Housing finance and financial stability: evidence from Malaysia, Thailand and Singapore

Hanifa, Mohamed Hisham and Masih, Mansur

INCEIF, Malaysia, INCEIF, Malaysia

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Mohamed Hisham Hanifa [1] and Mansur Masih[2]

Abstract

This paper discusses current housing finance practices in three emerging economies such as, Malaysia, Thailand and Singapore, as well as the impact of those practices on financial stability. National authorities and policymakers may find this analysis helpful as they reassess the structure and health of their housing finance systems, with particular attention given to those factors that have contributed to a stable housing finance system. The methodology used to determine the factors was panel cointegration and dynamic OLS. The country-specific housing finance systems vary significantly and have sometimes been shaped by pivotal historic events. Today's housing finance systems are determined by a range of factors, including the products offered to investors (floating or fixed interest rates over various maturities); the use of prepayment penalties; funding (deposits versus capital markets); the degree of lender recourse to defaulted borrowers' other assets and income; and government participation, including tax breaks. While different systems can work well to provide stable housing finance, a number of best practices emanate from the discussion and empirical analyses. They are enhanced underwriting and supervision; better calibrated government participation; and better-aligned incentives in capital-market mortgage funding. The paper concludes with a number of policy recommendations to encourage more stable housing finance system.
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[1] Mohamed Hisham Hanifa, Ph.D. Student in Islamic finance at INCEIF, Lorong Universiti A, 59100 Kuala Lumpur, Malaysia.

[2] **Corresponding author**, Professor of Finance and Econometrics, INCEIF, Lorong Universiti A, 59100 Kuala Lumpur, Malaysia. Phone: +60173841464 Email: mansurmasih@inceif.org

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Introduction

In many countries, house price swings have been associated with financial instability. There are several examples of house price booms and busts over the past two decades, including in Sweden in the early 1990s, and in Ireland, Spain, the United Kingdom, and the United States during the recent crisis (subprime). These house price gyrations can carry a significant cost to the economy, reflecting the importance of housing in the construction industry, household budgets, and overall wealth. Still, the degree to which such house price boom-bust episodes have led to more widespread financial instability differs between countries, in part because of important differences in countries' housing finance systems, including the role of government in the housing market. The recent financial crisis was triggered by problems in the U.S. domestic subprime mortgage markets, where cumulative loss rates of securitized subprime loan portfolios exceeded 20 percent by end-2010.

In the wake of the crisis, U.S. housing defaults have accelerated, reaching their highest level since the 1930s, with 11.1 million residential properties (or 23.1 percent of the total) having negative equity mortgages (that is, where the outstanding loan balance is greater than the property value) as of end-2010 (CoreLogic, 2011).

The purpose of this paper is to bring theoretical concepts and empirical evidence to bear on housing finance systems in a number of representative in emerging economies with those geographically connected i.e, Malaysia, Thailand and Singapore, in order to identify factors conducive to a stable housing finance system and financial stability more generally.

In particular, this paper will examine those aspects of housing finance systems that have contributed to financial instability, through empirical analyses.

In doing so, the paper will not focus on other factors affecting financial stability, nor on other aspects of housing finance such as measures to promote social housing. The concept of housing finance will be interpreted broadly, encompassing not only specific product types and lender structures but also the degree of government participation in a well-functioning mortgage market. The paper concludes with a number of policy recommendations to encourage more stable housing finance systems.

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Literature review :
Housing booms and busts—theory and stylized facts

Before examining the effects of housing finance on financial stability, it is useful to review why housing markets have been implicated in many episodes of financial instability. Housing booms and busts are often associated with systemic financial stress.

The recent experiences in advance economies, the United States, Spain, Ireland, and, to a lesser extent, the United Kingdom provide fresh examples of unsustainable housing booms that have turned into busts, with sizable output losses and banking crises in some cases[3]. Reinhart and Rogoff (2009) show that the six major historical episodes of banking crises in advanced economies since the mid-1970s were all associated with a housing bust. They document that this pattern can also be found in many emerging market crises, including the Asian financial crisis of 1997–98, with the magnitude of house price declines being broadly similar in both advanced and emerging market countries[4].

Given that housing busts weaken household and financial sector balance sheets, housing-linked recessions are, on average, more severe than recessions that are not accompanied by housing busts. Based on1960–2007 cross-country data from the Organization for Economic Cooperation and Development(OECD), Claessens, Kose, and Terrones (2008) show that output losses in recessions accompanied by housing busts are two to three times greater than they would otherwise be.

