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HOUSE PRICE CYCLES IN EMERGING ECONOMIES

by Alessio Ciarlone*

Abstract

In this paper, I investigate the characteristics of house price dynamics for a sample of 16 emerging economies from Asia and Central and Eastern Europe, over the period 1995-2011. Linking housing valuations to a set of conventional fundamental determinants – relative to both the supply and the demand side of the market, institutional factors and other asset prices – and modeling short-term price dynamics – which reflect gradual adjustment to underlying fundamentals – I draw conclusions about the existence, and the basic nature, of house price overvaluation (undervaluation). Overall, I find that actual house prices in the sample of emerging economies are not overly disconnected from fundamentals. Rather, they tend to reflect a somewhat slow adjustment to shocks to the latter. Moreover, the evidence that housing valuations may be driven by overly optimistic (or pessimistic) expectations is in general weak, even if this feature may have played a more prominent role up to the end of 2007, before the onset of the recent global real and financial crisis.

JEL Classification: E20, E21, E32, E44, C23, D12, P25, R21, R31.
Keywords: house prices, housing market, emerging markets, panel co-integration, asset prices.

Contents

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1. Introduction [1]

Global housing markets have been attracting a lot of attention in recent years, especially since developments in many countries have had similar dynamics: the prolonged boom in house prices until the financial and real crisis of 2008 – along with the subsequent sharp and widespread corrections – have been, in fact, at the centre of policymakers' discussions.

While much of the debate has focused on the experience of advanced economies – above all, the United States and United Kingdom – the characteristics of housing markets in emerging market economies (EMEs), as well as the links with overall macroeconomic conditions, have not yet been systematically researched. As it will be discussed below, over the last decade housing markets in emerging countries have been rapidly catching up with those in the developed world, with average annual price increases (adjusted for inflation) of around 15-20 percent not uncommon; moreover, the run-up in house prices before the 2008 crisis coincided with an unprecedented expansion of private sector credit.

Notwithstanding some cross-country differences, most EMEs have experienced substantial house price swings in real terms since the mid '90s, a dynamics similar to those experienced in advanced economies.[2] **Chart 1**, for instance, depicts the simple average of real house prices for both the overall sample of 16 EMEs, which are the object of this study, and for two regional groupings, Asia and Central and Eastern Europe,[3] comparing them with simultaneous developments in the US and UK housing markets.[4] Real house prices in both emerging regions underwent a substantial run-up from the historical trough following the Asian financial crisis until the peak recorded in early 2008, reaching valuations far above the respective historical averages. To a large extent, these dynamics have been driven by the sustained increases in housing valuations recorded in some countries in Central and Eastern Europe: in Latvia, Lithuania, Poland and Russia, in fact, housing valuations increased by almost 100 percent in real terms from 2005, when an acceleration took place, to the peak in early 2008 (**Chart 2**).[5] Asian economies showed more moderate gains in house prices during the same time span, with the more volatile markets of Singapore and Hong Kong recording the highest cumulative increases in real terms (42.4 and 26.6 percent, respectively) and Korea, Malaysia and Thailand experiencing the lowest (11, 2.7 and 0.6 percent, respectively).

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[1] This research was finalised when I was visiting the Faculty of Economics of the University of Cambridge. I am greatly indebted to Francesco Bripi, Luisa Corrado, Antonio De Socio, Valeria Rolli, Vanessa Smith, Giorgio Trebeschi, Teng Teng Xu and two anonymous referees for useful comments on earlier versions of this paper; any errors and omissions remain my own responsibility. The usual disclaimers apply.

[2] Girouard *et al.* (2006) note, for instance, the increasing coincidence of real house price movements internationally.

[3] The Asian aggregate comprises six countries: China, Hong Kong, Korea, Malaysia, Singapore and Thailand. The Central and Eastern Europe aggregate comprises the remaining ten: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Russia, Slovakia and Slovenia.

[4] The chart reports two indices widely used to monitor developments in the US and the UK housing markets, i.e. the Case-Shiller and the Halifax index respectively.

[5] The choice of 2005 as a base year is essentially a matter of convenience, as house price series are available for all 16 countries in the sample.

Real house prices rapidly changed course after the onset of the financial and real crisis that followed the collapse of Lehman Brothers on September 2008, falling sharply in almost all the emerging economies in the sample. The largest declines were recorded in those countries which had previously experienced the fastest and largest run-ups: real valuations, in fact, have come down substantially in Latvia, Estonia and Lithuania reaching, during the latest trough, a level 60, 58 and 51 percent lower than the previous peak, respectively. Adjustments in housing valuations were milder in Asian economies – with the exception of Hong Kong and Singapore – with Thailand, Malaysia and Korea experiencing real house price declines in the order of 4-8 percent.

Finally, while property prices in most Central and Eastern European economies were still decreasing or had stabilised at much lower levels in the last available quarters, since 2009 property valuations have been making a swift recovery in Asian countries: for instance, by June 2011, in Hong Kong and Singapore real valuations reached levels well above their previous 2008 peaks.

As regards housing market developments in China, after an initial phase of relatively stable dynamics (up to the end of 2004 annual price increases were, in fact, in the range of 4-6 percent), housing valuations underwent a relatively strong acceleration (up to 11-12 percent per annum) until mid-2008, when the eruption of the financial crisis took its toll. Driven by the fiscal stimulus package and massive credit expansion introduced by the government in response to this adverse global event, house prices soon regained a (more) sustained upward trend until mid-2010 when, against the background of increasing risks of overheating in the housing markets, the government started to change its course and introduced a number of policies geared at cooling down house price dynamics.[6] After more than fifteen months, these policies are having some impact, with sales down across the country and price increases down to more healthy levels (at around 4 per cent in the first half of 2011, from almost 15 in may 2010).[7]

These dynamics, characterised by rapid upward and downward swings, may raise the doubt that some of the observed real appreciation, and subsequent depreciation, may not be taken account of by changes in the underlying domestic economic fundamentals. While strong income and credit growth – to name just two of the various potential determinants of house prices – may account for a substantial part of the real appreciation observed up to early 2008, it is likely that other drivers can be traced back to global factors, such as low interest rates, excessive liquidity and risk-taking that prevailed up to mid-2007 (Terrones and Otrok, 2004; IMF, 2009). By the same token, the abrupt worsening in both real and financial sectors that the recent crisis undoubtedly brought about in several emerging economies may be due to the reversal of international financial conditions and investors' expectations.

A better understanding of the process that determines house prices may allow an informed assessment of the potential overvaluation in the market, which can become a source of economic and financial

[6] Examples include: closing down access to mortgage finance for those with more than two apartments, higher down-payment requirements, and restrictions in many cities on who can buy apartments (basically only registered residents). Developers' financing channels have also been somewhat squeezed.

[7] These considerations should be taken with a pinch of salt, due to the inherent deficiencies of house price statistics in China that make them difficult to compare with the rest of the emerging economies.

instability when it assumes the connotation of a bubble. A sudden collapse in property markets may, in fact, have negative spill-over effects on a country's financial stability and overall macroeconomic conditions (Hilbers *et al.*, 2008): the build-up of property price overvaluations, for instance, has been documented as one dramatic factor behind the onset of the Asian financial crisis in the late '90s (Collyns and Senhadji, 2002). In many advanced economies, and also in China, a softening of housing construction may have a significant negative impact on employment and economic activity. As regards the effects on consumption, though this is still under debate from a theoretical point of view, a growing body of empirical literature has suggested the existence of a potentially large impact of changes in house prices through wealth-effects.[8] Ciarlone (2011), for instance, estimates the impact that changes in real and financial wealth – proxied by house and stock market prices – are supposed to have on private consumption for the same panel of 16 emerging economies of this paper, and finds a larger elasticity of housing prices than of financial assets.

In the following analysis, I will address the question of whether the observed dynamics of real house prices in emerging economies is the result of a genuine change in the underlying macroeconomic determinants or, rather, whether house prices have been diverging from their fundamental-based levels due to the effects of other forces, among which overly optimistic (pessimistic) expectations about future developments in the housing market are supposed to play a major role. I will link 'equilibrium' house prices to plausible supply and demand fundamentals – such as real wages, real interest rates, real banking credit, demographics and institutional factors – and estimate a long-run 'equilibrium' relationship. Moreover, I will break down the possible degree of overvaluation (undervaluation) of actual prices with respect to long-run 'equilibrium' valuations into two components: the first one could be interpreted as a result of the interplay between (changes in) fundamentals and the inherent frictions that exist in the market for housing, which render impossible any immediate adjustment to a positive (negative) shock; the residual part, i.e. the share of overvaluation (undervaluation) not accounted for by the model, could instead be more likely driven by the effects of overly optimistic (or pessimistic) expectations on the side of individual agents about future developments in the housing market. Once this breakdown is finalised, it will be possible to draw conclusions about the current balance of risks for EMEs stemming from housing markets developments.

The paper is structured as follows: Section 2 introduces an overall framework for both the potential determinants of house prices and the different approaches used in the extant literature to assess the actual conditions of the housing market; Section 3 outlines the main feature of the empirical strategy implemented to measure whether actual house prices are overvalued (undervalued) with respect to the 'equilibrium' ones and to quantify the contribution stemming from each of the two components; Section 4

[8] In many countries, in fact, property is households' largest asset, and price developments in housing markets can have a substantial direct impact on consumption. There might also be an indirect impact working through the credit channel: although changes in housing prices may be considered a mere redistribution of wealth, and hence would not be expected to have much impact on net wealth in aggregate, they can nevertheless affect individual consumption by relaxing collateral constraints (Buiter, 2008).

describes the data used in the analysis and offers some preliminary tests, while Section 5 reports the main results of the analysis clearly showing that emerging economies did not suffer from large disconnections between actual and long-run 'equilibrium' house prices. Section 6 concludes.

2. The big picture

A first step in order to gauge movements in housing valuations more effectively is to hollow out their potential determinants. A large body of empirical research has shown that house prices – and house price changes – are closely related to a set of macroeconomic variables and market specific conditions which are expected to influence both the demand- and the supply-side of the market (Chen, 2001; Hilbers *et al.*, 2001; Hofmann, 2003; Tsatsaronis and Zhu, 2004; Gerlach and Peng, 2005; Egert and Mihaljek, 2007; Glindro *et al.*, 2008, 2011; Hilbers *et al.*, 2008; Klyuev, 2008).

Key demand-side factors include real disposable income and real interest rates, where the latter can play a dual role, such as determining financing costs (i.e. mortgage rates) and serving as an indicator of the opportunity cost (i.e. the risk-free interest rate) of owning a house. Other important demand-side factors are demographics, such as population growth, developments in the number and size of households, migratory flows. Strong links between property prices and bank lending practices have also been documented.[9] Finally, changes in overall job market conditions (proxied, for instance, by the unemployment rate) may also play a role in influencing housing demand and prices.

As in other markets, the responsiveness of supply to changes in demand conditions is of dramatic relevance for the dynamics of housing prices: key supply factors include the availability and price of buildable land, as well as overall construction costs. In general, housing supply responds only gradually to changes in demand conditions due to delays in obtaining permits, as well as design and construction lags: these factors work in both directions, and may introduce a certain degree of built-in overshooting (undershooting) in house prices (Glindro *et al.*, 2008; 2011).

Moreover, the functioning and depth of housing finance also affect housing market developments. A large share of housing transactions, in fact, is funded via bank credit, and conditions in the financial sector determine the availability and costs of funding real estate mortgages. The economic literature points to a large number of characteristics of the housing finance systems that are relevant for housing price developments (Tsatsaronis and Zhu, 2004; Zhu, 2006; Hilbers *et al.*, 2008; Warnock and Warnock, 2008).[10]

[9] Egert and Mihaljek (2007), for instance, recognize that the run-up in house prices in many Central and Eastern European economies coincided with an unprecedented expansion of private sector credit in the region, with loans for house purchases playing a key role in the expansion.

[10] Some of the relevant features are: the structure of the supply side; the flexibility of the products with regards to maturity, interest rate flexibility, repayment schemes; the presence and size of subprime mortgage markets; transaction costs; the existence of a secondary market for mortgages; the degree of financial liberalization; collateral and bankruptcies legislation and practices; information systems.

Finally, it is well documented that house prices tend to co-move with other asset prices, primarily stock market valuations (Sutton, 2002; Borio and McGuire, 2004), since they represent one of the viable investment destinations for private wealth.

An overall view of the conditions in housing markets – in order to assess whether there is a risk of overvaluation (undervaluation) or to make predictions about the direction of future price movements – needs to combine, as effectively as possible, all these sources of information. Making an assessment based only on one or a few variables – for instance, comparing the price-to-rent or the price-to-income ratios against their respective long-term averages, as often suggested – [11] may overlook other important factors, such as supply elasticity, demographics and so on. This approach, moreover, is less suitable for judging current conditions in EME housing markets simply because the 'long-term averages' – with which the afore-mentioned ratios are compared – fail to take into account the deep structural changes of the last decade or so.

To overcome these problems, two approaches have been suggested in the extant empirical literature.

The first one implies reverting to an asset pricing approach, and comparing the observed price-to-rent ratios with time-varying discount factors that are determined by the so-called 'user cost' approach, i.e. by combining, in a comprehensive index, the costs and offsetting benefits of owning a house (Hendershott and Slemrod, 1983; Poterba, 1984; Finicelli, 2007). According to the 'user cost' approach, the expected cost of owning a house should equal the cost of renting it in the long-run: rational households, in fact, would adjust their consumption of housing services until the marginal value of those services equals their marginal costs.[12] The inverse of the user cost turns out to be equal to the price-to-rent ratio consistent with equilibrium: by comparing the latter theoretical ratio with the actual one, it is therefore possible to assess whether, and to what extent, house prices are misaligned.

