons why the public and policymakers should monitor house price developments closely. In most countries, housing is generally households' single largest investment and hence house price risk may be considered to be the major financial risk they face (Cocco, 2004; Yao and Zhang, 2005). Fluctuations in residential property prices tend to have a bigger wealth effect than those of financial assets.[6] In addition, there are strong linkages between the residential property cycle and the credit cycle, and by extension the banking sector and the macroeconomy. This is because the purchase of a house is predominantly funded by mortgage loans originated by financial institutions, and real estate property is widely used as a major collateral asset for bank loans.[7] Reflecting these insights, the Financial Sector Assessment Program (FSAP), which was introduced by the IMF and the World Bank in 1999, advocates the inclusion of real estate prices in the recommended set of financial soundness indicators (FSIs).

House price risk has attracted much attention in recent years. A number of industrialised economies, including those of the United States, the United Kingdom and Spain, have witnessed a recent, protracted period of significant increases in house prices. The perceived lower risk has encouraged laxity in mortgage market lending criteria, which lie at the heart of the ongoing subprime crisis. By comparison, housing markets in most Asian economies have been relatively tranquil during the same period. However, the situation has started to change in the past several years. China, Hong Kong SAR and Korea have witnessed very strong

---

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

[2] Center for Monetary and Financial Policy, Bangko Sentral ng Pilipinas, Manila, Philippines.

[3] Economic Research Department, Bank of Thailand, Bangkok, Thailand.

[4] Economic Research, Hong Kong Monetary Authority.

[5] Senior Economist, Bank for International Settlements.

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

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

house price inflation recently (see Figure 1). Given the not-so-distant experience of financial crises in this region (eg the 1997 Asian crisis and the so-called “lost decade" in Japan), in which booms and busts in real estate markets played a crucial role, concerns have arisen that new housing bubbles could form. There are two opposite views. Pessimists argue that house prices have been overvalued in many countries and will face downward corrections in the near future. At the extreme, some see evidence of new speculative housing bubbles, and call for supervisors and central banks to take active measures to contain them. By contrast, the optimists consider this round of house price growth as a manifestation of recovery from the previous crisis. The optimists argue that, in the aftermath of a previous crisis, house prices were too low compared to their fundamental values. Therefore, the rebound of house prices from very low levels is simply a consequence of the mean reversion process. Moreover, the liberalisation of housing markets and housing finance systems in the past decade, including a general trend towards more market-based housing markets, greater availability of mortgage products and more liquid secondary mortgage markets, have arguably improved market efficiency, stimulated demand and contributed to house price growth.

The paper sheds some light on this debate by examining house price developments in nine economies in the Asia-Pacific area, including Australia, China, Hong Kong SAR, South Korea (Korea hereafter), Malaysia, New Zealand, the Philippines, Singapore and Thailand.[8] We examine the determinants of house price dynamics in two steps. In the first step, house price fundamentals are determined by country-specific demand and supply factors. In the second step, the characteristics of house price cycles are further explored by investigating evidence of serial correlation and mean reversion embedded in the short-term dynamics of house prices in each country. Not surprisingly, the patterns of national house price dynamics exhibit significant cross-country heterogeneity, which can be attributed to different stages of economic development, different institutional arrangements and market-specific conditions.

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

The distinction between the cyclical and bubble components of house price overvaluation can be important for policy considerations. To mitigate house price overvaluation driven by cyclical movements related to market frictions, a policymaker should probably focus on measures that aim at reducing the magnitude and frequency of house price cycles, such as loosening land use regulation, improving information availability and transparency and enhancing property right protection. By contrast, to contain a bubble, the policymaker should instead adopt measures that counter the over-confidence of investors in the housing market and their unwarranted expectations of capital gains.

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

The remainder of the paper is organised as follows. Section 2 provides an overview of the literature and highlights the contributions of this study. Section 3 explains the empirical method adopted in this study, and Section 4 describes the data and empirical results. Finally, Section 5 concludes and provides some policy perspectives.

2. Literature Review

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

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

Existing literature shows that house price movements are closely related to a common set of macroeconomic variables and market-specific conditions. Hofmann (2004) and Tsatsaronis and Zhu (2004) examine the determinants of house prices in a number of industrialised economies, and find that economic growth, inflation, interest rates, bank lending and equity prices have significant explanatory power. The linkage between property and bank lending is particularly remarkable, as highlighted by Herring and Wachter (1999), Hilbers et al (2001), Chen (2001) and Gerlach and Peng (2005). Moreover, housing markets are local in nature. Garmaise and Moskowitz (2004) find strong evidence that asymmetric information about local market conditions plays an important role in reshaping property transactions and determining the choice of financing. Green et al (2005) find that house price dynamics differ across metropolitan areas with different degrees of supply elasticities.

Given the heavy reliance on mortgage financing in the housing market, housing finance system arrangements turn out to be another key factor to be considered in examining house price movements. There are recognisably significant time variation[9] and cross-country differences in terms of the prevalent contract type, the lending practice, the valuation method of collateral assets, the development of mortgage backed securities (MBSs), the flexibility in

[9] In the last several decades, housing finance systems have experienced remarkable changes in both industrialised 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.

mortgage refinance and mortgage equity withdrawal. Such differences depend on the stage of economic development and the development of credit information systems and the strength of legal rights (Warnock and Warnock, 2007). There has been substantial evidence that institutional arrangements in housing finance systems have important implications on house price dynamics, both in time series (see Peek and Wilcox, 2006; Estrella, 2002; McCarthy and Peach, 2002) and cross-country analyses (see Tsatsaronis and Zhu, 2004; Égert and Mihaljek, 2007).

On the important issue of detecting house price bubbles, several approaches have been adopted in the literature. Bubble episodes are sometimes assessed by market analysts in terms of the price-rent ratio or the price-income ratio. Typically a bubble is identified if the current ratio is well above the historical average. These measures, however, may be inadequate barometers for policy analysis because they ignore the variation in "equilibrium" price-rent (or price-income) ratios driven by fluctuations in economic fundamentals (eg rent growth, income growth and the desired rate of return). To overcome these problems, two methods have been proposed. The first method is to compare observed price-rent ratios with time-varying discount factors that are determined by the user cost of owning a house, which consists of mortgage interest, property tax, maintenance cost, tax deductibility of mortgage interest payments and an additional risk premium (see Himmelbert et al, 2005; Ayuso and Restoy, 2006; Brunnermeier and Julliard, 2007). The second method is to compare observed house prices with fundamental values predicted based on the long-run relationship between house prices and macroeconomic factors (see, Abraham and Hendershott, 1996; Kalra et al, 2000; Capozza et al, 2002, for example). In this paper, we adopt the second method because of data limitations and heterogeneity in what constitutes appropriate measurement of the user cost across countries.[10]

This paper examines the characteristics of house price dynamics in nine Asia-Pacific economies and 32 cities/market segments in these countries, discusses the role of distinctive institutional arrangements and explores the possible emergence of housing bubbles. The two closely related papers are Capozza et al (2002) and Tsatsaronis and Zhu (2004). Capozza et al (2002) characterise the dynamics of house price cycles in US metropolitan areas by computing the serial correlation and mean reversion coefficients, the same two key parameters used in this study. Tsatsaronis and Zhu (2004) compare the features of national housing finance systems in 17 industrialised economies. Both papers find strong effects of institutional arrangements on house price dynamics, as we will illustrate in this study. However, our study differs substantially from those previous ones in three important ways.

First, previous studies have mainly focused on the lessons from industrialised economies. This study is one of the first papers to investigate the evidence in the Asia Pacific area, which has gained an increasing importance in the global economy. Given the remarkable experience of housing bubbles in many of the Asian economies in the 1990s, it is interesting to examine the house price movements after the crisis episode. In addition, Asia-Pacific housing markets differ substantially from those of industrialised 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 that provides a more robust message about 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 mortgage rate adjustability,

[10] 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.

maximum loan-to-value ratios, valuation method and mortgage equity withdrawal. These measures are constant over time for each country, implying that the impact of housing finance innovations on each market has been ignored. In Capozza et al (2002), the role of housing finance systems is in effect barely touched because the authors examine house price dynamics in metropolitan areas within the same country. In this study, we construct a measure of institutional factors on the basis of four different aspects of market developments, and this measure not only differs across countries but also varies over time. Therefore, we believe our results are more informative with respect to the role of institutional arrangements.