Moreover, housing busts tend to prolong recessions (averaging 18 quarters, compared with four quarters for the typical recession), as falling house prices act as a further drag on household consumption and residential investment while putting financial intermediary balance sheets under stress. Since house purchases typically involve household borrowing, house prices are likely to be strongly driven by credit conditions and household leverage[5]

An influential set of studies (Stein, 1995; Kiyotaki and Moore, 1997) posit that households can borrow only a fixed multiple of their down payment. This assumption of a fixed "leverage ratio" implies an "accelerator" mechanism, where a positive or negative shock to income (or net worth) is amplified by an expansion, or contraction, in borrowing capacity, in turn influencing house prices. Positive shocks to household income translate into larger house price increases where prevailing leverage ratios are higher (e.g., in the

[3]See Crowe and others (2011a), in particular their Figure 3.
[4]Stresses on the financial system can of course arise from sources other than a housing bust, including sovereign and currency crises, a general deterioration of economic prospects, and regional contagion.
[5]As documented in a large body of previous empirical literature, in addition to credit, house prices are strongly driven by fundamentals such as income and population growth. Parts of the theoretical literature stress nonfinancial frictions, such as overly optimistic (adaptive) expectations on both the demand and supply side as additional forces that can drive prices away from fundamentals (Shiller, 2008; McCue and Belsky, 2007;Burnside, Eichenbaum, and Rebelo, 2011).

United Kingdom), and smaller increases in countries where such leverage ratios are lower (e.g., in Italy)[6].

Leverage—and lending standards more broadly—can evolve in a procyclical fashion, resulting in powerful swings in house prices (Geanakoplos, 2010). Relaxing lending standards in good times drives up both credit and house price growth while a tightening of standards puts downward pressure on house prices. A number of studies of the recent housing boom in the United States show that rapid growth in credit to prime and subprime borrowers was associated with a sharp deterioration in lending standards that in turn fueled house price appreciation[7]

Global housing finance landscape

Housing finance systems differ considerably across countries along a number of dimensions, including product diversity, type of lender, mortgage funding, and the degree of government participation. Some of today's systems are the result of accident or history. Examples are the launch of the current Danish mortgage lending system after the great fire of Copenhagen in 1795, which spurred the need for an organized mortgage credit market to quickly provide funding to build a large number of new buildings and the German *Pfandbriefe* (covered bond) system, which dates to 1769 and was heavily influenced by the aftermath of the Seven Years' War. In response to the latest crisis, a number of countries have also taken steps to further strengthen their mortgage market regulations especially for the three country under study (Table 1), house financing system (Table 2) and Mortgage Market Characteristic (Table3). Different application of house financing system and mortgage market characteristic are presume to affect the house price differently.

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[6]Existing evidence confirms the presence of such a mechanism both within the United States and across the OECD (Lamont and Stein, 1999; Almeida, Campello, and Liu, 2005).
[7]See Favara and Imbs (2009); Dell'Ariccia, Igan, and Laeven (2008); Geanakoplos (2010); and Mian and Sufi (2009a). U.S. subprime mortgage originations almost tripled over 2000–06, reaching $600 billion or 20 percent of all mortgage origination

Table 1. Crisis Measures

Country	Policy Year	Description
Malaysia	March 2009 to November 2010	Mortgage interest tax relief (up to a limit) for 3 years and deferred loan payments for retrenched home-owners for 1 year as crisis-stimulus, capital gains tax reinstated for properties sold within 5 years; LTV on third-homes limited to 70 percent
Thailand	2009 to November 2010	LTV reduced from 70 to 80 percent; risk weights on LTV higher than 80% increased to 75 percent; relaxation of LTV limits for certain types of dwellings
Singapore	February 2010 to January 2011	Seller's stamp duty on property sold within a year introduced; LTV limit reduced from 90 to 80 percent (60 percent for second and subsequent mortgages granted by FIs regulated by the MAS; increasing housing grants to lower-income households; lengthening the minimum occupancy period for nonsubsidized flats; raising the seller's stamp duty rates to 16 percent if sold within a year, 4 percent if sold in the 4^{th} year.