The second approach implies comparing observed house prices with long-run 'equilibrium' valuations determined by both demand- and supply-side conditions. Typically, though not exhaustively, the specification of these models implies a long-run (co-integrating) relationship between house prices and these economic fundamentals, embedded in an error-correction mechanism which can be estimated in both a single equation or a panel setting. The interpretation of the co-integrating relationship would provide an estimate of 'equilibrium' or long-term house prices, against which current prices can be evaluated (Kalra *et al.*, 2000; Capozza *et al.*, 2002; OECD, 2004; Egert and Mihaljek, 2007; Hilbers *et al.*, 2008).

Due to severe data limitations and heterogeneity in what constitutes appropriate measurement of the user cost across emerging economies, the first approach could not be adopted in the present cross-country analysis. I have therefore adopted the second methodology and estimated, for each of the 16 EMEs in the

[11] Typically, a house price overvaluation or a bubble is identified if the current ratio is well above the historical average level.

[12] The user cost will, therefore, be computed by taking into account the foregone interest of investing in a risk-free asset; the property tax rate; deductions in both property taxes and mortgage interest payments; the maintenance cost; the expected capital gains; the risk premium of owning versus renting.

sample long-run equilibrium relationships linking together house prices with supply and demand determinants. By comparing equilibrium house prices with the actual ones, I was able first to draw conclusions about the degree of overvaluation (undervaluation), defined as a situation when actual prices are substantially higher (lower) than their long-run 'equilibrium' values. Second, by replicating the approach developed by Glindro *et al.* (2008, 2011), I was able to breakdown the observed degree of house price overvaluation (undervaluation) into two main components: on the one hand, inherent imperfections in housing markets, such as lags in supply adjustment as well as credit market frictions, can introduce a degree of built-in overshooting (undershooting) in actual house prices, which can therefore temporarily deviate – sometimes quite substantially – from the 'equilibrium' value in the short-run; on the other hand, overly optimistic (pessimistic) expectations of future house price movements or housing market developments may push asset valuations further beyond the values coherent with serial correlation and mean reversion.

From a policy perspective, this decomposition has important implications: it would be paramount, therefore, for policymakers to implement market-specific diagnoses, and to find the right policy instruments that can ideally distinguish between the two underlying components driving house price short-run dynamics. To mitigate price overvaluation driven by inherent frictions and imperfections in the housing market, a policymaker should probably focus on measures aimed at reducing the magnitude and frequency of house price cycles, such as a loosening of land supply policy and boosting the number of apartments, improving information disclosure and transparency, and so on. By contrast, to contain the effect of unwarranted high expectations of capital gains or overconfidence of investors in the housing market, the policymaker should instead implement prudential measures, in particular reductions in loan-to-value limits and anti-property market speculation measures, such as special stamp duty taxes on transactions. The experience of Hong Kong authorities in recent years is, from this point of view, exemplary (Craig and Hua, 2011).

3. The empirical strategy

The methodology used to characterize house price dynamics and to analyze the two components of house price overvaluation (undervaluation) for the sample of 16 EMEs is a three-step approach, which merges together different pieces of empirical literature. Capozza *et al.* (2002) were the first to investigate both the long- and the short-run determinants of house price movements in US metropolitan areas by computing the serial correlation and mean reversion coefficients inherent in the dynamics of house price cycles. Egert and Mihaljek (2007) checked for the existence of a long-run equilibrium relationship linking house prices to a set of demand and supply factors for a sample of 8 transition economies and 19 OECD countries. Finally, Glindro *et al.* (2008, 2011) applied the approach developed by Capozza *et al.* to a sample of 9 Asian economies (both advanced and emerging) and developed it further by breaking up their measure of overvaluation (undervaluation) into what they called a 'cyclical' and a 'bubble' component.

The first stage assumes that in each period and for each country there is an 'equilibrium' housing valuation determined by a set of explanatory fundamentals:

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

where X_{it} is a vector of both macroeconomic and institutional determinants in country i at time t. Assuming that the housing market is in equilibrium in the long-run, with demand equal to supply, equation (1) represents an estimable reduced-form with P^{*}_{it} being the predicted price from the regression. Potential determinants of house prices (the X_{it}'s) could be extrapolated from four main families. The first comprises the demand-side of the housing market, i.e. real households' income, real interest rates, real credit and developments in the job market (proxied by the unemployment rate). Higher income would be positively related to house prices, since it would tend to encourage greater demand for new housing, as well as housing improvements; higher real interest rates, on the contrary, would be expected to depress both demand and prices of residential properties, since they would imply higher financing costs for households; a larger availability of credit, in turn, would increase households' financing capacity, and would therefore be expected to be positively related to housing valuations; finally, favourable developments in the job market, with lower levels of unemployment and/or an increasing share of the population which is employed, are expected to exert a positive effect on housing demand and, therefore, on prices. The second family of the X_{it}'s encompasses supply-side factors, mainly real construction costs and the availability of land for new residential constructions (i.e. building permits). The burden of higher real construction costs would be very likely passed by developers onto purchasers, therefore implying a positive relationship with equilibrium house prices. The effect of an increase in the availability of land and building permits is less easily discernable *ex ante*: on the one hand, by easing supply conditions, it should tend to bring down house prices in the long-run; on the other hand, this effect can be mitigated by the existence of structural constraints, such as building and zoning regulations, long planning and construction phases and so on (Hilbers *et al.*, 2008). Moreover, higher availability of land may well be incorporated by developers into an expectation of a booming housing market and, ultimately, higher house prices. The third group of variables aims to capture the role played by housing finance systems. Unfortunately, it is difficult to identify effective indicators for capturing the latter's degree of development, depth, efficiency and flexibility, since reliable and timely information is not available on a systematic basis for all the countries in the sample. I will rely, therefore, on an indirect measure of "institutional development", based on the first principal component of five different indices which are regularly published by the Heritage Foundation for a large number of EMEs tracking the extent of business freedom, investment freedom, financial freedom, freedom from corruption and property rights. This synthetic measure is expected to exert a positive effect on house prices, since an improvement in the overall business environment would tend to reduce the searching and transaction costs, increase demand for housing, and facilitate a larger number of credit transactions, thus

exerting a positive effect on house prices.[13] The fourth block of potential determinants includes prices of other types of assets, typically equity prices: the direction of the link between stock market valuations and house prices is not clear *ex-ante* from a theoretical point of view, since the substitution and wealth effects work in opposite directions.[14]

The second step of the empirical strategy requires modelling the fluctuations of actual prices around their long-run 'equilibrium' values. Equilibrium, in fact, is rarely observed in the short-run, due to the existence of inherent frictions and imperfections that prevent an immediate adjustment to new information. Following Abraham and Hendershott (1996), Capozza *et al.* (2002) and Glindro *et al.* (2008, 2011), house price changes in the short-run are supposed to be governed by reversion to long-run 'equilibrium' values and serial correlation according to:

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

where P_{it} is the log of real house prices at time t for country i and Δ is the difference operator. This is the simplest functional form that captures the necessary dynamics of housing valuations. Considering, in fact, that housing is a slow-clearing durable asset, it is reasonable to expect that current price changes are governed by previous changes in the own price level (where $\alpha>0$ is the serial correlation term), by the deviation from the equilibrium value (where $0<\beta<1$ is the rate of adjustment to long-run 'equilibrium' values) and by immediate partial adjustment to changes in fundamentals (which implies that $0<\gamma<1$).

Other things being equal, the greater the actual price change in the previous period $\Delta P_{i,t-1}$ or the equilibrium-actual price difference at the beginning of the period $(P^*_{i,t-1} - P_{i,t-1})$ or the change in the equilibrium price level ΔP^*_{it}, the larger the actual price change during the period. For α positive, the first term acts to perpetuate growth, generating house price overvaluation (undervaluation): following Abraham and Endershott (1996), this expression will be therefore termed 'overvaluation- (undervaluation-) builder'. For β positive, the second term captures the tendency of the overvaluation (undervaluation) to eventually burst when the actual price level $P_{i,t-1}$ exceeds the equilibrium level $P^*_{i,t-1}$: for this reason, this expression will be labelled 'overvaluation- (undervaluation-) buster'. Lastly, for γ positive the latter term measures the speed of the contemporaneous adjustment of actual prices to current shocks to long-run 'equilibrium' values.

Equation (2) can be rewritten as:

[13] A higher score in the institutional factor would be associated with greater business freedom, better regulatory conditions, lower corruption, a higher degree of legal protection, a greater range of intermediation functions, a better environment for domestic and foreign investment. Therefore, a higher score would tend to reduce the searching and transaction costs, facilitate credit transactions and allow investors to respond more quickly to changes in the housing market.

[14] The substitution effect would predict a negative relationship between the prices of the two assets, since a higher return in one market should depress demand in the other; the wealth effect, on the contrary, would predict a positive relationship, since higher returns in one market will increase the total wealth of investors and their capability of investing in other assets.

$$(3)\ P_{i,t} - (1+\alpha-\beta)P_{i,t-1} + \alpha P_{i,t-2} = \gamma P^{*}_{i,t} + (\beta-\gamma)P^{*}_{i,t-1}$$

the dynamic behaviour of which can be studied by applying the "z-transform" $b^n=P_n$ and then analyzing the resulting "characteristic equation" of the difference equation in (3), which is given by

$$(4)\ b^2 - (1+\alpha-\beta)b + \alpha = 0$$

Skipping, for the sake of brevity, all the technical details – the interested reader is referred to the above mentioned papers for a clear exposition of the different possible results and the ensuing dynamic properties – it turns out that the necessary and sufficient condition for house price cycles to be stable is that $\alpha<1$ (i.e. non explosive paths) and $\beta>0$ (i.e. a certain degree of mean reversion to long-run 'equilibrium' values). Once this condition is satisfied, there are two possible types of house price movements: if $(1+\alpha-\beta)^2 - 4\alpha \geq 0$, house prices converge monotonically to the equilibrium level; if $(1+\alpha-\beta)^2 - 4\alpha < 0$, the transitory path in response to changes in the 'equilibrium' housing valuations exhibit damped fluctuations around this new equilibrium level.[15]

The third and final step of the empirical strategy requires employing the results of the first two stages to investigate the degree of house price overvaluation (undervaluation) – defined as a situation in which actual house prices P_{it} are significantly higher (lower) than the relative long-run 'equilibrium' value P^{*}_{it} – and breaking down this deviation into two parts. The first component would describe the short-run interaction between (changes in) fundamentals and market imperfections – the existence of inherent frictions, lags and imperfections in the housing market can, in fact, introduce a certain degree of built-in overshooting (undershooting) of actual prices with respect to equilibrium ones – while the second component (the residual) would be more likely driven by the possible influence of overly optimistic (pessimistic) expectations about future developments in the housing market.

I will assume that the first component could be estimated through the short-run dynamics defined in equation (2). More precisely, for actual house price deviations from (predicted) long-run 'equilibrium' values

$$(5)\ P^{*}_{i,t} - P_{i,t}$$

the first component, driven by the interaction between (changes in) fundamentals and intrinsic housing market frictions, will be computed as

$$(6)\ P^{*}_{i,t} - E_{t-1}(P_{i,t})$$

where the expectation is conditional on information available at time $t-1$. In turn, this formula could be easily re-written as

[15] If $\alpha\geq 1$ or $\beta\leq 0$ then the house price is unstable: house prices may either diverge or exhibit amplified fluctuations away from the equilibrium level.

$$(7)\ P^{*}_{i,t} - [P_{i,t-1} + E_{t-1}(\Delta P_{i,t})]$$

where $E_{t-1}(\Delta P_{i,t})$ would be proxied by the predicted value of short-term dynamics defined in equation (2).

The share of overvaluation (undervaluation) not related to short-run dynamics – i.e. the residual component given by the difference between expressions (5) and (7) – would be interpreted as the result of other forces that could push actual prices far from the equilibrium ones linked, for instance, to the existence of overly optimistic (pessimistic) expectations on the part of individual agents regarding future developments in the housing market.

There are, of course, certain limits in this interpretation of the residual. For one, it is defined too loosely. Since it essentially refers to the share of overvaluation (undervaluation) not accounted for by the chosen macro-financial variables, it is contingent on the accuracy of the model used to estimate house price short-run dynamics. The most serious form of misspecification is given by the omitted variable problem: if the list of fundamentals explaining equilibrium house prices is not complete, in fact, the residual would mistakenly include a fundamental-related component, therefore puzzling the decomposition analysis. An important example is given by both transaction and search costs – brokerage fees, the level of VAT, stamp and registration duties, inheritance taxes and so on – which are typically quite substantial in the housing markets. The higher the transaction and search costs, the slower the response of house prices to shocks to both demand and supply fundamentals, therefore leading to deviations from equilibrium in the short-run and to ample house price cycles. Unfortunately, the difficulty of coming up with complete and inclusive information about transaction and search costs for the available emerging economies might indeed represent a problem in the present context. Certain aspects of the methodology are specifically designed to minimize the relevance of this concern like, for instance, the recourse to the first principal component of the five different indices published by the Heritage Foundation: a higher score of the institutional factor, in fact, would tend to reduce the searching and transaction cost, facilitate credit transactions and allow investors to respond more quickly to changes in the housing market. Nevertheless, I acknowledge that these refinements are by no means perfect.