Third, we extend the housing bubble literature by distinguishing between house price growth and house price overvaluation, and between cyclical and bubble components of house price overvaluation. The first distinction is quite obvious. House price growth may simply reflect the increase in the fundamental value of the property, which is driven by income, mortgage rates and other factors. By contrast, house price overvaluation refers to the situation that current house prices are higher than the fundamental values.

The second distinction is more subtle. A bubble is necessarily related to house price overvaluation, but not vice versa. This is because frictions in the housing market, including lags in supply and credit market imperfections, may cause house prices to deviate from their fundamental values in the short term. In this paper, we consider that this cyclical component of house price overvaluation can be reflected by the serial correlation and mean reversion of house price dynamics, and define the unexplained part as the bubble component that is more likely to be driven by overly optimistic expectations in the housing market. Such a distinction is particularly important from a policymaker's perspective, because policy recommendations are quite different depending on what drives overvaluation of house prices.

3. Methodology

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

3.1 Characterising house price dynamics

We follow the framework developed by Capozza et al (2002) to investigate the long-term and short-term determinants of house price movements. The approach can be divided into three steps. In the first step, the fundamental value of housing is calculated. In the second step, the short-term dynamics of house prices are determined by a mean reversion process to their fundamental values and by a serial correlation movement. The pattern of house price movements can be characterised by the mean reversion and serial correlation coefficients. In the third step, interactive terms are introduced to investigate the impact of institutional factors on house price dynamics.

3.1.1 The fundamental value of housing

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

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

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

house price fundamentals. We choose four blocks of explanatory variables based on theoretic reasoning or previous empirical work.

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

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

The third block of variables are prices of other types of assets, including equity prices and exchange rates. It is well documented that house prices tend to comove with other asset prices. For instance, Sutton (2002) and Borio and McGuire (2004) find strong linkages between equity price and house price movements. The direction of such linkage, from a theoretical perspective, is not clear, as the substitution effect and wealth effect point in opposite directions[11]. Moreover, a real effective exchange rate appreciation is expected to exert positive influence on property market prices, particularly in markets where there is substantial demand from non-residents for investment purposes. In countries where foreign investments play an important role in the economy such as in Asia, an exchange rate appreciation is normally associated with housing booms.

Lastly, we also include an institutional factor that attempts to account for the impact of market arrangements on equilibrium house prices. The institutional factor is constructed as the first principal component of four index variables: the business freedom index, the corruption index, the financial sector index and the property rights index.[12] The institutional factor is designed to examine the impact of business, regulatory and financial conditions on the determination of house prices.

Several remarks are worth mentioning. First, we adopt a general-to-specific approach in assessing the determinants of house price fundamentals. That is, we start by including the whole list of possible explanatory factors to investigate their long-term relationship with house prices, using either single-equation ordinary least squares (OLS) or panel data techniques.[13] Only regressors found to be significant at the five percent level are retained.

---

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

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

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

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

Third, we use the trend series of mortgage credit to GDP ratios and equity prices in explaining the long-run house price fundamentals. The original raw series may contain non-fundamental component, and a housing bubble often comes with excessive growth in mortgage credit and sometimes interact with extreme equity price movements. Using the trend series of the two variables can ensure that our estimates of house price fundamentals are not contaminated by the non-fundamental (or bubble) components and by extension, minimise potential errors in the analysis.

3.1.2 Short-run dynamics

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

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

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

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

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

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

We then proceeded to study the characteristic roots of the corresponding characteristic equation given by $b^2 - (1+\alpha-\beta)b + \alpha = 0$, which determine the properties of house price dynamics. In graphical form, house price dynamics can be depicted as in Figure 2.[14]

To summarise, the sufficient and necessary condition for a house price cycle to be stable is $\alpha < 1$ and $\beta > 0$. If satisfied, there are two possible types of house price movements: (i) if $(1+\alpha-\beta)^2 - 4\alpha \geq 0$ (see Region I in Figure 2), the house price will converge monotonically to the equilibrium level. In this case, the transitory path itself does not generate house price cycles; in other words, house price cycles only reflect cyclical movements in their fundamental values. The speed of convergence depends on the magnitude of the two coefficients: the convergence rate is generally higher when α and β are larger. (ii) if $(1+\alpha-\beta)^2 - 4\alpha < 0$ (see Region II in Figure 2), the transitory path in response to changes in equilibrium house price values exhibits a damped fluctuation around the equilibrium level. The magnitude of the two coefficients, again, decide on the property of the oscillation.

[14] The strict proof is available upon request.

Generally, a higher α implies a higher amplitude and a higher β implies a higher frequency of the fluctuation process.

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

3.1.3 The role of institutional factors

Given the importance of mean reversion and serial correlation coefficients, the question to be asked is: what determines α and β? Following Capozza et al (2002), we posit that they are determined by region-specific factors, including the stage of economic development, the elasticity of land supply and other institutional factors that reflect differences in business environment and housing finance system arrangements.

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

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

where Y_{ijt} is a list of region-specific economic and institutional factors that may affect the property of house price dynamics.[15] 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 $\alpha_i = \alpha_0 + \sum_j \alpha_j \bar{Y}_{ijt}$ and $\beta_i = \beta_0 + \sum_j \beta_j \bar{Y}_{ijt}$, respectively, where $\bar{Y}_{ijt}$ represents the time average of Y_j in country i.

3.2 Detecting housing bubbles

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

House price overvaluation is defined as the fact that observed house prices (P_t) are higher than predicted house price fundamentals (P_t^*) (see section 3.1.1, subscript i omitted). Intuitively, it is distinct from high house price inflation because the latter may simply reflect the increase in house price fundamentals.

More importantly, we also make a clear distinction between house price overvaluation and a house price bubble, the concepts of which are often mixed in the existing literature. Throughout this paper, a housing bubble is defined via component analysis of house price overvaluation. As suggested by Wheaton (1999) and Davis and Zhu (2004), frictions in housing markets can generate intrinsic house price cycles, causing house prices to deviate (sometimes substantially) from their fundamental values in the short term. We consider this cyclical component of house price overvaluation to be reflected in our estimates of short-term dynamics. The residual component that cannot be explained by the intrinsic adjustment

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

process is what we define in this paper as the "bubble" component (also see Brunnermeier and Julliard, 2007).

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

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

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

4. Data description and empirical findings

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

To start with, Table 1 summarises and compares the developments of housing markets in the nine Asia-Pacific economies. Culturally, there was a general trend towards encouraging home ownership in Asia during the period under review. The property sector is normally dominated by a few major developers. The banking system, alongside the government housing finance system, plays an important role in meeting the demand for housing in most sample economies. The national housing markets share certain similarities (eg the prevalent use of floating-rate mortgage contracts), but there are also important differences.

4.1 Data description

Quarterly data for residential property sector in nine economies and 32 cities/market segments in Asia[16] were used in the analysis. Where data are available, quarterly series spanning the period 1993-2006 were used.

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

Apart from the residential property price index, other series used in this study include real GDP, population, the construction cost index, the land supply index, mortgage credit to GDP ratios, real mortgage rates, real effective exchange rates, the stock price index, and four institutional indices: the business freedom index, the financial freedom index, the corruption index and the property rights index. Table 2 reports summary statistics of key variables used in this study, for each country and for the whole sample.

A key explanatory variable used in this study is the institutional factor, which is defined as the first principal component of the four institutional indices as mentioned above. It is constructed so that we can investigate the role of institutional factors in determining long-run and short-run dynamics of house prices in a parsimonious way. It turns out that the first principal component has approximately equal weights of the four indices, and can account for about 80% of the variability in the four index series. A higher score in the institutional factor is associated with higher business freedom, better regulatory conditions, lower corruption, a greater range of intermediation functions by the financial sector and a higher degree of flexibility in acquiring land and better legal protection to land/home owners. Therefore, a higher institutional factor score tends to reduce the searching and transaction cost, facilitate credit transactions and allow investors to respond more quickly to changes in the housing market. As shown in Figure 3, the institutional factor exhibits substantial time variation and cross-country differences. The nine economies can be easily divided into two groups: Australia, Hong Kong, New Zealand and Singapore as more business-friendly and the other five economies less so. Overtime, Australia and New Zealand experienced major improvements, while Malaysia and Thailand witnessed deterioration in their business environment during the period under review.[17]

4.2 Characterising house price dynamics

To investigate the characteristics of house price dynamics, we follow the Capozza et al (2002) approach as described in Section 3.1. We run three different regressions.