LTV is Loan-to-value (LTV) ratios

Table 2:House Financing System

		Mortgage Funding			
Economy	Main lenders	Deposits ("fx" if foreign currency funding is used and foreign currency loans granted)	Covered Bonds/ Residential Loans Ratio (percent)	Residential Mortgage-Backed Securities/Residential Loans Ratio (percent)	Notes
Malaysia	Banks and Treasury Housing Loan Division	Some plus refinancing through Cagamas plus unsecured debt		4.0	Treasury Housing Loan Division (12 percent) which provides (subsidized) housing loans to government employees only; Employees' Provident Fund, early withdrawal for house ownership; Cagamas are goverment-promoted secondary mortgage liquidity facility, are not involved in origination but only in refinancing. Loans sold to Cagamas are not off balance sheet. Malaysia has issued staff housing loan receivables via Cagamas, to further develop the asset backed securities market.
Thailand	Banks and housing finance agencies	Mainly; also government-backed bonds	Low		State-owned financial institution has the largest share.
Singapore	Banks and Housing Development Board				State-owned Housing Development Board has the largest share.

Sources: European Mortgage Federation; Housing Finance Network; Merrill Lynch Guide to Emerging Mortgage and Consumer-Credit Markets, Vol. 1.
Note: LTV = loan-to-value ratio; AHML = Agency for Housing Mortgage Lending.
[1]The Czech Republic has been reclassified as an advanced economy; it was an emerging economy during the pre-crisis years.

Table 3: Mortgage Market Characteristic

	Government Support							Interest Rate Type	Loan-to-Value Ratio (LTV)			
Economy	Subsidies to First-Time Buyers Up Front	Subsidies to Buyers through Savings Account Contributions	Subsidies to Selected Groups, Low-Income	Provident Funds Early Withdrawal for Housing Purposes	Housing Finance Funds, Govt. Agency Providing Guarantees, Loans	Tax Deductibility of Mortgage Interest	Capital Gains Tax Deductibility	Majority of the Contracts	Maximum Allowed with Mortgage Insurance	Average	Observed Maximum[1]	For Covered Bonds
Malaysia			Yes, to government employees	Yes	Yes, through Cagamas, but without formal govt. support			Variable			80	90
Singapore			Yes, through Housing Development Board	Yes	Yes (loan origination)	Yes		Variable		<70	80	80–90
Thailand	Yes, tax breaks				Yes	Yes, up to a maximum		Fixed/Variable			90-100	70–90 (100 by Government Housing Bank)

Sources: European Mortgage Federation; Housing Finance Network; Merrill Lynch Guide to Emerging Mortgage and Consumer-Credit Markets, Vol. 1; Warnock and Warnock (2008); Crowe and others (2011b).
Note: MBS = mortgage-backed securities.
[1]The observed maximum refers not only to published maximum LTV ratio, but also to anecdotal evidence from various sources cited.
[2]The Czech Republic has been reclassified as an advanced economy; it was an emerging economy during the pre-crisis years.

Methodology

The panel unit roots test

Investigations into the unit root in panel data have recently attracted a lot of attention. Abuaf and Jorion (1990) point out that the power of unit root tests may be increased by exploiting cross-sectional information. LL (1993)[8]proposes a panel-based ADF test that restricts parameters ci by keeping them identical across cross-sectional regions as follows:

$$\Delta y_{it} = \alpha_i + \gamma_i y_{it-1} + \sum_{j=1}^{k} \alpha_j \Delta y_{it-j} + e_{it}, \quad (1)$$

where t =1,. . ., T time periods and i =1,. . .N members of the panel. LL tests the null hypothesis of ci =c =0 for all i, against the alternate of c1=c2. . .=c b0 for all i, with the test based on statistics tc =cˆ/s.e.(cˆ). One drawback is that c is restricted by being kept identical across regions under both the null and alternative hypotheses.

[8]This was finally published as Levine et al. (2002).