Having said that, the following formulas sum-up the main features of the three-step decomposition approach:

a) House price overvaluation (undervaluation) = $(P^{*}_{i,t} - P_{i,t})$

b) Component driven by short-run dynamics = $P^{*}_{i,t} - [P_{i,t-1} + E_{t-1}(\Delta P_{i,t})]$

c) Component driven by overly optimistic (pessimistic) expectations = overvaluation (undervaluation) – component driven by short-run dynamics = $(P^{*}_{i,t} - P_{i,t}) - [P^{*}_{i,t} - [P_{i,t-1} + E_{t-1}(\Delta P_{i,t})]] = E_{t-1}(\Delta P_{i,t}) - (P_{i,t} - P_{i,t-1})$

4. Data description and preliminary tests

Time series for house prices (in local currency) were difficult to collect. Eventually, I put together quarterly data for 16 emerging economies – 6 from Asia (China, Hong Kong, Korea, Malaysia, Singapore, and Thailand) and 10 from Central and Eastern Europe (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Russia, Slovakia, Slovenia) – hovering, whenever data are available, the period from March 1995 to June 2011 (**Annex I** contains detailed information on the sources of data on house prices). Residential property prices, unfortunately, have many limitations: while some series are derived using a hedonic pricing method, others are based on floor area prices collected by national authorities; while some countries publish house prices in national currency per-square metre (or per apartment or per dwelling), others calculate an index number scaled to some base year; while some countries publish statistics for the whole national territory, others produce data only for the capital city or for the largest cities in the country. Often, data from national sources refer to different types of residential property: new vs. existing housing; apartments in different types of buildings; single vs. multiple family houses. Finally, available time series are relatively short,[16] which may adversely affect the robustness of estimation results.[17]

For some of the variables used as potential determinants of equilibrium house prices, it is worth giving a few more details. As regards households' income, it is measured by real wages: in those instances where data on wages were unavailable, or available for too short a time span, I substituted it with national disposable income (GNDI) or gross domestic product (GDP), both expressed in real, per capita terms on a seasonally-adjusted basis. As regards real interest rates, I selected those applied on housing loans: when unavailable, I used real interest rates on loans to households or on loans to the private sector. Real interest rates are defined in an ex-post sense, i.e. as nominal rates less the annual realised inflation rate. As regards real credit, I tended to favour – when available – the stock of housing loans scaled to GDP.[18] As regards stock prices, I relied on indices expressed in local currency (to avoid adverse effects from changes in the exchange rate). [19] Finally, all the variables are expressed in logs with the exception of real interest rates.

In order to identify the existence a long-run equilibrium relationship between house prices and the set of potential determinants, I need first to ascertain whether the series are non-stationary by implementing a battery of first-generation panel unit root tests. It is widely acknowledged in the literature that panel unit

[16] Of the 16 countries in the sample, only for Hong Kong, Korea, Singapore and Thailand I was able to find data spanning the whole period 1995-2009; for the majority of the other countries, statistics were not compiled until the late nineties; for Latvia, Poland, Slovakia and Slovenia time series of property prices are available from 2003 only.

[17] Notwithstanding these limitations, a big effort has been made to ensure all the series are as comparable as possible. When quarterly frequencies were not available, annual data have been linearly interpolated using a quadratic matching average procedure. Property prices in national currency have been transformed into number indices, all rescaled to the same base year (2005). Finally, nominal property prices have been deflated by the country's CPI in order to express them in real terms.

[18] Again, whenever these series were not available, I selected the total stock of loans to households or the total stock of loans to the private sector.

[19] Quarterly averages from daily quotes were rescaled to the same base year of house prices (2005) and corrected for inflation.

root tests have higher power than unit root tests based on individual time series. These tests can be broadly classified into two categories: those that assume the persistence parameters to be common across cross-sections, like the ones suggested by Breitung (2000), Hadri (2000) and Levin, Lin and Chu (2002), and those that allow the persistence parameter to vary across the panel countries, like the one developed by Im, Pesaran and Shin (2003). The Hadri test considers the null of no unit root against the alternative hypothesis of a unit root, while the remaining tests take the null of a unit root against the alternative hypothesis of no unit root. All other technical details are skipped for the sake of brevity, and the interested reader is referred to the references above for additional explanations and a much more rigorous treatment. The outcome of this battery of panel unit root tests – run by assuming a constant in the test regression – is presented in **Table 1**: it suggests no rejection of the presence of a unit root for almost all the series of interest, with the notable exceptions of real stock prices and unemployment rates.[20]

The results obtained for real stock market indices may seem, at first sight, quite odd especially from the point of view of the efficient market hypothesis, which is in fact associated with the idea of a random walk. Two aspects are, in my opinion, responsible for this outcome. On the one hand, running these tests requires a strongly balanced panel, where the time dimension is therefore constrained by that of the country with the shortest available series. On the other hand, the financial crisis that erupted in September 2008 brought about a sharp drop in stock valuations for all the emerging economies in the sample, ranging from -40 to -86 percent in real terms from peak to trough. Such a huge price fall, if studied within a panel characterized by a relatively small *T* dimension, may well end up being interpreted as a sort of mean-reverting process by the unit root tests at hand. In order to shed more light on this aspect, I restricted the sample to those emerging economies with the longest available series (from 1994Q1 onwards),[21] and re-run all the previous tests: with the only exception of the Im-Pesaran-Shin test, all the others seem now to point more clearly to the random walk behaviour implied by the efficient market hypothesis.[22]

As regards the results for the unemployment rates, from a theoretical point of view it is not clear whether these series should be considered as stationary or not.[23] Instead of assuming by the outset that the series of interest are in fact I(1), I opted for a more rigorous procedure: first of all, I extended the sample of countries by considering the largest number (31) of emerging economies for which a time series for the unemployment rate is readily available; moreover, I extended the length of each time series up to the first quarter of 1990; finally, I re-run all the previous tests for a second time. With the only exception of the

[20] First differenced data turned out to be I(0); results are not reported here but are available upon request.

[21] The following four countries have been excluded because of their relatively shorter series: Bulgaria, Estonia, Latvia and Lithuania.

[22] Results are not reported here but are available upon request

[23] It is possible to distinguish, in fact, two competing hypotheses on unemployment behaviour: the first one, the so-called 'natural' rate of unemployment or NAIRU, characterises unemployment dynamics as a mean-reverting process, therefore supporting the level stationarity of the series; the second one, also known as the 'hysteresis' hypothesis, states that cyclical fluctuations have permanent effects on the level of unemployment, therefore being compatible with the presence of unit roots.

Levin-Lin-Chu test, all the others seem now to point more clearly to the 'hysteresis' behaviour of the unemployment rate.[24]

5. Estimation results

Once reassured by the results of panel unit root tests, I now turn to the issue of estimating a long-run equilibrium relationship for housing valuations. A preliminary set of regressions, hosted in **Table 2**, relies on panel data techniques with country fixed effects to estimate equation (1) over the whole sample of countries to capture the common picture, if any, of the fundamental variables that influence house price dynamics, with the baseline specification linking real house prices to real wages and real mortgage rates only (Reg. (1)). To this initial model I then add, one by one, all the other variables discussed in the previous paragraph relative to the demand- and supply-side of the housing market, institutional characteristics of housing finance systems and other asset prices (Reg. (3)-(7)). Since households' income and housing credit are strongly correlated, multicollinearity may arise in empirical estimates: to tackle this problem, I estimate separately an equation excluding households' real wages and including only housing loans (Reg. (2)). Finally, in the very last two specifications (Reg. (8) and (9)) all the variables are included, controlling for real wages and housing loans respectively.

It is paramount to remember that the long-run relationship given by equation (1) represents a reduced-form equation, derived by solving a system composed of a supply and a demand schedule; thus, both prices (the dependent variable) and quantities (regressors) end up being endogenous. This can represent a severe problem, causing inconsistency of the standard OLS estimates. For this reason, I resorted to more robust econometric techniques, more precisely panel instrumental variable (IV) methods, and estimated equation (1) by two-stage least squares instrumenting all right-hand side regressors with their own lags. The estimated coefficients of the different specifications for the long-run relationship, along with their *p*-values, are reported in the top panel of **Table 2**.

Overall, results for this preliminary set of regressions are largely consistent with theoretical predictions. The coefficients of real wages are highly significant and have the expected, positive sign in all the different specifications. Higher real interest rates have a negative effect on house prices, increasing the financing costs for households and dampening the demand for houses, although the magnitude is relatively modest. A larger availability of credit has a strong positive impact on housing demand and, therefore, on house prices. As regards other demand-side factors, coefficient estimates for unemployment are also significant and have the expected negative sign. Turning to supply-side variables, results suggest that higher construction costs are passed onto higher house prices; moreover, the coefficient of the land supply index (i.e. building permits) is positive, apparently to indicate that a larger availability of land is incorporated by developers in expectations of booming housing markets and higher house prices. Interestingly, the institutional factor has a positive and significant effect on house valuations, supporting the view that more

[24] Again, the results are not reported here but are available upon request.

sophisticated housing markets and housing finance systems may enhance the dynamics of the latter. Finally, house prices turn out to be negatively related to equity prices, once all other variables are controlled for: this suggests that the substitution effect from equity holdings dominates the wealth effect.

The bottom panel of **Table 2** shows Kao's (1999) statistics for testing the null hypothesis of *no* co-integration in a panel setting. Once reassured by the results of panel unit root tests – pointing to non-stationarity of the series of interest – it is, in fact, necessary to test for the existence of a co-integrating relationship among the same variables. I opted for panel co-integration tests since they are considered to be a more powerful procedure than applying individual time-series co-integration tests.[25] As for standard time series, there are different ways of testing the null hypothesis of *no* co-integration in a panel setting: typically, tests are grouped in two large families, the residual-based and the likelihood-based ones.[26] The results displayed in the bottom panel of **Table 2** for the test statistics of the Kao's residual-based family – the *DF*, the *DF** and the *ADF* – clearly suggest rejection of the null of *no* co-integration.[27]

These results have been subjected to two different kinds of robustness checks.

First of all, one may doubt that real wages represent the most correct proxy for households' disposable income, and that other variables might do a better job in explaining the long-run determinants of housing prices. Real and financial wealth derived from the flow of funds accounts would undoubtedly provide a more precise measurement of households' total wealth. Unfortunately, this kind of information is not widely available for the sample of emerging economies in question: the best I can do is to substitute real wages with the GNDI series from the IFS which, nevertheless, still represent only a distant proxy for actual households' wealth, since they are calculated by aggregating all the sectors of the economy. **Table 2.A** contains this new set of estimates, showing that the main results still hold even with the change of variable.

Second, one may wonder whether the estimated relationships between real house prices and the chosen set of macro-financial fundamentals hold when each of the two different country groupings, Emerging Europe and Asia, is accounted for separately. **Table 2.B** and **Table 2.C** host the same set of nine

[25] While the latter tests are known to have low power especially for a short *T* dimension, panel co-integration tests have the notable feature of being implementable with much shorter time spans, improving upon the small sample limitations of conventional non-stationary methods (Pedroni, 2000).

[26] Residual-based families are constructed on the basis of the Engle and Granger's (1987) test in time-series framework, and use residuals of the panel static regression to construct the test statistics and to tabulate the relative distributions; the likelihood-based families represent extensions to a panel setting of the methods pioneered by Johansen (1991, 1996) for vector autoregressive models.

[27] Within the residual-based family, Kao (1999) studied Dickey-Fuller (DF) and augmented Dickey-Fuller (ADF) tests for the null of *no* co-integration, deriving the limiting distributions of the test statistics when applied to spurious regressions in a panel setting. After appropriate normalisations, these test statistics converge, by sequential limit theory, to random variables with normal distributions. Kao's approach involves first estimating the presumed long-run relationship by pooled OLS, obtaining the residuals, and finally implementing a (normalised) pooled Dickey-Fuller (or Augmented Dickey-Fuller) regression on these residuals. These tests statistics, moreover, may contain nuisance parameters to account for possible weak exogeneity in the regressors and serial correlation in the residuals: more precisely, it is the DF* test statistics that contain this parametric modification.

regressions estimated for the first and second country grouping, respectively: overall, the results are still again largely consistent with theoretical predictions.[28]

The panel results provide a first overall picture of the determinants of housing valuations for the country sample in question. Housing, nevertheless, is still a local market, the developments of which are determined by specific factors that may vary across countries. To reflect this important aspect, I allow long-run 'equilibrium' equations to be determined by country-specific regressions (stage 1), and use these country-specific predicted long-run 'equilibrium' values in the subsequent analysis of short-term dynamics (stage 2) and in the final breakdown of the eventual degree of overvaluation (undervaluation) into the two components (stage 3).

Starting with the first stage, and mimicking the procedure followed in the panel setting, I produced a set of estimates by resorting again to instrumental variable (IV-2SLS) methods, where equation (1) is estimated on a country-by-country basis by two-stage least squares, instrumenting all the right-hand regressors with their own lags.[29] Moreover, in order to confirm the robustness of these results, I also produced a second set of estimates by means of the fully-modified OLS (FM-OLS) methodology proposed by Phillips and Hansen (1990).[30]

Displayed in the upper parts of **Table 3** and **Table 4**, respectively, the estimation outcomes confirm that the influence of fundamentals on house prices tends to be country-specific; nevertheless, the coefficient signs and statistical significance encountered in the panel setting are confirmed in general. Moreover, the regressors that turned out to be significant in country-by-country equations have good explanatory power, with an adjusted R-squared that hovers around 0.90 for both the econometric procedures. Finally, the test

[28] The only notable exception might be given by the insignificant real interest rates for Asian economies. The problem here is that, for most of them, I was unable to find information on actual mortgage rates paid by households on the debt incurred to buy a house, and I had to resort to the IFS prime rate series. As a matter of fact, prime rates might be not a good proxy for those applied to house mortgages, therefore explaining the evident absence of significance.