---

[16] At the city level, Beijing, Chongqing, Guangzhou, Shanghai, Shenzhen and Tianjin are included in China; Busan, Daegu, Daejon, Gwangju, Incheon, Seoul and Ulsan are included in Korea; Johor, Kuala Lumpur, Pahang, Perak and Pinang are included in Malaysia; Caloocan, Makati, Manila, Pasay, Pasig and Quezon are included in the Philippines. In addition, for Hong Kong, Singapore, Bangkok, Manila and Kuala Lumpur, there are two separate sets of house prices for the average market and for the luxury market segments respectively.

[17] The differences in institutional factors are highly consistent with the differences in housing finance system developments. Among the nine sample economies, Australia, Hong Kong, New Zealand and Singapore have more advanced housing financing systems and more active secondary mortgage markets (see Zhu, 2006).

The first regression relies on a panel data technique to estimate the determinants of fundamental house prices (Equation 1) and the short-run dynamics (Equation 3), with the results reported in Table 3. The regression attempts to capture the common picture, if any, of house price cycles for the nine economies during the sample period, ie 1993-2006. In stage 1, the determination of house price fundamentals yields results that are largely consistent with the theoretical predictions (Table 3.A). First, higher income, prospects of higher capital gains from real effective exchange rate appreciation and greater credit availability (mortgage credit-to-GDP) are associated with increases in house prices in Asia-Pacific economies. Second, increases in real mortgage rates have a dampening effect on house prices by raising the cost of housing purchase, but the magnitude is relatively small. Third, the coefficient of the land supply index is positive, which conflicts with the theoretical prediction that increases in land supply have a dampening effect on house prices in the long run. This may, however, reflect a linkage in the opposite direction, ie higher house prices provide an incentive for developers to build new residential property projects. Fourth, the institutional factor has a positive and significant effect, suggesting that the improvement in business environment (higher transparency in business regulations, lower corruption, a higher degree of financial sector development) facilitates additional transactions and exerts a positive impact on house prices. Lastly, equity prices are negatively related to house prices, suggesting that the substitution effect prevailed over the wealth effect during the sample period.

Results for the short-term dynamics, using the house price fundamentals predicted in the panel regression results, are reported in Table 3.B. Figure 4 summarises the characteristics of house price dynamics in each of the nine economies, by plotting the average persistence and mean reversion coefficients using the time-average of country-specific variables. They are separated into two groups. Australia, Hong Kong, New Zealand and Singapore typically observe damped oscillation of house prices if the fundamental values change, whereas China, Korea, Malaysia, the Philippines and Thailand observe a convergence to the fundamental values.[18] The speed of convergence is the lowest in China and the Philippines, suggesting that the price discovery function is the weakest in these two markets.

The differences in national house price dynamics can be explained by differences in market arrangements, such as the supply elasticity, mortgage rate adjustability and the institutional factor (Table 3.B).[19] First, the land supply index has a negative interactive effect on the persistence coefficient. As expected, increases in the land supply index and the construction cost index (proxies for higher supply elasticity) temper the magnitude of house price cycles. Second, changes in mortgage rates have a positive interactive effect on the mean reversion coefficient. This is probably because larger changes in mortgage rates may reflect a more liberalised mortgage market or higher flexibility in mortgage rate adjustment, which is often associated with a faster speed of convergence to the equilibrium price (a higher mean reversion coefficient). Lastly, the institutional factor has a positive interactive effect on the persistence parameter and a negative interactive effect on the mean-reversion parameter. That is, a higher score in the institutional factor tends to increase the amplitude but lower the frequency of house price cycles. This is quite surprising as it indicates that a more flexible market is associated with more significant house price fluctuations.[20] There might be two

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

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

[20] Along the same lines, Zhu (2006) also suggests that house prices in Hong Kong and Singapore, the two economies with the most flexible housing finance arrangement, are much more volatile than a number of other Asian economies.

reasons. For one, the housing market is characterised by many frictions, making housing a unique type of asset. By introducing more flexible housing finance systems and improving the business environment, the role of housing as an investment good expands and the price-discovery function in the housing markets strengthens. This probably explains the higher volatility when housing markets become more market-oriented. On the other hand, the less volatile house prices in those economies with a lower score in their business freedom index is probably attributable to more extensive government support and finance-linked subsidies in these economies.

The second regression (Table 4) is similar to the first one, except that country-specific regressions are used to identify the determination of house price fundamentals.[21] It is commonly known that housing is a local product and the determination of house prices tend to be market-specific. To reflect this we allow the house price fundamentals to be determined in each country-specific analysis, and use the country-specific predicted fundamental values in the analysis on the short-run dynamics.

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

The third regression (Table 5), instead, employs city-level data. As in the second regression, the fundamentals are determined on the basis of country-specific or market-specific analysis. The panel regression results of the endogenous adjustment equation, as shown in Table 5, show significant and positive interactive effects of a dummy variable that defines the most important market segments in each country.[22] By contrast, the interactive effects of supply and construction cost indices are washed out. This suggests that the high-end markets or the leading markets are more likely to be associated with lower response of supply to market demand, which causes them more likely to face a higher volatility of house price movements. By contrast, the negative (positive) interactive between the institutional factor (mortgage rate adjustment) and the mean-reversion parameter remains robust.

4.3 Detecting housing bubbles

Following the methodology described in Section 3.2, we try to address the question of whether house prices in selected Asia-Pacific economies are overvalued, and if so, whether there is evidence of some bubble being formed in this region.

The analysis is based on the second regression described above, which treats the determination of house price fundamentals as country-specific and relies on a panel data regression to analyse the patterns of short-run dynamics. In Figure 6, we first plot the deviation of house prices from predicted fundamentals, represented by the blue bars. At the national level, the evidence of house price overvaluation in recent years is rather weak. Except for Hong Kong SAR (where the house price was 10% higher than predicted

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

[22] It equals one for high-end markets (in Bangkok, 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).

fundamentals in year 2005), the deviation of house prices from fundamental values is quite small. The result contrasts sharply before the Asian-crisis, where house prices are about 20% higher than their fundamental values in Korea and Malaysia. It appears that the recent strong house price growth (eg in Australia, China, Korea and Hong Kong, see Figure 1) is mainly attributable to strong macroeconomic fundamentals.

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

The analysis also extends to city-level (or market-level) house price dynamics. Figure 7 plots, for each country, the house price deviation from fundamentals in the high-end market (or a leading market) versus the average market. There are two interesting findings. First, except for Malaysia, a more remarkable overvaluation has been detected in the leading market compared to the other markets in the current run-up of house prices. In other words, the house price overvaluation that is observed at the national level comes mainly from the leading market segment. Moreover, over the whole sample period, house prices in the leading market are more likely to deviate substantially from their fundamental values. These results are consistent with the conventional view that the leading market is more volatile than the average market. Second, the breakdown analysis suggests that speculative housing bubbles may exist at particular market segments, for instance, the luxury market in Manila and to a lesser degree in Bangkok, Seoul, Beijing and Shanghai. From a policy perspective, it is important for policymakers to implement market-specific diagnoses and to find the right policy instruments that can ideally distinguish between cyclical and bubble components.

5. Conclusion

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

Despite the relatively benign housing market environment in Asia, it remains crucial for regulators to understand the potential risks embedded in the evolving housing market structure. Whereas our study tries to investigate the determination of house price dynamics and evidence of house price bubbles, the answers are far from complete. Further exploration calls for improved data compilation and a better understanding of the mechanism of house price determination. For most of Asia, there appears to be a pressing need to improve the quality and timeliness of house price data if these are to aid in better analysis for policy decision-making purposes. Reliable information on city level or across market segments is crucial to the understanding of possible local/ market segment bubbles.

Appendix A.