For the above reason, IPS (1997) relax the assumption of the identical first-order autoregressive coefficients of the LL test and allow c to vary across regions under the alternative hypothesis. IPS test the null hypothesis of ci =0 for all i, against the alternate of ci b0 for all i. The IPS test is based on the mean-group approach, which uses the average of the tci statistics to perform the following

$$\bar{Z} = \sqrt{N}(\bar{t} - E(\bar{t})) \Big/ \sqrt{\mathrm{Var}(\bar{t})}, \qquad (2)$$

where $\bar{t}=(1/N)\sum_{i=1}^{N} t_{\gamma_i}$, the terms $E(\bar{t})$ and $\mathrm{Var}(\bar{t})$ are, respectively, the mean and variance of each t_{γ_i} statistic, and they are generated by simulations and are tabulated in IPS (1997). The $\bar{Z}$ converges to a standard normal distribution. Based on Monte Carlo experiment results, IPS demonstrate that their test has more favorable finite sample properties than the LL test.

Hadri (2000) argues differently that the null should be reversed to be the stationary hypothesis in order to have a stronger power test. Hadri's (2000) Lagrange multiplier (LM) statistic can be written as

$$L\hat{M} = \frac{1}{N} \sum_{i=1}^{N} \left(\frac{\frac{1}{T^2} \sum_{t=1}^{T} S_{it}^2}{\hat{\sigma}_\varepsilon^2} \right), \quad S_{it} = \sum_{j=1}^{t} \hat{\varepsilon}_{ij}, \qquad (3)$$

where $\hat{\sigma}_\varepsilon^2$ is the consistent Newey and West (1987) estimate of the long-run variance of disturbance terms.

The panel cointegration tests

Pedroni (1999) considers the following time series panel regression

$$y_{it} = \alpha_{it} + \delta_{it} t + X_i \beta_i + e_{it}, \qquad (4)$$

where y_{it} and X_{it} are the observable variables with dimension of $(N*T) \times 1$ and $(N*T) \times m$, respectively. He develops asymptotic and finite-sample properties of testing statistics to examine the null hypothesis of non-cointegration in the panel. The tests allow for heterogeneity among individual members of the panel, including heterogeneity in both the long-run cointegrating vectors and in the dynamics, since there is no reason to believe that all parameters are the same across countries.

Two types of tests are suggested by Pedroni. The first type is based on the within dimension approach, which includes four statistics. They are panel m-statistic, panel q statistic, panel PP-statistic, and panel ADF-statistic. These statistics pool the autoregressive coefficients across different members for the unit root tests on the estimated residuals.

The second test by Pedroni is based on the between-dimension approach, which includes three statistics. They are group q-statistic, group PP-statistic, and group ADF-statistic. These statistics are based on estimators that simply average the individually estimated coefficients for each member. Following Pedroni (1999), the heterogeneous panel and heterogeneous group mean panel cointegration statistics are calculated as follows.

Panel v-statistic:

$$Z_v = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{it-1}^{2} \right)^{-1}$$

Panel ρ-statistic:

$$Z_\rho = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{it-1}^{2} \right)^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \left(\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_i \right)$$

Panel PP-statistic:

$$Z_t = \left(\hat{\sigma}^2 \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{it-1}^{2} \right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \left(\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_i \right)$$

Panel ADF-statistic:

$$Z_t{}^* = \left(\hat{s}^{*2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{it-1}^{*2} \right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{it-1}^{*} \Delta \hat{e}_{it}^{*}$$

Group ρ-statistic:

$$\tilde{Z}_{\rho} = \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{e}_{it-1}^2 \right)^{-1} \sum_{t=1}^{T} \left(\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_i \right)$$

Group PP-statistic:

$$\tilde{Z}_{t} = \sum_{i=1}^{N} \left(\hat{\sigma}^2 \sum_{t=1}^{T} \hat{e}_{it-1}^2 \right)^{-1/2} \sum_{t=1}^{T} \left(\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_i \right)$$

Group ADF-statistic:

$$\tilde{Z}_{t}{}^{*} = \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{s}_i^2 \hat{e}_{it-1}^{*2} \right)^{-1/2} \sum_{t=1}^{T} \left(\hat{e}_{it-1}^{*} \Delta \hat{e}_{it}^{*} \right)$$

Here, $\hat{e}_{it}$ is the estimated residual from Eq. (4) and $\hat{L}_{11i}^2$ is the estimated long-run covariance matrix for $\Delta \hat{e}_{it}$. Similarly, $\hat{\sigma}_i^2$ and $\hat{s}_i^2$ ($\hat{s}_i^{*2}$) are, respectively, the long-run and contemporaneous variances for individual i. The other terms are properly defined in Pedroni (1999) with the appropriate lag length determined by the Newey–West method. All seven tests are distributed as being standard normal asymptotically. This requires a standardisation based on the moments of the underlying Brownian motion function. The panel v-statistic is a one-sided test where large positive values reject the null of no cointegration. The remaining statistics diverge to negative infinitely, which means that large negative values reject the null. The critical values are also tabulated by Pedroni