[29] For reasons of parsimony – available time series for house prices are, in fact, relatively short – only the first lag has been included in the displayed regressions; I have also tested specifications with longer lags, obtaining similar results (available from the author upon request).

[30] This econometric procedure resolves most of the problems that might arise in a simple OLS framework: as a matter of fact, though OLS estimators are still consistent, the presence of simultaneity, unit roots and serial correlation determines an asymptotically second-order bias, i.e. the estimators' limit distributions may be misallocated or shifted away from the true parameters. The classic assumptions are violated in our case for the following reasons: a) there might be an endogeneity problem, i.e. the regressors may be simultaneously determined; b) because all the listed variables have unit roots, the asymptotic distribution of their estimators is no longer Gaussian; c) the residuals in the equation might be serially correlated. By means of a semi-parametric correction – i.e. a transformation involving the long-run variance and covariance matrix of the residuals – the FM-OLS methodology specifically deals with the presence of endogeneity in the regressors, as well as the potential serial correlation in the residuals; moreover, it is asymptotically efficient and does not require the use of instruments. Finally, it gives asymptotically unbiased estimators as well as t-statistics which are asymptotically normal, meaning that the usual tests can be carried out in order to evaluate the significance of the explanatory variables.

outcomes reported in the middle sections of **Table 3** and **Table 4** suggest that the null hypothesis of *no* co-integration can be easily rejected.[31]

Turning now to the second stage, I will use the estimated long-run relationship for house prices $P^*_{i,t}$ as 'equilibrium' values around which to model actual price short-run dynamics based on equation (2), where the α coefficient would represent the degree of serial correlation, β the extent of mean reversion, and γ the contemporaneous adjustment of actual prices to current shocks to long-run 'equilibrium' values. If house prices adjusted instantaneously to local economic shocks and real estate markets were perfectly efficient, γ would be equal to 1 and α equal to 0; theory has, instead, no prediction for β (in perfect markets actual prices would never deviate from their long-run 'equilibrium' values). Of course, the actual values of α, β and γ will be far from those predicted only on efficiency grounds, and will be extremely useful in analysing the kind of cycle that actual house prices depict around the respective long-run 'equilibrium' level.

The results from this second stage are displayed in the bottom parts of **Table 3** and **Table 4**; since the terms in equation (2) are all stationary, estimates have been obtained by means of standard OLS procedure. Coefficient outcomes are quite dispersed across the 16 emerging economies, suggesting different short-run dynamics. Looking at the average value across the sample for the γ coefficient, the contemporaneous house price adjustment hovers at around 45% of the shock to (predicted) 'equilibrium' valuations (irrespective of the adopted econometric procedure). In addition, house prices appear to exhibit a certain degree of serial correlation, with an average α coefficient of 0.35. Finally, actual house prices converge slowly to their long-run 'equilibrium' values, covering only 33-34 percent of the gap every year. Across the sample countries, the conditions for stable house price cycles, i.e. $\alpha<1$ (i.e. non explosive paths) and $\beta>0$ (i.e. a certain degree of mean reversion to long-run 'equilibrium' values), is always satisfied; moreover, according to the different values assumed by the three coefficients along with the ensuing two types of stable cycles, in five countries (Estonia, Hungary, Korea, Lithuania, Malaysia and Thailand) house price dynamics seem to follow a straight convergence to the 'equilibrium' value, while for all the others a path of damped fluctuations is observed.

The third and last step of the empirical approach tracks down the degree of overvaluation (undervaluation) exhibited by actual house prices over the sample period, and breaks it down into two components: the first one linked to short-run interactions between (changes in) fundamentals and frictions in the housing market, and the second, residual, one to agents' expectations about future developments in housing markets. This analysis is based on the estimated coefficients describing short-run dynamics – i.e. the degree of serial correlation α, the rate of adjustment to departures from equilibrium β and the degree of contemporaneous response to changes in long-run 'equilibrium' values γ – obtained by means of the IV-

[31] The Engle and Granger (1987) two-step procedure was used to test for co-integration between the significant regressors. This amounts to testing for a unit root in the residuals of a first stage regression using the ADF test. The critical values associated with the test should be taken from MacKinnon (1996) and depend on the number of explanatory variables. A constant was included in the test, and the lag structure was chosen by the Schwarz Information Criterion.

2SLS procedure, hosted in the bottom part of **Table 3**. Once these estimates are computed, in fact, it is possible to derive the three measures discussed in paragraph 3:

a) House price overvaluation (undervaluation) = $(P^*_{i,t} - P_{i,t})$

b) Component driven by short-run dynamics = $P^*_{i,t} - [P_{i,t-1} + E_{t-1}(\Delta P_{i,t})]$

c) Component driven by overly optimistic (pessimistic) expectations = $E_{t-1}(\Delta P_{i,t}) - (P_{i,t} - P_{i,t-1})$

Annex II shows the respective charts plotting the deviation of actual house prices from (predicted) long-run 'equilibrium' ones for each country in the sample and for all the quarters for which the estimation was feasible (the blue line) along with the two subcomponents, the first one driven by the short-run dynamics between (changes in) fundamentals and inherent frictions in the housing market (purple bars) and the residual one more likely steered by overly optimistic (pessimistic) expectations (green bars).

By looking at the charts, several conclusions can be drawn. First of all, from a historical perspective the degree of overvaluation (undervaluation) of housing prices has tended to remain in a relatively small interval (±6 percent) in the majority of the sample countries. Exceptions are, however, represented by a few rather volatile housing markets in Asia in the years surrounding the crises of the late '90s (Hong Kong and Singapore) and by the relatively larger deviations occurred in some emerging European countries (Bulgaria, Latvia, Lithuania, Poland and Russia) in the years preceding the last period of financial turmoil in 2008-2009. Latvia stands out as the only instance for which, according to the estimation results, the degree of overvaluation reached levels as high as 40 percent in 2007.

Second, when assessing the degree of overvaluation (undervaluation), the first of the two subcomponents (purple bars) plays the lion's share, implying that disconnections between actual prices and long-run 'equilibrium' levels are largely accounted for by the interactions between (changes in) fundamentals and inherent frictions in the housing market, rather than by the possible disruptive effects stemming from overly optimistic (pessimistic) expectations about future developments in housing markets.

For instance, the fall of house prices well below equilibrium levels recorded in some Asian economies (Hong Kong, Korea and Singapore) as a result of the crises of the late '90s is mainly attributable to a collapse in fundamentals throughout the region. More recently, the sharp worsening of real and financial conditions through the end of 2008 and the beginning of 2009 has indeed played a dominant role in pushing down actual housing valuations, sometimes to clearly undervalued level, in most emerging economies.

However, looking at the boom period up to 2007 characterised by widespread situations of house price overvaluation with respect to long-run 'equilibrium' values, genuine changes in fundamentals turn out not to be the main determinant: in some Central and Eastern European economies (for instance, Estonia, Lithuania, Slovakia and Slovenia) as well as in Thailand the residual contribution more likely stemming from overly optimistic expectations clearly predominates.

Finally, my model allows assessing the current degree of overvaluation (undervaluation) on the basis of the most recent available data (up to the second quarter of 2011). The empirical procedure suggests that actual house prices are close to long-run 'equilibrium' values in most of the sample economies. There are, however some exceptions: a clear situation of overvaluation is found in Hong Kong (almost 22% the quarterly average through June 2011), while the property markets in Bulgaria (-27%), Latvia (-21%) and Russia (-18%) appear to be clearly undervalued.[32]

Overall, these results are coherent with the extant, rather scant (and mostly centred on Asian economies), empirical literature on the dynamics of house prices in emerging economies. Glindro *et al.* (2011) conclude too that the run-up in house prices experienced by a sample of nine emerging and advanced Asian economies up to 2006 mainly reflects adjustment to improved fundamentals rather than speculative housing bubbles. The majority of single-country cases focused on China, with the majority of works seemingly pointing to the same conclusion about the existence of a very different story between the (average) national and city-level house prices. For instance, Hu *et al.* (2006) break down the national house prices into two components – the first linked to a set of economic fundamentals and the second to the capital gains (losses) due to expected house price changes – showing that, over the period 1990Q1-2005Q1, these valuations were mainly driven by market fundamentals and that speculative forces, though existing in the market, contributed little to the variation of property prices. Yu *et al.* (2006), on the other hand, studied the dynamics of house prices in the top five major cities from 1995 to 2004, concluding that signs of severe overvaluation started to be relevant for the majority of them by the end of the sample period. More recently Ahuja *et al.* (2010), by means of the user-cost approach, found out that, over the period 2000Q1-2009Q4, the levels of residential house prices for the country as a whole did not seem significantly higher than would be justified by underlying fundamentals, while signs of overvaluation were present in some cities' mass-market and luxury segments. A similar difference between national and city-level house prices is reported for Korea in Chung and Kim (2004), with the degree of overvaluation of the former being much smaller than that of the latter. By examining property market developments in Hong Kong SAR over the period 1980-98, Kalra *et al.* (2000) concluded that residential prices in this country may be subject to ample and persistent cycles: at the peak of the upswing in the first quarter of 1997, real property prices were 10-15% higher than trend. Lastly, the evidence reported by Joshi (2006) for India suggests that, in the fiscal years 2001-2005, the housing market remained fairly well equilibrated if seen in terms of the proximity of the actual housing prices and the estimated long-run equilibrium housing prices.

6. Conclusions

In this work I have developed an empirical procedure aimed at identifying the degree of overvaluation (undervaluation) of actual prices with respect to long-run 'equilibrium' values, and subsequently breaking

[32] Overall, this juxtaposition is coherent with the findings of the IMF (2010) which – analysing the most recent developments in housing markets worldwide – defined Hong Kong SAR as a "rebound economy", while Bulgaria and Latvia, are defined as "bust economies".

down this divergence into a term related to short-run interactions between (changes in) fundamentals and inherent frictions in the housing market, and a component accounted for by residual forces, which I have interpreted as more likely linked to overly optimistic (pessimistic) expectations about future developments of the housing market.

The results of my analysis show that, for the sample of 16 EMEs at hand, housing markets have rarely displayed dramatic signs of overvaluation (undervaluation): Latvia represents the only instance in which, according to estimation results, the degree of overvaluation reached levels of around 40% in 2007.

Moreover, even in those cases in which actual house prices look disconnected from fundamental-based 'equilibrium' levels, the component linked to the interactions between (changes in) fundamentals and frictions in the housing market predominates in shaping house prices short-term dynamics. This seems to be the case for both the period after the eruption of the Asian crisis in the late '90s and the more recent episode of global financial turmoil of late-2008, during which house prices undershot below 'equilibrium' levels as the result of the collapse in fundamentals. For the boom period up to mid-2007, characterised by low global interest rates, high levels of global liquidity and extraordinarily low levels of risk aversion, episodes of overvaluation were, on the other hand, only partly justified by improvement in fundamentals, while they may have been fuelled by overly optimistic expectations on the part of economic agents.

At the most recent available date (second quarter of 2011), actual house prices seem to have adjusted towards long-run 'equilibrium' levels in most of the sample economies: the most significant exceptions are, however, represented by cases of clear undervaluation in some Central and Eastern European economies.

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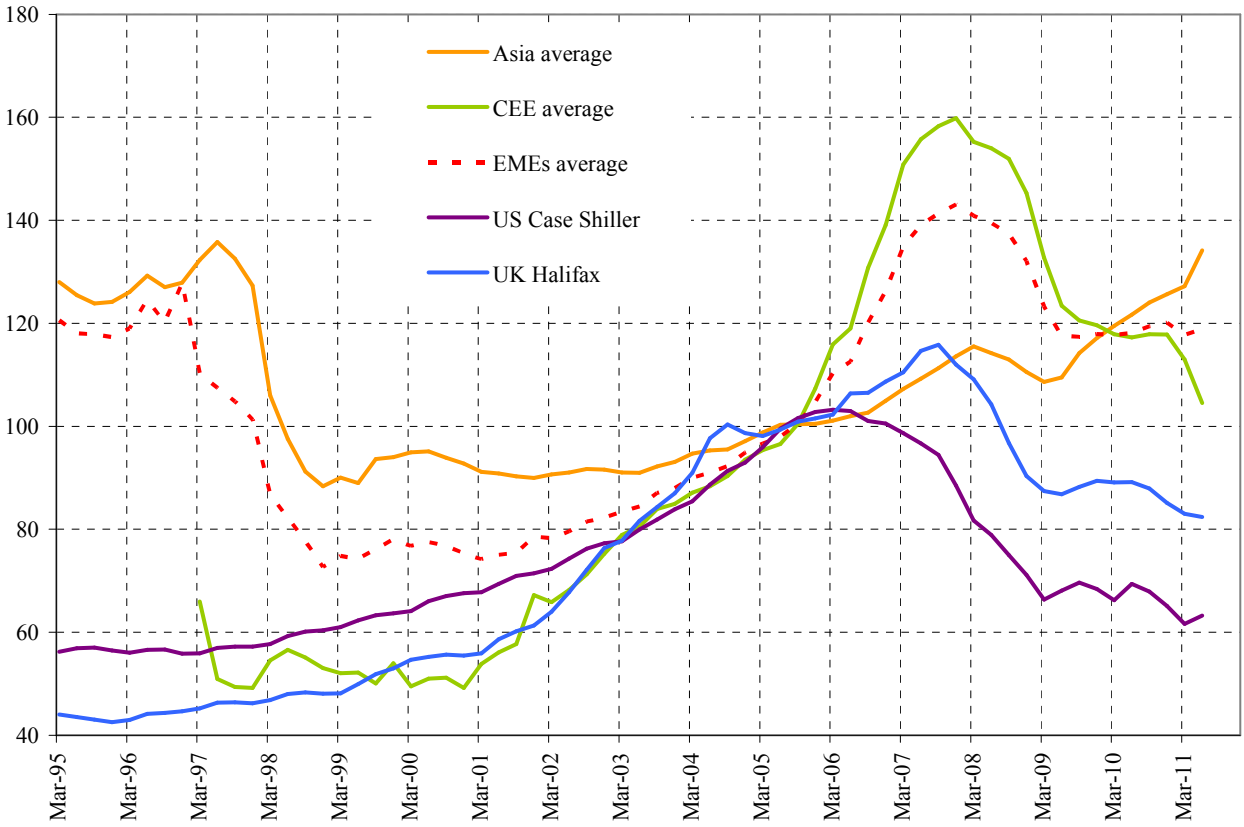
Chart 1. Real house prices in selected advanced and emerging economies