House prices: definitions and data sources

Country	Series definition	Sources	Remarks
Australia	Residential property price index	national source	Weighted average of eight capital cities in Australia, namely Sydney, Melbourne, Brisbane, Adelaide, Perth, Hobart, Darwin and Canberra.
China	Property price index (both residential and commercial)	CEIC	Same source: city level information is also available. Beijing, Chongqing, Guangzhou, Shanghai, Shenzhen and Tianjin are included in this study
Hong Kong SAR	(i) Residential property price index (repeat sales); (ii) Capital value of luxury residential property	(i) CEIC; (ii) Jones Lang LaSalle (JLL)	(i) A composite index for all classes of private domestic, the most common official figures for property price measurement; (ii) Top capital value for a prime quality residential property in the best location
Korea	Residential overall house price index (including detached house and apartment prices)	CEIC	Same source: city level information is also available. Busan, Daegu, Daejon, Gwangju, Incheon, Seoul and Ulsan are included in this study.
Malaysia	(i) Residential house price index; (ii) Capital value of luxury residential property in Kuala Lumpur	(i) National source; (ii) CEIC	(i) Nationwide, all dwellings (per sq.m) is from national source. City-level/state-level residential house prices are from CEIC, using hedonic method. Johor, Kuala Lumpur, Pahang, Perak and Pinang are included in this study; (ii) Top capital value for a prime quality residential property in the best location in Kuala Lumpur
New Zealand	Residential property price index	National source	Total New Zealand index is from the total current valuations of the relevant local authorities combined and used to calculate the current average valuation for each quarter. These current valuations are then used to calculate the price index using sales price

Philippines	(i) Residential property price index; (ii) Capital value of luxury residential property	(i) NSO; (ii) JLL/Colliers International	(i) Constructed from available value of building permits and corresponding floor area. City level information is available for the National Capital Region (represented by Caloocan, Makati, Manila, Pasig, Pasay and Quezon; 2000=100); (ii) Top capital value for a prime quality residential property in the best location in Manila, Makati and Ortigas Center.
Singapore	(i) Residential property price index; (ii) Capital value of luxury residential property	(i) CEIC; (ii) JLL	(i) HDB resale price index, which is calculated from the quarterly average resale price of HDB flats by date of registration; (ii) Top capital value achievable for a prime quality residential property in the best location
Thailand	(i) Residential property price index; (ii) Capital value of luxury residential property in Bangkok	(i) BOT; (ii) JLL	(i) Bangkok and vicinities, single detached house and town house, including land (hedonic method); (ii) Top capital value achievable for a prime quality residential property in the best location in Bangkok

Table 1

House market conditions in selected Asia-Pacific economies

Country	LTV ratio	Mortgage credit Mortgage rate	Loan term	Government housing finance corporation[1]	Home-ownership rates[2]
Australia	60-70	variable	25	-	72.0 (2002-04)
China	80	variable	10-15 (≤30)	HPF	59.0 (2000)
Hong Kong SAR	70	variable	20	HKMC	57.0 (2004)
Korea	70	variable	3-20	KHFC	56.0 (2000)
Malaysia	80	variable	30	Cagamas	85.0 (1998)
New Zealand	80-85	variable	25-30	-	68.0 (2002-04)
Philippines	70	variable	10-20	HDMF	71.1 (2000)
Singapore	80	variable	30-35	HDB	92.0 (2005)
Thailand	80	variable	10-20 (≤30)	GHB	82.4 (2005)

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

Notes: [1] China has provident fund schemes, with housing loan facility made available to members. Shanghai pioneered the Housing Provident Fund (HPF) scheme in 1991, which became the model for national housing provident scheme introduced in 1994. The Philippines has Home Development Mutual Fund (HDMF), Government Service Insurance System and the Social Security System. [2] Various survey years reported in Cruz (2006) for Southeast Asian and East Asian countries and Ellis (2006) for Australia and New Zealand.

Table 2

Summary statistics

Variables	Total	AU	CN	HK	KR	MY	NZ	PH	SG	TH
RHP	109.07	109.05	108.35	114.28	116.87	102.29	116.87	105.95	95.73	109.50
	20.0	26.0	10.0	27.1	13.4	3.7	24.6	20.2	13.9	11.7
∆RHP(%)	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
∆Real GDP (%)	5.12	3.72	9.08	4.33	5.26	5.66	3.51	4.36	6.18	4.01
	4.0	1.2	1.5	4.3	4.3	4.9	1.7	2.0	4.8	5.3
Population (mn)	161.41	19.09	1249.03	6.57	46.37	22.62	3.87	73.73	3.87	61.73
	380.5	0.9	39.5	0.2	1.3	2.1	0.2	5.6	0.3	2.4
RMR (%)	4.84	5.13	2.32	4.75	2.98	3.33	6.60	6.06	5.37	5.64
	3.3	1.7	6.1	3.9	0.7	2.1	1.3	2.4	1.3	2.4
Mort/ GDP(%)	97.09	151.76	8.22	164.21	7.60	91.26	252.49	20.55	147.19	15.38
	82.1	40.6	1.7	34.5	7.6	15.1	37.5	5.9	31.3	1.4
LSI	147.05	105.95	108.47	91.74	123.18	87.94	119.26	115.26	138.75	440.68
	185.7	14.5	56.4	47.8	32.8	18.3	29.1	30.5	137.8	448.7
RCC	102.53	99.39	108.51	92.15	103.96	102.02	102.34	105.12	103.60	104.47
	7.7	3.1	11.1	5.9	4.9	3.7	3.5	10.1	4.4	5.9
EPI	104.16	110.89	94.48	93.24	103.46	106.14	120.41	102.72	100.31	105.83
	13.3	10.4	8.8	10.5	11.0	11.1	13.5	12.6	5.7	12.0
REER	110.32	93.82	73.67	74.13	110.41	99.76	108.94	130.99	90.00	106.04
	57.9	27.8	21.2	17.8	32.3	22.7	16.7	41.8	16.0	11.7
BFI	60.64	60.37	31.74	89.78	52.80	61.73	72.55	35.35	90.36	52.12
	21.4	13.9	5.8	0.8	9.4	10.0	8.1	9.4	1.2	7.1
FFI	63.46	90	40	88.33	56.67	40	90	48.33	70	50
	21.0	0	10.1	5.6	9.5	10.1	0	5.6	0	0
CI	64.83	83.33	31.583	85.67	58.75	61.583	92.18	27	91.08	54.58
	25.1	8.1	2.1	5.3	13.5	10.1	2.5	5.5	1.5	18.5
PRI	72.80	90	30	90	83.33	60	90	53.33	90	70
	22.0	0	0	0	9.5	10.1	0	16.2	0	14.3

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

Table 3

Panel regression results

3.A. Determinants of house price fundamentals, dependent variable: log of real house prices

Variables	Coefficient	t-statistics
Real GDP	0.36	2.0
Real mortgage rate	-0.033	6.4
MORT/GDP trend	0.37	4.6
Land supply index	0.078	4.1
Real effective exchange rate	0.55	3.8
EPI trend	-0.22	3.6
Institutional factor (IF)	0.14	3.4
Adjusted R^2	0.55	

3.B. Short-run house price dynamics, dependent variable: real house price growth

	Coefficient	t-value
Persistence parameter (α)	0.24	5.1
Mean reversion parameter (β)	0.22	7.8
Contemporaneous adjustment parameter (γ)	0.30	5.6
α* (change in land supply index)	-0.42	3.9
α* (change in construction cost)	-10.95	2.9
α* institutional factor	0.37	6.9
β* (change in mortgage rate)	0.14	4.4
β* (change in land supply index)	-4.67	2.4
β* institutional factor	-0.12	4.3
Adjusted R^2	0.36	

Notes: This table shows the regression results for the long-term determinants of house price fundamentals and short-term house price dynamics. Both regressions adopt the panel data regressions with fixed effects. "MORT/GDP trend" and "EPI trend" refer to the HP-filtered trend series of mortgage credit/GDP ratios and equity price indices, and the institutional factor refers to the first principal component of four institutional variables: BFI, FFI, CI and RPI as defined in Table 2. In panel A, all variables (except for mortgage rate and "MORT/GDP trend") are in logs. To avoid simultaneity bias, regressors are instrumented with own lags. Panel unit root tests on the residuals reject null of unit root process. Moreover, panel B uses the model as specified in Equation 3.

Table 4

Panel regression based on a country-specific model of house price fundamentals

4.A. Determinants of house price fundamentals, dependent variable: log of real house prices

	AU (OLS)	**CN (panel)**	**HK (OLS)**	**KR (panel)**	**MY (panel)**	**NZ (OLS)**	**PH (panel)**	**SG (OLS)**	**TH (OLS)**
Constant	4.21	4.07	-8.39	5.60	2.42	-4.01	3.50	-4.82	4.76
Real GDP	0.38	0.18	0.022	-	0.41	0.56	-	-	-0.18
Mort/ GDP[1] trend	0.92	-	-	-	0.24	-	1.08	-0.031	0.98
Real mortgage rate	-	-	-0.051	-0.034	0.010	-	0.017	-	-
Land supply index	0.23	-3.51	-	-0.16	-	-	0.16	-	0.074
Real construction cost	-	0.25	-	-	-	-	-	0.78	-
REER[2]	-	-	0.99	-	-	0.32	-	1.30	-
Equity price trend	-0.84	-	2.22	-	-	0.98	-	-	-
Adjusted R^2	0.99	0.77	0.87	0.51	0.82	0.98	0.41	0.65	0.88

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

4.B. Short-run house price dynamics, dependent variable: real house price growth

	coefficient	t-value
Persistence parameter (α)	0.12	2.5
Mean reversion parameter (β)	0.26	2.6
Contemporaneous adjustment parameter (γ)	0.68	10.9
α* (change in land supply index)	-0.46	3.7
α* (change in construction cost)	-10.8	3.1
α* INSTITUTION	0.20	4.1
β* (mortgage rate)	0.018	1.8
β* (change in land supply index)	-0.45	3.8
β*institutional factor	-0.085	1.8
Adjusted R^2	0.51	

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

Table 5

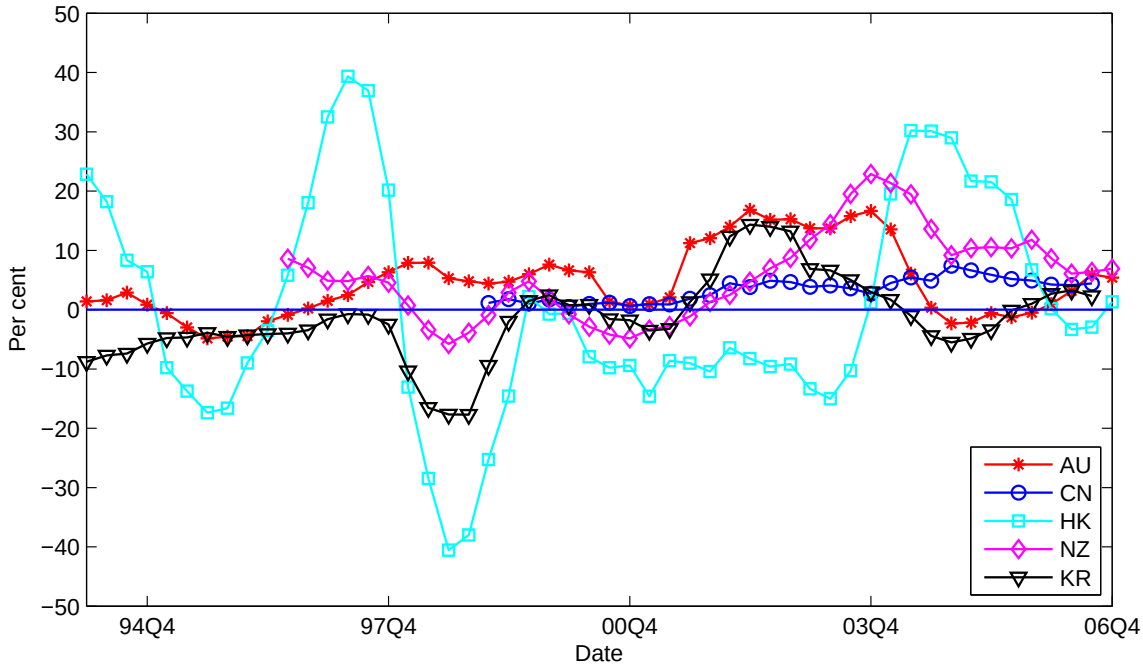
City-level endogenous adjustment panel regression results

	coefficient	t-value
Persistence parameter (α)	-0.14	5.7
Mean reversion parameter (β)	0.54	11.8
Contemporaneous adjustment parameter (γ)	0.91	29.4
α* (change in land supply index)	0.068	2.4
α* (dummy for major cities)	0.22	2.4
β* (change in mortgage rate)	0.084	2.6
β* institutional factor	-0.086	3.0
β* (dummy for major cities)	0.084	2.6
Adjusted R^2	0.32	

Notes: The regression is based on a panel data for 32 cities (markets) in seven Asia-Pacific economies (Australia and New Zealand excluded), using the panel regression with fixed effects. House price fundamentals are determined by the country-specific panel regressions or market-specific regressions, which are not reported here. The institutional factor refers to the first principal component of four institutional variables: BFI, FFI, CI and RPI as defined in Table 2. The dummy for major cities (markets) equals one for the following cities (markets): Kuala Lumpur luxury, Bangkok luxury, Manila luxury, HK SAR luxury, Singapore private, Beijing, Shanghai and Seoul.

Figure 1

House price inflation (yoy) in average residential markets, 1994-2006



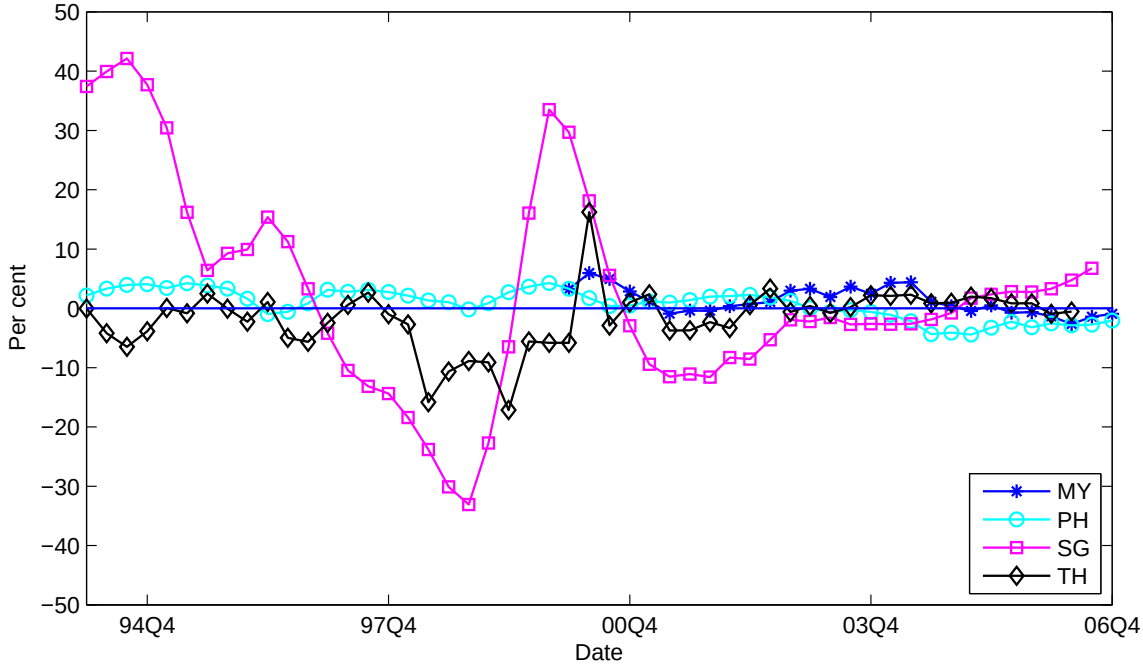
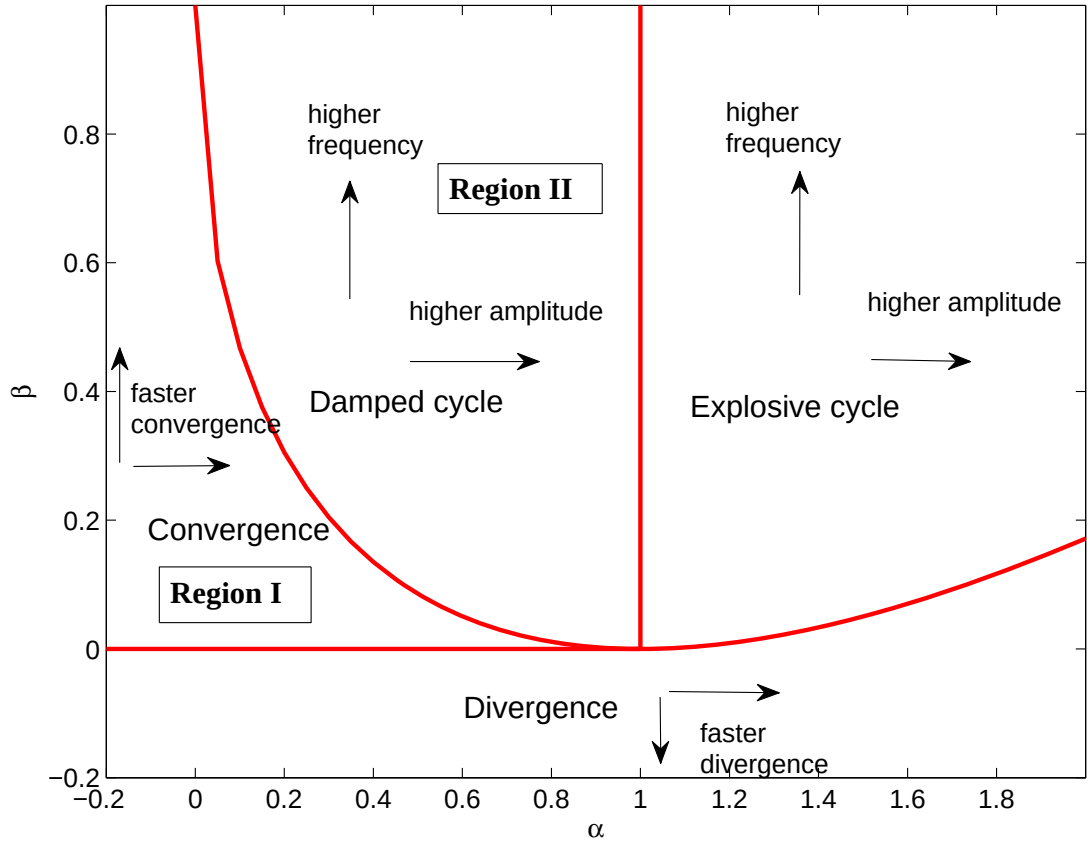