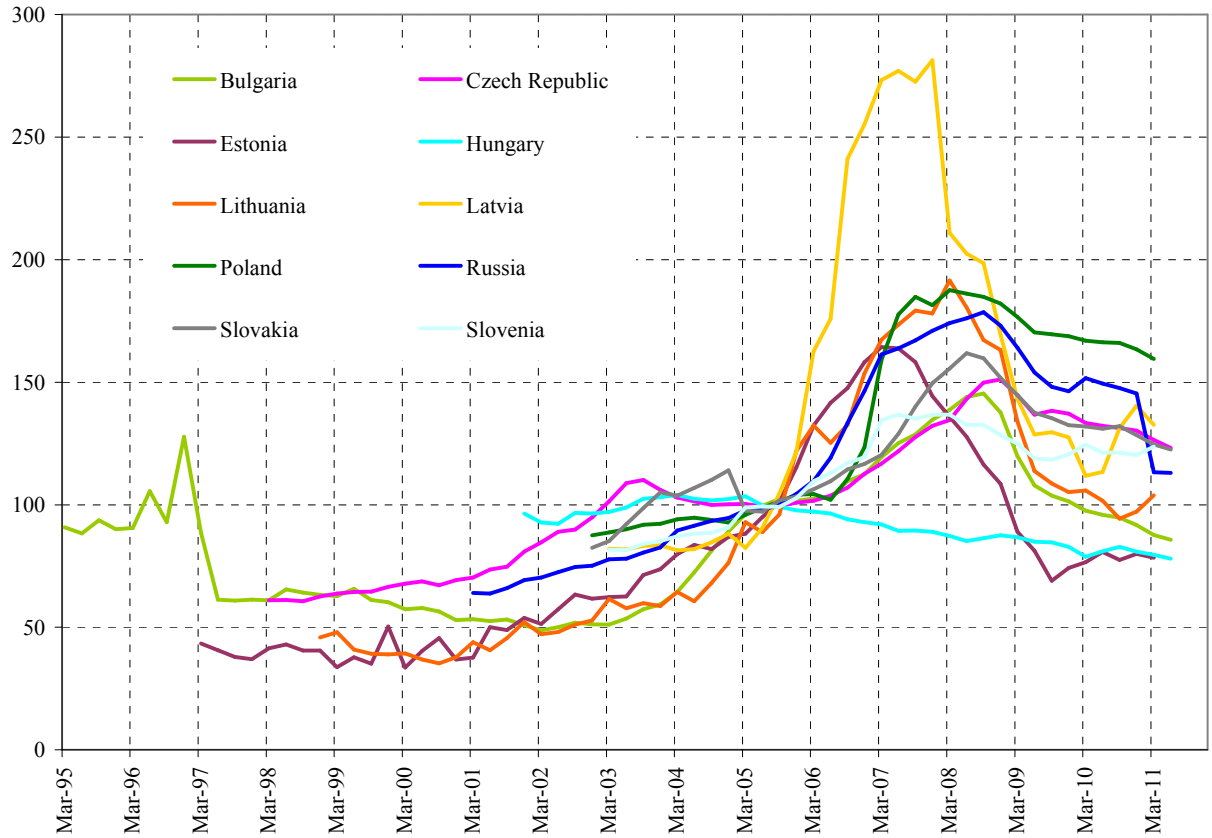
(quarterly data; indices, 2005 = 100)

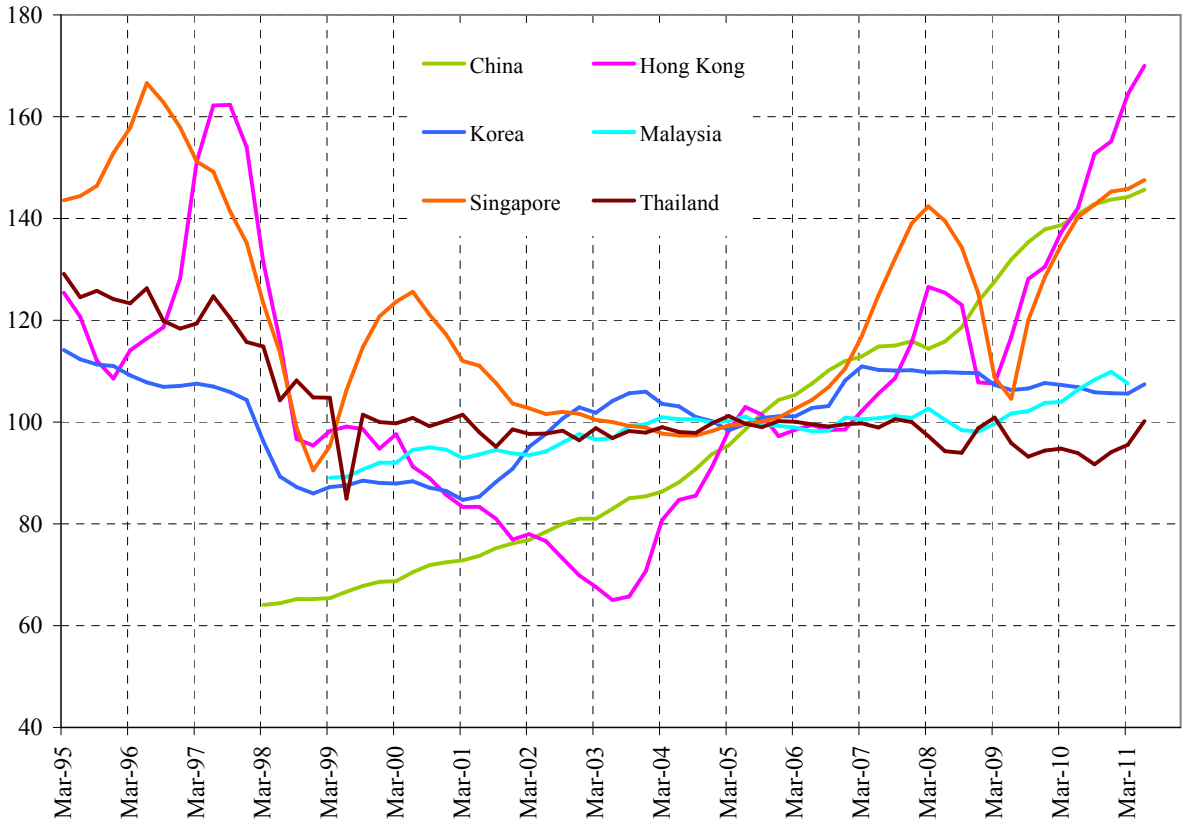


Source: author's calculations on data from national central banks and statistical offices, BIS data bank, Thomson Reuters Datastream, Bloomberg.

Chart 2. Real house price developments in selected emerging economies

(quarterly data; indices, 2005 = 100)





Source: author's calculations on data from national central banks and statistical offices, BIS data bank, Thomson Reuters Datastream, Bloomberg.

Table 1. Panel unit root tests

Variable	Breitung	Levin-Lin-Chu	Im-Pesaran-Shin	ADF Fisher $\chi 2$	ADF Choi Z-statistic	Hadri
real house prices	1.24	-1.84	0.49	27.96	0.43	10.29
	(0.89)	*(0.03)*	*(0.69)*	*(0.57)*	*(0.67)*	*(0.00)*
real wages	2.89	-0.25	1.79	26.22	1.74	16.86
	(1.00)	*(0.40)*	*(0.96)*	*(0.66)*	*(0.96)*	*(0.00)*
real mortgage rates	-0.90	4.80	-1.00	34.23	-0.65	7.07
	(0.18)	*(1.00)*	*(0.16)*	*(0.27)*	*(0.26)*	*(0.00)*
housing loans (scaled to GDP)	6.37	4.60	6.04	17.65	5.64	13.54
	(1.00)	*(1.00)*	*(1.00)*	*(0.96)*	*(1.00)*	*(0.00)*
unemployment rate	0.80	-2.79	-3.35	61.70	-3.32	6.03
	(0.79)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*
real construction costs	0.00	-1.48	-1.36	33.33	-1.24	5.75
	(0.50)	*(0.07)*	*(0.09)*	*(0.15)*	*(0.11)*	*(0.00)*
building permits	7.03	-1.53	-2.21	53.61	-1.69	8.83
	(1.00)	*(0.06)*	*(0.01)*	*(0.01)*	*(0.05)*	*(0.00)*
institutional factor	1.20	-1.32	0.88	28.70	1.02	13.51
	(0.88)	*(0.09)*	*(0.81)*	*(0.53)*	*(0.85)*	*(0.00)*
real stock market prices	-0.20	-2.05	-2.22	40.75	-2.24	7.68
	(0.42)	*(0.02)*	*(0.01)*	*(0.09)*	*(0.01)*	*(0.00)*

Note: all p-values (in parenthesis) are reported such that Ho is rejected if p-value<0.05; models include an intercept.

Table 2. House price fundamentals: panel IV–2SLS method *(dependent variable: log of real house prices)*

Variable	Reg. (1)	Reg. (2)	Reg. (3)	Reg. (4)	Reg. (5)	Reg. (6)	Reg. (7)	Reg. (8)	Reg. (9)
constant	1.73	3.76	1.71	-2.97	1.74	1.52	1.62	-2.68	-1.34
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.02)*	*(0.31)*
real wages	0.66		0.80	0.80	0.38	0.71	0.53	0.47	
	(0.00)		*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	
real mortgage rates	-0.04	-0.03	-0.01	-0.03	-0.02	-0.04	-0.03	-0.01	-0.01
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.02)*
housing loans (scaled to GDP)		0.25							0.14
		(0.00)							*(0.00)*
unemployment rate			-0.39					-0.12	-0.11
			(0.00)					*(0.02)*	*(0.01)*
real construction costs				0.88				1.00	1.06
				(0.00)				*(0.00)*	*(0.00)*
building permits					0.27			0.28	0.28
					(0.00)			*(0.00)*	*(0.00)*
institutional factor						0.07		0.06	0.04
						(0.00)		*(0.00)*	*(0.00)*
real stock market prices							0.15	-0.11	-0.11
							(0.00)	*(0.04)*	*(0.02)*
Adjusted R^2	0.65	0.74	0.78	0.72	0.72	0.75	0.68	0.81	0.82
Kao's panel cointegration tests									
DFρ	2.15	2.06	1.93	1.97	0.00	1.73	2.15	-0.25	-0.54
	(0.02)	*(0.02)*	*(0.03)*	*(0.02)*	*(0.50)*	*(0.04)*	*(0.02)*	*(0.40)*	*(0.29)*
DFρ*	0.70	0.48	0.96	0.67	-2.12	0.13	0.82	-1.65	-1.69
	(0.24)	*(0.32)*	*(0.17)*	*(0.25)*	*(0.02)*	*(0.45)*	*(0.21)*	*(0.05)*	*(0.05)*
DFt	-0.26	-0.43	-0.18	0.10	-2.83	-0.47	-0.33	-1.99	-2.39
	(0.40)	*(0.33)*	*(0.43)*	*(0.46)*	*(0.00)*	*(0.32)*	*(0.37)*	*(0.02)*	*(0.01)*
DFt*	*-1.42*	*-1.61*	*-1.04*	*-0.99*	*-3.60*	*-1.59*	*-1.42*	*-2.65*	-2.92
	(0.08)	*(0.05)*	*(0.15)*	*(0.16)*	*(0.00)*	*(0.06)*	*(0.08)*	*(0.00)*	*(0.00)*
ADF	-2.67	-3.75	-3.37	-3.45	-3.69	-3.05	-3.69	-4.88	-4.73
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*

Note: all p-values (in parenthesis) are reported such that Ho is rejected if p-value<0.05.