Figure 2

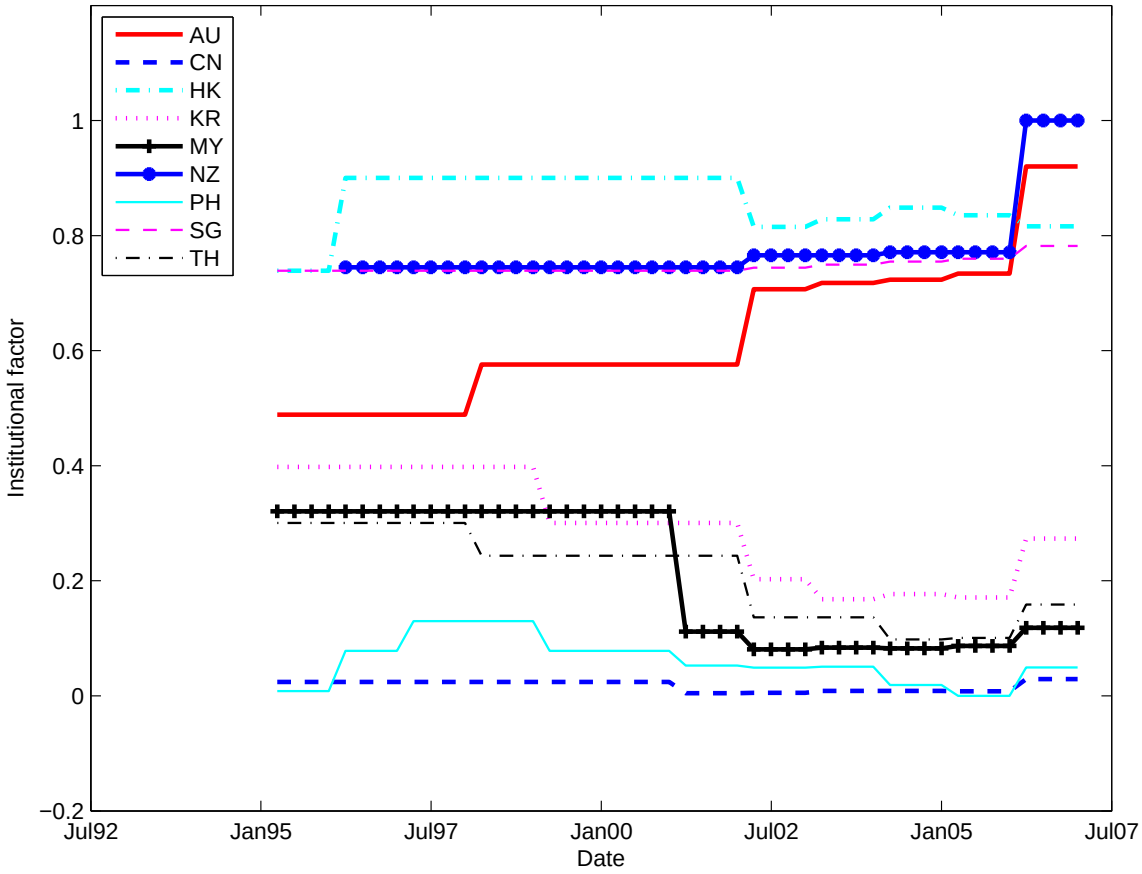
Characteristics of house price dynamics: illustration



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

Figure 3

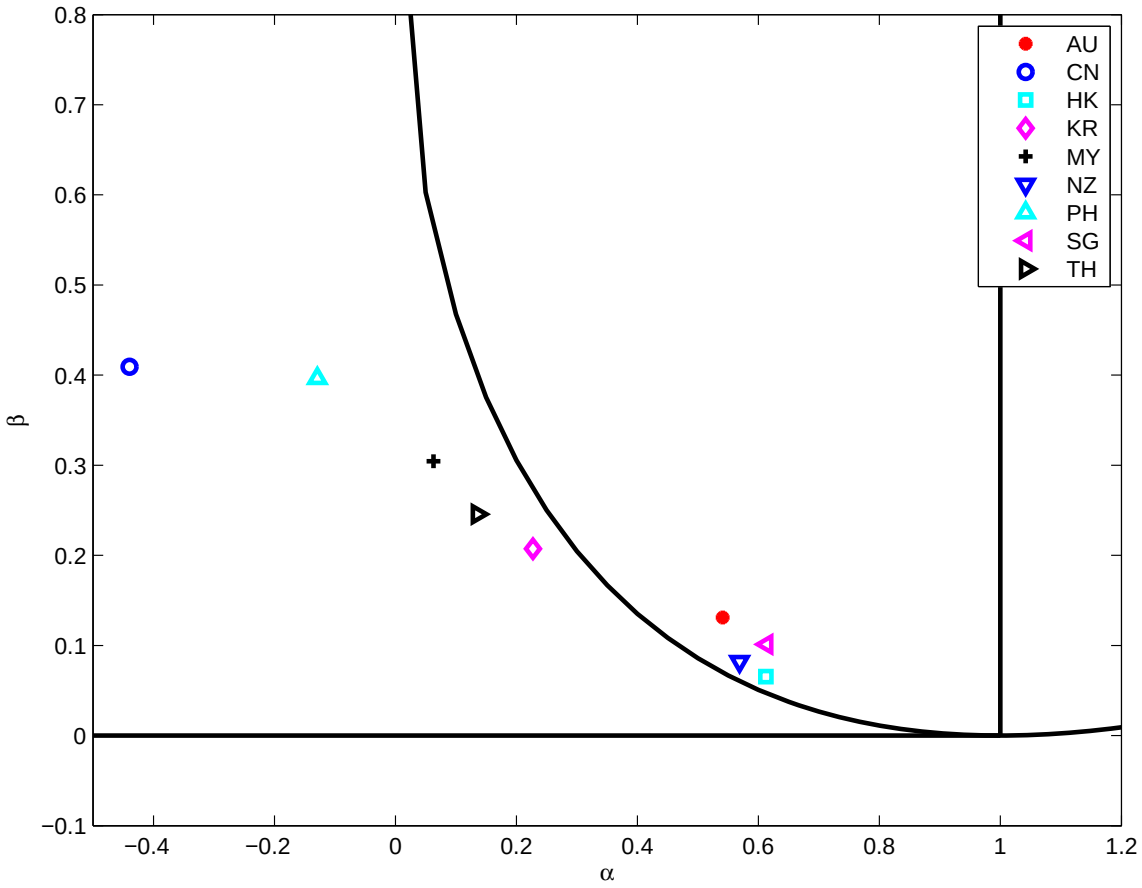
Institutional factors in nine Asia-Pacific economies



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

Figure 4

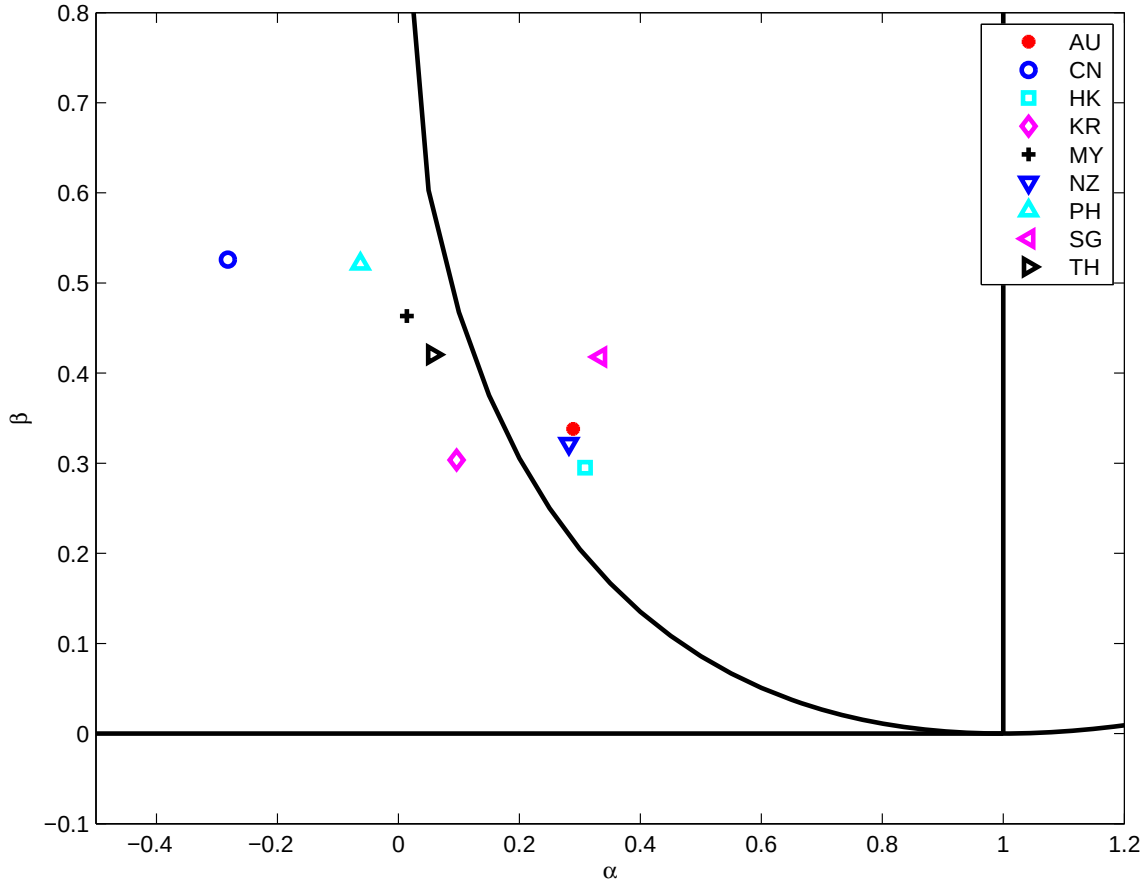
House price dynamics: panel regression results