Table 2.A House price fundamentals: real wages vs. gross national disposable income
(dependent variable: log of real house prices)

Variable	Reg. (1)	Reg. (2)	Reg. (3)	Reg. (4)	Reg. (5)	Reg. (6)	Reg. (7)	Reg. (8)	Reg. (9)
constant	1.34	3.76	2.01	-2.61	1.46	0.98	1.46	-2.71	-1.34
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.03)*	*(0.31)*
gross national disp. income	0.74		0.71	0.94	0.45	0.82	0.60	0.59	
	(0.00)		*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	
real mortgage rates	-0.03	-0.03	-0.01	-0.02	-0.02	-0.03	-0.03	-0.01	-0.01
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.13)*	*(0.02)*
housing loans (scaled to GDP)		0.25							0.14
		(0.00)							*(0.00)*
unemployment rate			-0.32					-0.08	-0.11
			(0.00)					*(0.00)*	*(0.01)*
real construction costs				0.65				0.86	1.06
				(0.85)				*(0.00)*	*(0.00)*
building permits					0.26			0.26	0.28
					(0.00)			*(0.00)*	*(0.00)*
institutional factor						0.07		0.06	0.04
						(0.00)		*(0.00)*	*(0.00)*
real stock market prices							0.12	-0.08	-0.11
							(0.00)	*(0.06)*	*(0.02)*
Adjusted R^2	0.68	0.73	0.76	0.74	0.73	0.79	0.68	0.80	0.81
Kao's panel cointegration tests									
DFρ	2.39	2.06	2.31	2.30	0.34	1.88	2.34	-0.26	-0.54
	(0.01)	*(0.02)*	*(0.01)*	*(0.01)*	*(0.37)*	*(0.03)*	*(0.01)*	*(0.40)*	*(0.29)*
DFρ*	1.19	0.48	1.42	1.39	-1.40	0.59	1.20	-1.41	-1.69
	(0.12)	*(0.32)*	*(0.08)*	*(0.08)*	*(0.08)*	*(0.28)*	*(0.12)*	*(0.08)*	*(0.05)*
DFt	0.31	-0.43	0.55	0.77	-2.29	-0.13	0.19	-1.15	-2.39
	(0.38)	*(0.33)*	*(0.29)*	*(0.22)*	*(0.01)*	*(0.45)*	*(0.43)*	*(0.13)*	*(0.01)*
DFt*	*-0.83*	*-1.61*	*-0.38*	*-0.19*	*-3.07*	*-1.17*	*-0.90*	*-1.77*	-2.92
	(0.20)	*(0.05)*	*(0.35)*	*(0.43)*	*(0.00)*	*(0.12)*	*(0.19)*	*(0.04)*	*(0.00)*
ADF	-2.38	-3.91	-2.61	-2.63	-3.50	-2.87	-2.63	-4.01	-5.05
	(0.01)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*

Note: all p-values (in parenthesis) are reported such that Ho is rejected if p-value<0.05.

Table 2.B House price fundamentals in Emerging Europe *(dependent variable: log of real house prices)*

Variable	Reg. (1)	Reg. (2)	Reg. (3)	Reg. (4)	Reg. (5)	Reg. (6)	Reg. (7)	Reg. (8)	Reg. (9)
constant	-1.50	3.63	0.11	-1.37	-1.44	-1.23	-1.42	-0.58	0.63
	(0.00)	*(0.00)*	*(0.70)*	*(0.01)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.03)*	*(0.01)*
real wages	1.34		1.15	1.34	1.06	1.28	1.21	0.66	
	(0.00)		*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	
real mortgage rates	-0.03	-0.02	-0.02	-0.03	-0.01	-0.03	-0.03	-0.01	0.00
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.13)*	*(0.25)*
housing loans (scaled to GDP)		0.31							0.10
		(0.00)							*(0.00)*
unemployment rate			-0.36					-0.23	-0.24
			(0.00)					*(0.00)*	*(0.00)*
real construction costs				-0.02				0.35	0.68
				(0.85)				*(0.00)*	*(0.00)*
building permits					0.27			0.26	0.28
					(0.00)			*(0.00)*	*(0.00)*
institutional factor						0.04		0.05	0.06
						(0.00)		*(0.00)*	*(0.00)*
real stock market prices							0.12	-0.03	-0.05
							(0.00)	*(0.22)*	*(0.01)*
Adjusted R^2	0.85	0.83	0.89	0.84	0.90	0.86	0.86	0.93	0.92
Kao's panel cointegration tests									
DFρ	0.72	1.41	0.62	0.66	0.56	0.91	1.45	0.18	0.24
	(0.24)	*(0.08)*	*(0.27)*	*(0.25)*	*(0.29)*	*(0.18)*	*(0.07)*	*(0.43)*	*(0.40)*
DFρ*	-0.73	0.05	-0.24	-0.82	-0.44	-0.39	0.00	-0.68	-0.39
	(0.23)	*(0.48)*	*(0.40)*	*(0.21)*	*(0.33)*	*(0.35)*	*(0.50)*	*(0.25)*	*(0.35)*
DFt	-1.40	-0.24	-1.52	-1.44	-1.65	-0.71	-0.53	-1.46	-1.53
	(0.08)	*(0.40)*	*(0.06)*	*(0.08)*	*(0.05)*	*(0.24)*	*(0.30)*	*(0.07)*	*(0.06)*
DFt*	*-2.14*	*-1.20*	*-2.03*	*-2.17*	*-2.21*	*-1.50*	*-1.49*	*-1.93*	-1.90
	(0.02)	*(0.10)*	*(0.02)*	*(0.01)*	*(0.01)*	*(0.07)*	*(0.07)*	*(0.03)*	*(0.03)*
ADF	-2.99	-3.30	-4.71	-3.22	-4.79	-2.82	-2.54	-5.28	-5.02
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.01)*	*(0.00)*	*(0.00)*

Note: all p-values (in parenthesis) are reported such that Ho is rejected if p-value<0.05.

Table 2.C House price fundamentals in Asia *(dependent variable: log of real house prices)*

Variable	Reg. (1)	Reg. (2)	Reg. (3)	Reg. (4)	Reg. (5)	Reg. (6)	Reg. (7)	Reg. (8)	Reg. (9)
constant	3.23	4.87	2.77	2.12	2.81	2.72	3.08	1.35	3.58
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*
real wages	0.33		0.49	0.10	0.26	0.44	0.24	0.55	
	(0.00)		*(0.00)*	*(0.09)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	
real mortgage rates	-0.02	-0.02	0.00	-0.02	-0.01	-0.02	-0.02	0.00	0.00
	(0.00)	*(0.00)*	*(0.13)*	*(0.00)*	*(0.10)*	*(0.00)*	*(0.00)*	*(0.42)*	*(0.16)*
housing loans (scaled to GDP)		-0.03							0.15
		(0.19)							*(0.00)*
unemployment rate			-0.22					-0.07	-0.12
			(0.00)					*(0.00)*	*(0.00)*
real construction costs				0.46				0.15	0.14
				(0.00)				*(0.00)*	*(0.00)*
building permits					0.14			0.05	0.05
					(0.00)			*(0.00)*	*(0.00)*
institutional factor						0.02		0.04	0.02
						(0.00)		*(0.00)*	*(0.00)*
real stock market prices							0.12	-0.02	-0.01
							(0.00)	*(0.12)*	*(0.48)*
Adjusted R^2	0.39	0.24	0.46	0.24	0.63	0.42	0.42	0.80	0.80
Kao's panel cointegration tests									
DFρ	0.45	0.80	0.42	-2.00	-0.39	0.09	0.39	-16.66	-17.97
	(0.33)	*(0.21)*	*(0.34)*	*(0.02)*	*(0.35)*	*(0.46)*	*(0.35)*	*(0.00)*	*(0.00)*
DFρ*	-0.61	-0.16	-0.30	-3.20	-1.26	-1.33	-0.51	-5.73	-6.14
	(0.27)	*(0.44)*	*(0.38)*	*(0.00)*	*(0.10)*	*(0.09)*	*(0.30)*	*(0.00)*	*(0.00)*
DFt	-0.22	0.52	-0.05	-0.21	-2.29	-0.45	-0.18	-2.85	-3.03
	(0.41)	*(0.30)*	*(0.48)*	*(0.42)*	*(0.01)*	*(0.33)*	*(0.43)*	*(0.00)*	*(0.00)*
DFt*	*-0.85*	*-0.21*	*-0.54*	*-0.65*	*-2.61*	*-1.14*	*-0.74*	*-0.71*	-0.82
	(0.20)	*(0.42)*	*(0.30)*	*(0.26)*	*(0.00)*	*(0.13)*	*(0.23)*	*(0.24)*	*(0.21)*
ADF	-2.00	-3.30	-1.62	-0.93	-2.31	-2.41	-2.10	-0.40	-1.87
	(0.02)	*(0.00)*	*(0.05)*	*(0.18)*	*(0.01)*	*(0.01)*	*(0.02)*	*(0.34)*	*(0.03)*

Note: all p-values (in parenthesis) are reported such that Ho is rejected if p-value<0.05.

Table 3. House price fundamentals: country-specific IV–2SLS method *(dependent variable: log of real house prices)*

Variable	Bulgaria	China	Czech Rep.	Estonia	Hong Kong	Hungary	Korea	Latvia
constant	4.02	2.12	4.86	3.37	3.44	3.94	2.96	2.82
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*
real wages		0.70					0.12	
		(0.00)					*(0.01)*	
real mortgage rates	-0.03				-0.01			-0.05
	(0.00)				*(0.06)*			*(0.00)*
housing loans (scaled to GDP)	0.23		0.18	0.23		0.25		0.69
	(0.00)		*(0.00)*	*(0.00)*		*(0.00)*		*(0.00)*
unemployment rate		-0.33	-0.28	-0.30	-0.38	-0.53	-0.22	
		(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.01)*	*(0.00)*	
real construction costs					0.39		0.30	
					(0.01)		*(0.00)*	
building permits				0.27		0.21		
				(0.00)		*(0.03)*		
institutional factor								
real stock market prices		-0.06						
		(0.00)						
Adjusted R^2	0.97	0.99	0.96	0.97	0.78	0.94	0.78	0.63
N. of observations	46	54	54	57	66	52	66	33
ADF statistic (*)	-26.90	-49.60	-30.89	-45.47	-34.68	-23.85	-71.34	-20.55
	(0.01)	*(0.00)*	*(0.01)*	*(0.02)*	*(0.01)*	*(0.00)*	*(0.00)*	*(0.03)*
α	0.74	0.56	0.54	-0.08	0.46	0.29	0.41	0.43
	(0.00)	*(0.00)*	*(0.00)*	*(0.52)*	*(0.01)*	*(0.02)*	*(0.00)*	*(0.00)*
β	0.34	0.19	0.20	0.80	0.14	0.20	0.13	0.15
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.06)*	*(0.00)*	*(0.01)*	*(0.14)*
γ	0.20	0.40	0.20	1.00	0.34	0.54	0.38	0.38
	(0.05)	*(0.00)*	*(0.14)*	*(0.00)*	*(0.11)*	*(0.00)*	*(0.01)*	*(0.03)*
type of cycle?	Damped fluctuations	Damped fluctuations	Damped fluctuations	Convergence	Damped fluctuations	Convergence	Convergence	Damped fluctuations

Note: α, β and γ represent, respectively, the persistence, the mean reversion and the contemporaneous adjustment parameters; all p-values (in parenthesis) are reported such that Ho is rejected if p-value<0.05; unit root tests do not include an intercept nor a time trend; (*) MacKinnon (1996) *p* -values.

Table 3 (cont.) House price fundamentals: country-specific IV–2SLS method *(dependent variable: log of real house prices)*

Variable	Lithuania	Malaysia	Poland	Russia	Singapore	Slovakia	Slovenia	Thailand
constant	4.79	3.92	4.12	0.41	-0.59	6.16	1.92	4.05
	(0.00)	*(0.00)*	*(0.28)*	*(0.20)*	*(0.12)*	*(0.00)*	*(0.00)*	*(0.00)*
real wages			0.49	0.77				
			(0.02)	*(0.00)*				
real mortgage rates	-0.01				-0.02			
	(0.07)				*(0.00)*			
housing loans (scaled to GDP)	0.29	0.13					0.50	0.09
	(0.00)	*(0.00)*					*(0.00)*	*(0.00)*
unemployment rate	-0.39		-0.62			-0.63	-0.09	
	(0.00)		*(0.00)*			*(0.00)*	*(0.09)*	
real construction costs								
building permits					0.66	0.27	0.33	0.09
					(0.00)	*(0.00)*	*(0.00)*	*(0.00)*
institutional factor					*0.04*			
					(0.00)			
real stock market prices		0.06		0.16	0.50	-0.23		
		(0.01)		*(0.02)*	*(0.00)*	*(0.00)*		
Adjusted R^2	0.97	0.84	0.96	0.88	0.84	0.83	0.96	0.84
N. of observations	50	49	34	46	66	35	33	66
ADF statistic (*)	-23.91	-15.07	-48.37	-22.75	-33.51	-26.39	-33.42	-47.15
	(0.08)	*(0.26)*	*(0.00)*	*(0.04)*	*(0.03)*	*(0.03)*	*(0.00)*	*(0.00)*
α	0.03	0.17	0.60	0.41	0.47	0.34	0.23	-0.10
	(0.82)	*(0.26)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.09)*	*(0.13)*	*(0.25)*
β	0.44	0.31	0.42	0.13	0.30	0.27	0.57	0.65
	(0.00)	*(0.00)*	*(0.00)*	*(0.02)*	*(0.00)*	*(0.09)*	*(0.00)*	*(0.00)*
γ	0.72	0.58	0.57	0.34	0.33	0.34	0.58	0.59
	(0.00)	*(0.01)*	*(0.02)*	*(0.00)*	*(0.00)*	*(0.05)*	*(0.01)*	*(0.10)*
type of cycle?	Convergence	Convervence	Damped fluctuations	Damped fluctuations	Damped fluctuations	Damped fluctuations	Damped fluctuations	Convergence

Note: α, β and γ represent, respectively, the persistence, the mean reversion and the contemporaneous adjustment parameters; all p-values (in parenthesis) are reported such that Ho is rejected if p-value<0.05; unit root tests do not include an intercept nor a time trend; (*) MacKinnon (1996) *p* -values.