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

Figure 5

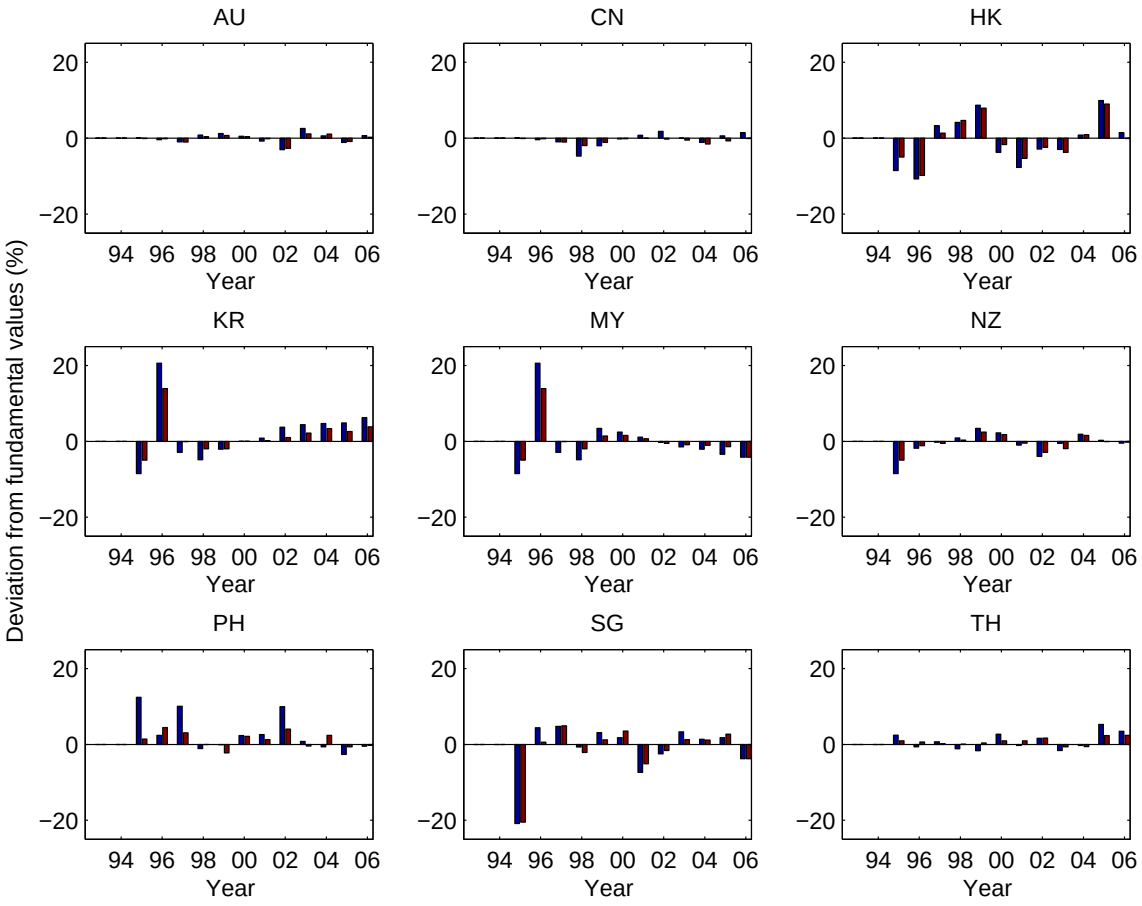
House price dynamics: baseline results



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

Figure 6

Deviation of country-level house prices from fundamental values



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

Figure 7

Deviation of city-level house prices from their fundamentals

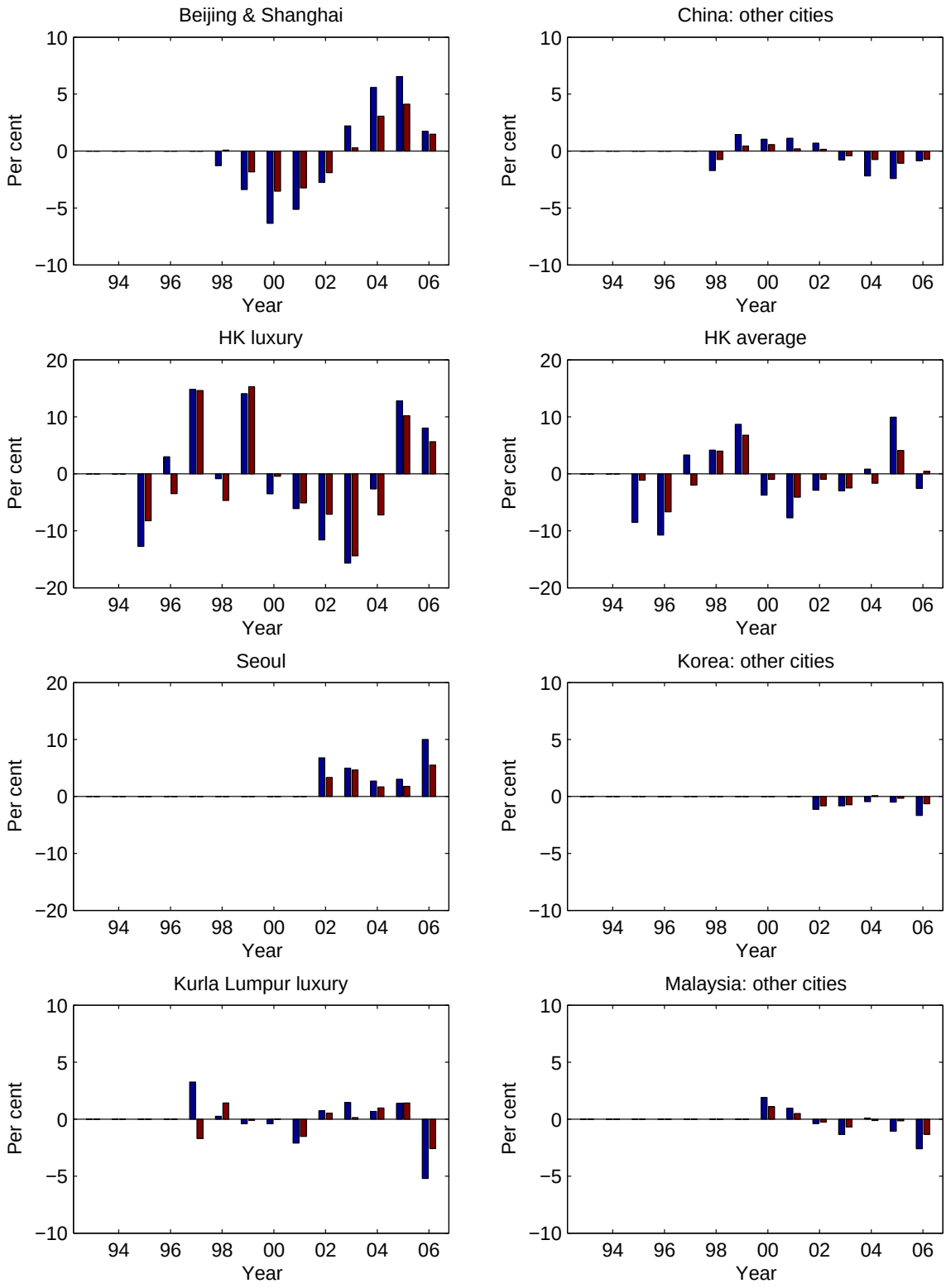
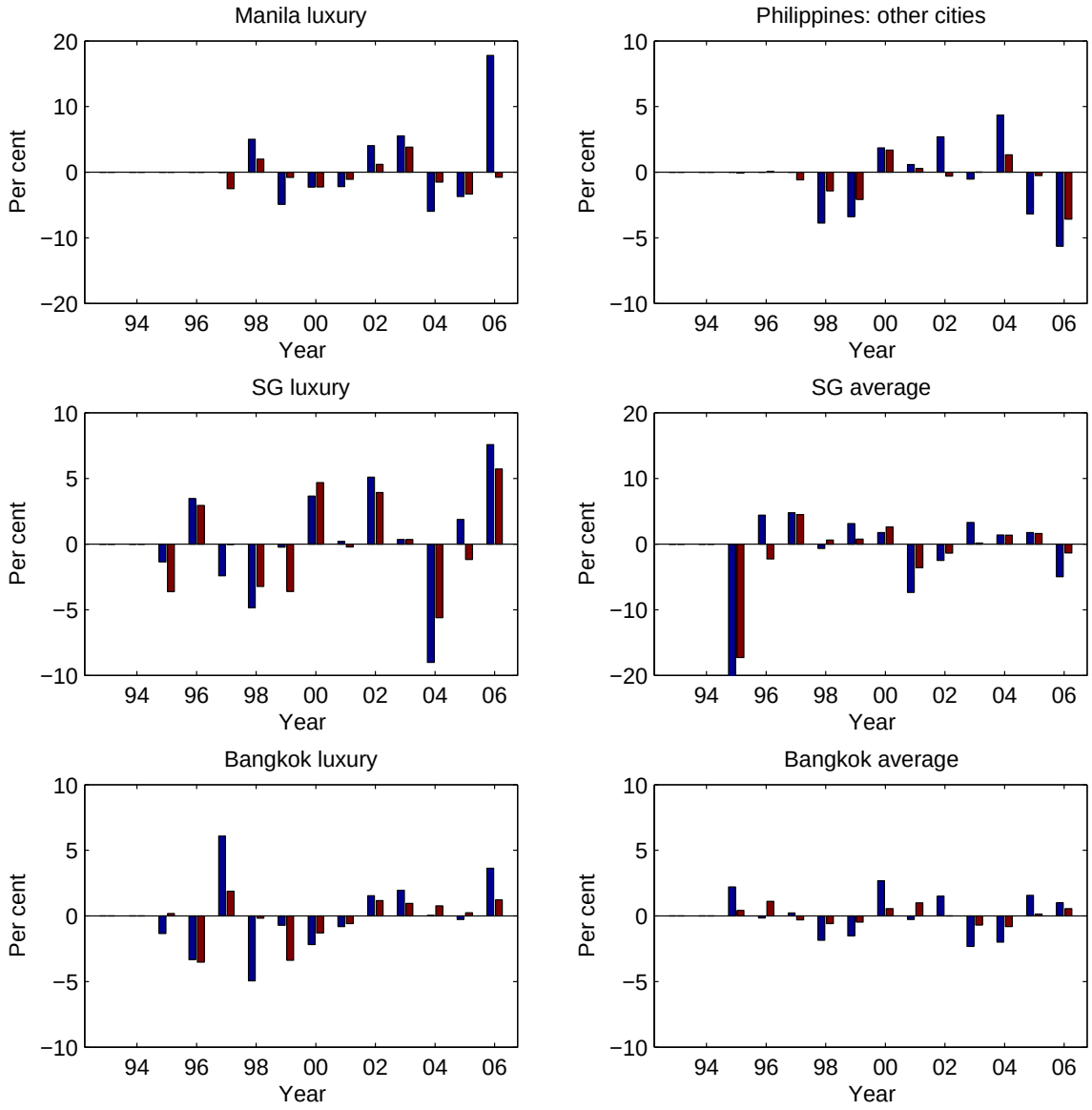


Figure 7 (cont)

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, ie 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 the Philippines, "other cities" refer to the average of Caloocan, Makati, Manila average market, Pasay, Pasig and Quezon.

References

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

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.

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

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.

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.

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.

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

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

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.

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

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.

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

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

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

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

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

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

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

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

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.

ECB (2003): “Structural Factors in the EU Housing Markets”, European Central Bank, March.

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

Ellis, L (2006). “Housing and Housing Finance: The View from Australia and Beyond”, RBA Research Discussion Paper no 2006-12.

Estrella, A (2002): “Securitization and The Efficacy of Monetary Policy”, FRBNY Economic Policy Review, May, pp 243-55.

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

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.

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

Girouard, N and S Bl¨ondal (2001): “House Prices and Economic Activity”, OECD Economics Department Working Papers, no 279.

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.

Hegedüus, 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.

Helbling, T and M Terrones (2003): “When Bubbles Burst”, in World Economy Outlook, International Monetary Fund, pp 61-94.

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.

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

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.

Hofmann, B (2004): “Bank Lending and Property Prices: Some International Evidence”, Working Paper.

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

Kiyotaki, N and J Moore (1997): “Credit Cycles”, Journal of Political Economy, vol 105, issue 2, pp 211-48.

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

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

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.

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.

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

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

Ng, A (2006): “Housing and Mortgage Markets in Malaysia”, in B Kusmiarso (ed), Housing and Mortgage Markets in the SEACEN Countries, SEACEN.

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

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.

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.

Subhanij, T (2007): “Some Lessons from Securitisation Crisis”, *Bangkok Post*, Business news, 13 July 2007.

Sutton, G (2002): “Explaining changes in house prices”, *BIS Quarterly Review*, September, pp 46-55.

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

Warnock, V and F Warnock (2007): “Markets and Housing Finance”, mimeo.

Wheaton, W (1999): “Real Estate ‘Cycles’: Some Fundamentals”, Real Estate Economics, vol 27, pp 209-30.

Wong Partnership (2007): “Land Appreciation Tax to be Strictly Enforced”, *China Watch*, January 31.

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.

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