Table 4. House price fundamentals: country-specific FM-OLS method *(dependent variable: log of real house prices)*

Variable	Bulgaria	China	Czech Rep.	Estonia	Hong Kong	Hungary	Korea	Latvia
constant	4.05	2.11	4.62	3.52	2.77	4.03	2.86	3.02
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*
real wages		0.68					0.20	
		(0.00)					*(0.01)*	
real mortgage rates	-0.03				-0.01			-0.05
	(0.00)				*(0.01)*			*(0.04)*
housing loans (scaled to GDP)	0.22		0.20	0.24		0.28		0.64
	(0.00)		*(0.00)*	*(0.00)*		*(0.00)*		*(0.03)*
unemployment rate		-0.32	-0.19	-0.33	-0.33	-0.56	-0.19	
		(0.00)	*(0.04)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	
real construction costs					0.51		0.24	
					(0.00)		*(0.01)*	
building permits				0.24		0.19		
				(0.00)		*(0.02)*		
institutional factor								
real stock market prices		-0.04						
		(0.00)						
Adjusted R^2	0.96	0.99	0.95	0.97	0.77	0.93	0.73	0.61
N. of observations	46	54	54	57	66	52	66	33
ADF statistic (*)	-26.90	-49.60	-30.89	-45.47	-34.68	-23.85	-71.34	-20.55
	(0.01)	*(0.00)*	*(0.01)*	*(0.02)*	*(0.01)*	*(0.00)*	*(0.00)*	*(0.03)*
α	0.74	0.55	0.61	-0.05	0.49	0.32	0.38	0.43
	(0.00)	*(0.00)*	*(0.00)*	*(0.67)*	*(0.01)*	*(0.02)*	*(0.00)*	*(0.00)*
β	0.31	0.19	0.15	0.82	0.14	0.16	0.12	0.14
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.08)*	*(0.01)*	*(0.02)*	*(0.12)*
γ	0.17	0.48	0.21	1.09	0.30	0.58	0.41	0.35
	(0.09)	*(0.00)*	*(0.19)*	*(0.00)*	*(0.15)*	*(0.00)*	*(0.01)*	*(0.06)*
type of cycle?	Damped fluctuations	Damped fluctuations	Damped fluctuations	Convergence	Damped fluctuations	Convergence	Convergence	Damped fluctuations

Note: α, β and γ represent, respectively, the persistence, the mean reversion and the contemporaneous adjustment parameters; all p-values (in parenthesis) are reported such that Ho is rejected if p-value<0.05; unit root tests do not include an intercept nor a time trend; (*) MacKinnon (1996) *p* -values.

Table 4 (cont). House price fundamentals: country-specific FM-OLS method *(dependent variable: log of real house prices)*

Variable	Lithuania	Malaysia	Poland	Russia	Singapore	Slovakia	Slovenia	Thailand
constant	4.78	3.91	4.52	0.44	-1.57	6.19	2.17	4.03
	(0.00)	*(0.00)*	*(0.00)*	*(0.20)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*
real wages			0.42	0.79				
			(0.10)	*(0.00)*				
real mortgage rates	-0.02				-0.03			
	(0.06)				*(0.00)*			
housing loans (scaled to GDP)	0.28	0.12					0.48	0.09
	(0.00)	*(0.00)*					*(0.00)*	*(0.00)*
unemployment rate	-0.37		-0.64			-0.62	-0.11	
	(0.00)		*(0.00)*			*(0.00)*	*(0.00)*	
real construction costs								
building permits					0.80	0.22	0.30	0.09
					(0.00)	*(0.01)*	*(0.00)*	*(0.00)*
institutional factor					*0.08*			
					(0.00)			
real stock market prices		0.07		0.13	0.57	-0.19		
		(0.06)		*(0.08)*	*(0.00)*	*(0.01)*		
Adjusted R^2	0.97	0.80	0.96	0.85	0.84	0.80	0.96	0.84
N. of observations	50	49	34	46	66	35	33	66
ADF statistic (*)	-23.91	-15.07	-48.37	-22.75	-33.51	-26.39	-33.42	-47.15
	(0.08)	*(0.26)*	*(0.00)*	*(0.04)*	*(0.03)*	*(0.03)*	*(0.00)*	*(0.00)*
α	0.02	0.17	0.60	0.41	0.44	0.33	0.23	-0.10
	(0.83)	*(0.25)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.08)*	*(0.17)*	*(0.24)*
β	0.43	0.29	0.41	0.12	0.28	0.30	0.54	0.64
	(0.00)	*(0.00)*	*(0.01)*	*(0.03)*	*(0.00)*	*(0.07)*	*(0.01)*	*(0.00)*
γ	0.72	0.60	0.55	0.42	0.43	0.35	0.51	0.63
	(0.00)	*(0.01)*	*(0.02)*	*(0.00)*	*(0.00)*	*(0.08)*	*(0.06)*	*(0.09)*
type of cycle?	Convergence	Convergence	Damped fluctuations	Damped fluctuations	Damped fluctuations	Damped fluctuations	Damped fluctuations	Convergence

Note: α, β and γ represent, respectively, the persistence, the mean reversion and the contemporaneous adjustment parameters; all p-values (in parenthesis) are reported such that Ho is rejected if p-value<0.05; unit root tests do not include an intercept nor a time trend; (*) MacKinnon (1996) *p* -values.

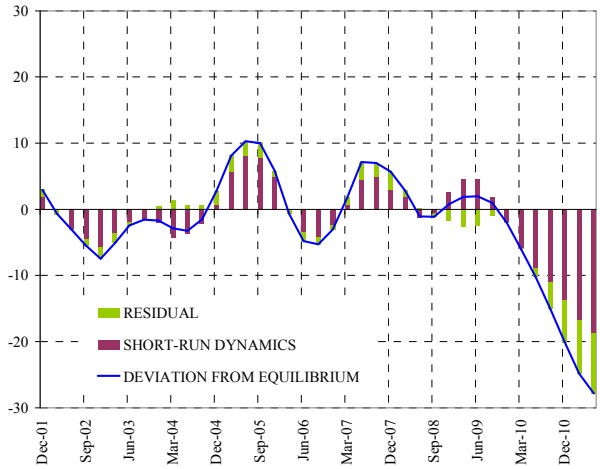
Annex I. Sources of house price data

COUNTRY	SERIES DEFINITION	SOURCES	REMARKS	AVAILABILITY
ASIA PACIFIC				
China	Property prices, residential and commercial, index PY=100, NSA.	BIS Macro Series (code: VSIC:CN:01) National Bureau of Statistics, monthly data www.stats.gov.cn/english/statisticaldata/index.htm#	Quarterly data obtained as average of three months in each quarter; sales price indices of buildings in 70 medium-large sized cities.	1998 Q1 - 2011 Q2
Hong Kong	Residential property prices, all dwellings (Hong Kong), index 1999=100, NSA.	BIS Macro Series (code: VSJA:HK:05) Hong Kong Monetary Authority, Census and Statistics Department, Hong Kong Monthly Digest of Statistics.	Quarterly data obtained as average of three months in each quarter; private domestic units are defined as independent dwellings with separate cooking facilities and bathroom (and/or lavatory).	1995 Q1 - 2011 Q2
Korea	Residential property prices, all dwellings, index dec 2007=100, NSA.	Datastream	Quarterly data obtained as average of three months in each quarter.	1995 Q1 - 2011 Q2
Malaysia	Residential property prices, all dwellings (Malaysia), index 2000=100, NSA.	BIS Macro Series (code VSJA:MY:00) Bank Negara Malaysia, monthly statistical bulletin, house price indicators www.bnm.gov.my/index.php?ch=109&pg=294&mth=1&yr=2010	Quarterly data.	1999 Q1 - 2011 Q1
Singapore	Residential property prices, all dwellings, index 1998Q4=100, NSA.	Datastream	Quarterly data.	1995 Q1 - 2011 Q2
Thailand	Residential property prices, index 1991=100, NSA.	Bank of Thailand http://www.bot.or.th/English/Statistics/EconomicAndFinancial/EconomicIndices/Pages/StatPropertyIndicators.aspx	Quarterly data, town house indcluding land.	1995 Q1 - 2011 Q2
CENTRAL AND EASTERN EUROPE				
Bulgaria	Residential property prices, existing flats (big cities), Bulgarian lev per square metre, NSA.	BIS Macro Series (code: VSKA:BG:24) Nationa Statistical Institute: www.nsi.bg/Cpi_e/CPI_e.htm	Quarterly data, end of period, statistical survey based on real contracts for existing flats in regional centres.	1995 Q1 - 2011 Q2
Czech Republic	Residential property prices, all dwellings, index 2005=100, NSA.	BIS Macro Series (code VSJA:CZ:00) Czech Statistical Office www.czso.cz/csu/2008edicniplan.nsf/p/7009-08	Quarterly data, average of period, index of residential property prices from data compiled from tax returns.	1998 Q1 - 2011 Q2
Estonia	Residential property prices, existing flats (Tallin), Estonian kroon per square metre, NSA.	BIS Macro Series (code VSKA:EE:44) Statistical Office of Estonia http://pub.stat.ee/pxweb.2001/I_Databas/Economy/26Real_estate/11Transactions_in_real_estate/11Transactions_in_real_estate.asp	Quarterly data; for 1997-2001, purchase-sale contracts of movable assets; since 2002, purchase-sale contracts of real estate, dwellings of satisfactory conditions, prices of 2-rooms and kitchen in Tallin.	1997 Q1 - 2011 Q1
Hungary	Residential property prices, existing dwellings (Budapest), index 2001 Q4=100, NSA.	BIS Macro Series (code VSKA:HU:45)	Quarterly data, weighted average (by number of transactions) prices of purchase-sale contracts registered at the regional Land Registry Offices.	2001 Q4 - 2011 Q2
Latvia	Residential property prices, existing flats, Latvian lat per square metre, NSA.	BIS Macro Series (code VSKA:LV:04) Central Statistical Bureau www.csb.gov.lv/csp/content/?lng=en&cat=355	Quarterly data, whole country, average price per square metre of the total residential apartments (flats) sold.	2003 Q1 - 2011 Q1
Lithuania	Residential property prices, existing dwellings (Lithuania), index 1998 Q4=100, NSA.	BIS Macro Series (code VSJA:LT:00)	Quarterly data, all residential property (houses and flats) transacted in the whole country and registered at the State Enterprise Centre of Registers.	1998 Q4 - 2011 Q1
Poland	Residential property prices, Polish zloti per square metre, new dwellings (Poland), NSA.	Central Statistical Office www.stat.gov.pl/gus/5840_4671_ENG_HTML.htm	Quarterly data, price of a square meter of usable floor space of a residential building.	2002 Q4 - 2011 Q1
Russia	Residential property prices, Russian ruble per square metre, existing dwellings (Moscow), NSA.	Bloomberg	Quarterly data.	2001 Q1 - 2011 Q2
Slovakia	Residential property prices, existing dwellings (Slovakia), index 2002=100, NSA.	BIS Macro Series (code VSKA:SK:00) National Bank of Slovakia www.nbs.sk/en/statistics/selected-macroeconomics-indicators	Quarterly data, existing apartments and houses in whole country.	2002 Q4 - 2011 Q2
Slovenia	Residential property prices, existing dwellings (Slovenia), index 2005=100, NSA.	Statistical Office of the Republic of Slovenia housing price index www.stat.si/eng/tema_ekonomsko_cene.asp	Quarterly data, observation units are second-hand dwellings and family houses; actually their selling (transaction) prices.	2003 Q1 - 2011 Q1

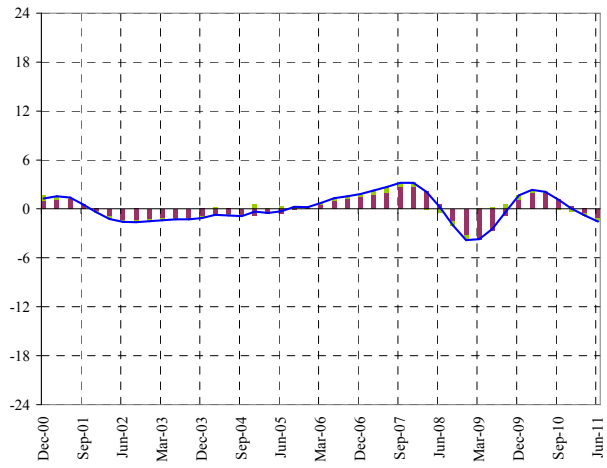
Annex II. Real house price deviations from long-run 'equilibrium' levels

(4-quarters moving average; in percent)

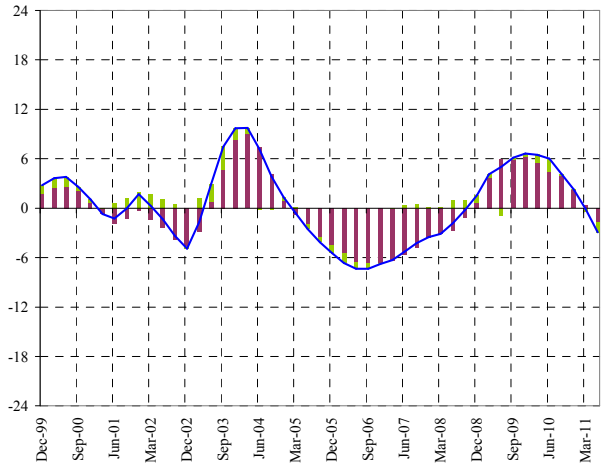
BULGARIA



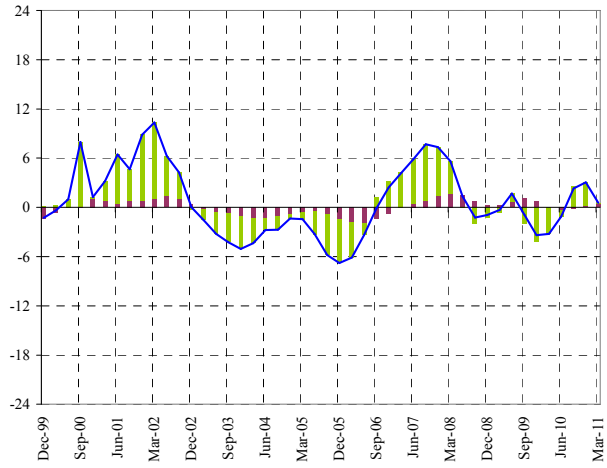
CHINA



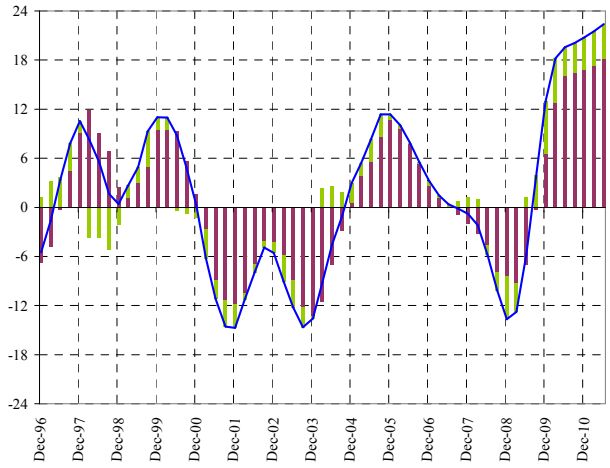
CZECH REPUBLIC



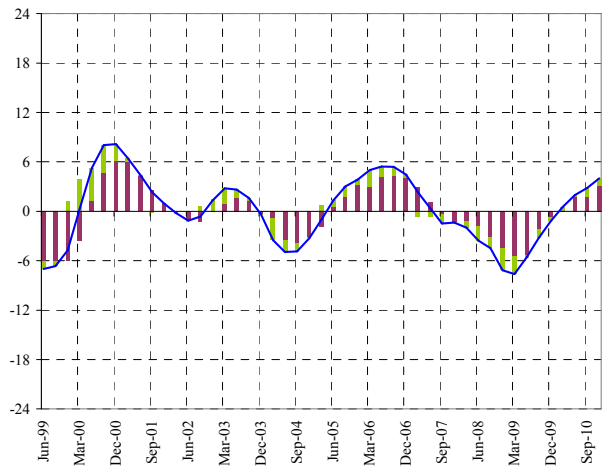
ESTONIA



HONG KONG

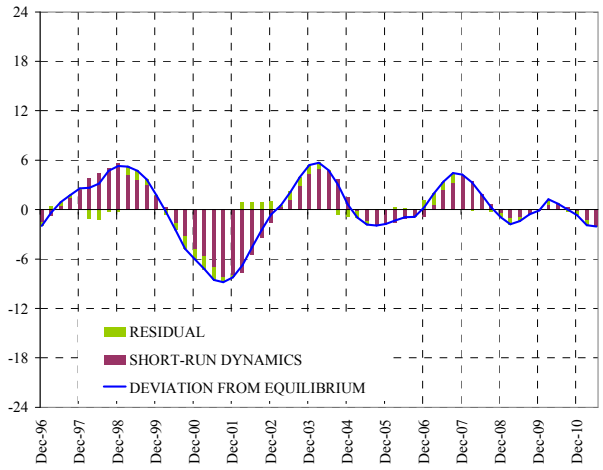


HUNGARY

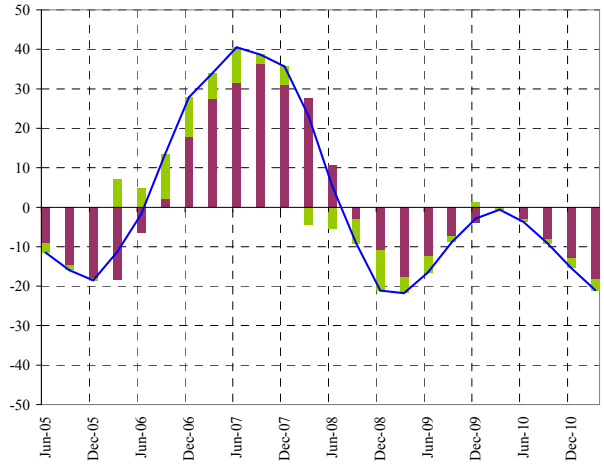


Notes: the blue lines represent the four-terms moving average of quarterly deviations of actual house prices from their long-run 'equilibrium' ones, with a positive (negative) value indicating an overvaluation (undervaluation); the purple bars represent the short-run dynamics driven by the interactions between (changes in) fundamentals and inherent frictions in the market; the green bars represent the residual component driven by overly optimistic (pessimistic) expectations. Results are based on country-specific regressions on the determinants of house price fundamentals and on the short-term dynamics contained in Table 3.

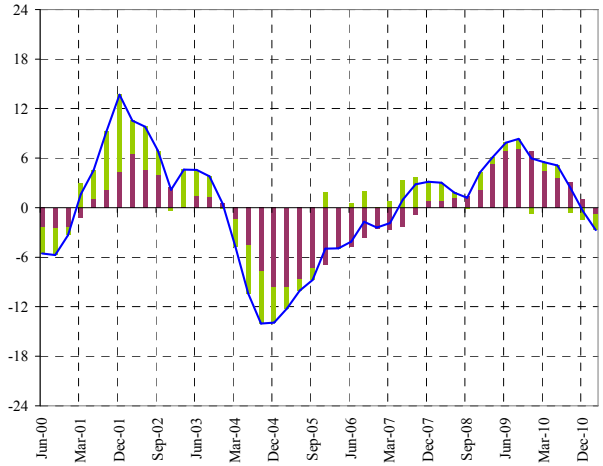
KOREA



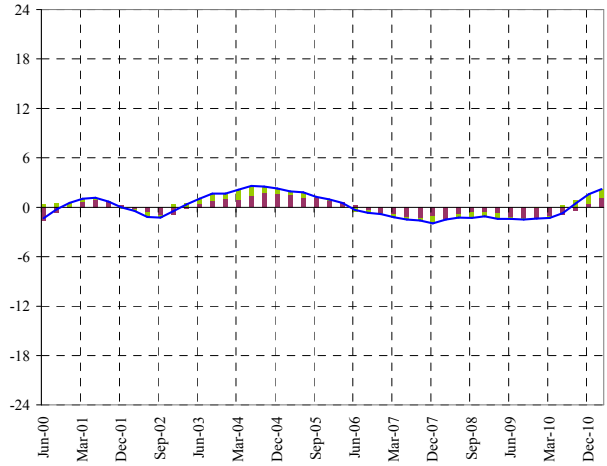
LATVIA



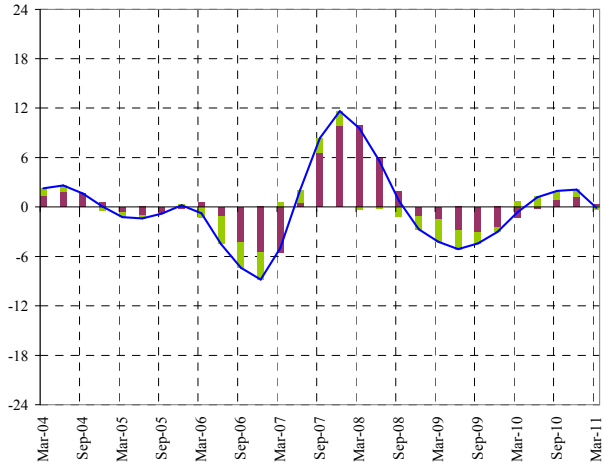
LITHUANIA



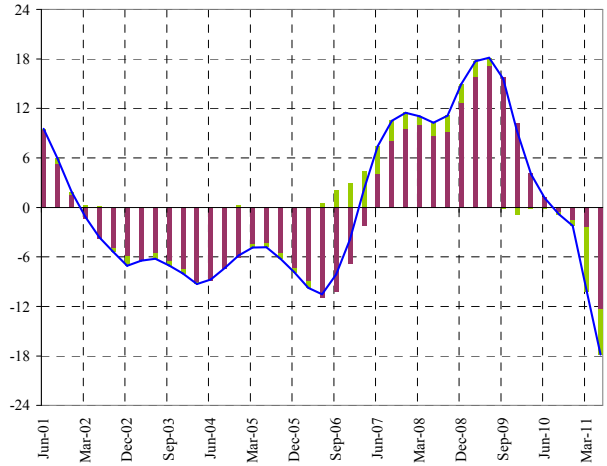
MALAYSIA



POLAND

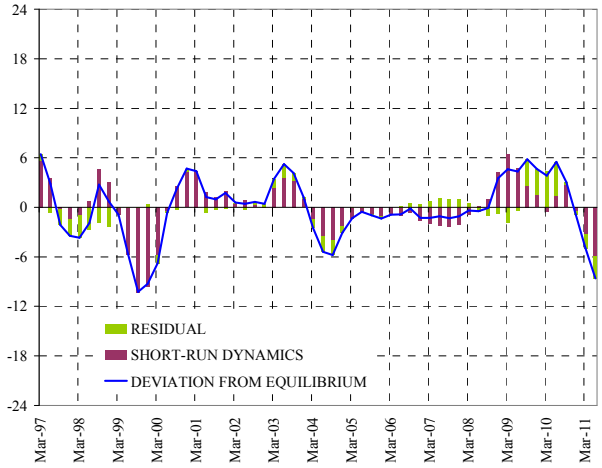


RUSSIA

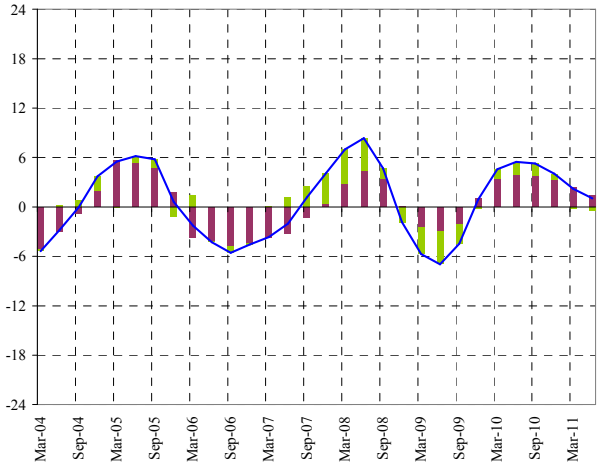


Notes: the blue lines represent the four-terms moving average of quarterly deviations of actual house prices from their long-run 'equilibrium' ones, with a positive (negative) value indicating an overvaluation (undervaluation); the purple bars represent the short-run dynamics driven by the interactions between (changes in) fundamentals and inherent frictions in the market; the green bars represent the residual component driven by overly optimistic (pessimistic) expectations. Results are based on country-specific regressions on the determinants of house price fundamentals and on the short-term dynamics contained in Table 3.

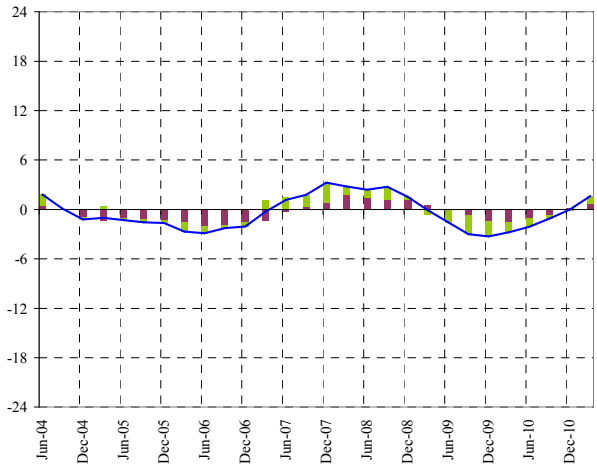
SINGAPORE



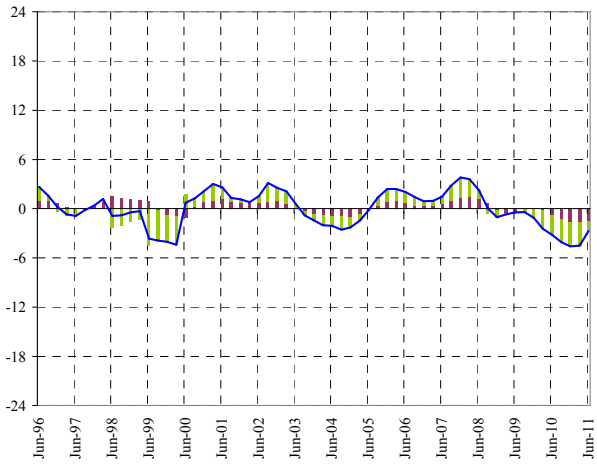
SLOVAKIA



SLOVENIA



THAILAND



Notes: the blue lines represent the four-terms moving average of quarterly deviations of actual house prices from their long-run 'equilibrium' ones, with a positive (negative) value indicating an overvaluation (undervaluation); the purple bars represent the short-run dynamics driven by the interactions between (changes in) fundamentals and inherent frictions in the market; the green bars represent the residual component driven by overly optimistic (pessimistic) expectations. Results are based on country-specific regressions on the determinants of house price fundamentals and on the short-term dynamics contained in Table 3.

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