In the presence of unit root variables, the effect of superconsistency may not dominate the endogeneity effect of the regressors if OLS is employed. Pedroni (2000) shows how FMOLS and DOLS can be modified to make an inference in being cointegrated with the heterogeneous dynamic. In the FMOLS and DOLS setting, non-parametric techniques are exploited to transform the residuals from the cointegration regression and can get rid of nuisance parameters.

Empirical investigation

Our study uses quarterly time series for the 3 developing countries listed in Table below. Quarterly data for House Price Index (1994=100) of respective countries are obtained from statistics department through Datastream. The unit is expressed in index. The empirical period depends on the availability of data, where the time period used is 2001 – 2010 which covers two episodes: the 2004–07 global liquidity expansion (the “boom”), and the 2007–09 crisis period (the “bust”).

PART A: Unit root, Cointegration and DOLS

Step 1: Unit Root

LLC as a pooled DF or ADF comes as a solution which can be used across different sections in the panel.

Limitation from assumption:

1.LLC assumes that the individual processes are cross-sectionally independent. Therefore, this test might neglect the significant distortions for the test due to correlations between groups.

2.The coefficient of the lagged Yi (autoregressive coefficient) is restricted to be homogenous across all units of the panel.

Hadri

1.Hadri maintains the two assumptions on LLC.

2.Hadri differs from other tests. It has a null of stationary rather than non-stationary. In many cases, the test, with non-stationary as a null, does not result very powerful against relevant alternative hypothesis and fails to reject the null hypothesis for many economic series. Hence, Hadri test addresses this problem.

IPS, Im. Pesaran and Shin

1.The IPS maintains the assumption number 1 on LLC.

2.The IPS relaxes the assumption number 2 on LLC. IPS extends LLC by allowing heterogeneity on the coefficient of the lagged Yi (autoregressive coefficient). It allows different specifications of the parametric values, the residual variance and the lag lengths.

3.The IPS put the restrictive assumption that T should be the same for all cross-sections which requires a balanced panel.

In the following, we will use only IPS and Hadri tests because of the two limitations of LLC.

1 – Unit root

a- **Using LLC**

***H0*: Non Stationary**

Levin, Lin & Chu Unit Root Test on LPRO? HPI? INT? LGDP?

Null Hypothesis: Unit root (common unit root process)
Series: LPRO1, LPRO2, LPRO3, HPI1, HPI2, HPI3, INT1, INT2, INT3, LGDP1, LGDP2, LGDP3
Date: 05/08/11 Time: 22:12
Sample: 1 40
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 8
Newey-West automatic bandwidth selection and Bartlett kernel
Total number of observations: 450
Cross-sections included: 12

Method	Statistic	Prob.**
Levin, Lin & Chu t*	2.16830	0.9849

** Probabilities are computed assuming asympotic normality

Intermediate results on LPRO? HPI? INT? LGDP?

Series	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
LPRO1	-0.30527	0.0568	0.0161	0	9	9.0	39
LPRO2	-0.18811	0.0038	0.0075	1	9	4.0	38
LPRO3	-0.08610	0.0034	0.0063	1	9	1.0	38
HPI1	0.03111	1.4928	1.4106	1	9	3.0	38
HPI2	-0.08168	9.5185	8.2117	0	9	1.0	39
HPI3	-0.10779	8.7769	83.479	8	9	3.0	31
INT1	-0.55010	0.7828	0.2554	0	9	20.0	39
INT2	-0.44112	2.2135	0.8696	0	9	8.0	39
INT3	-0.30951	1.2000	1.0306	0	9	1.0	39
LGDP1	-0.03692	5.E-05	3.E-05	6	9	12.0	33
LGDP2	-0.02868	5.E-05	7.E-05	0	9	2.0	39
LGDP3	-0.01214	0.0001	0.0255	1	9	0.0	38

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-0.02781	-2.818	1.064	-0.539	0.860		450

The above result shows that all series are non-stationary

b- Using IPS

Im, Pesaran and Shin Unit Root Test on LPRO? HPI? INT? LGDP?

Null Hypothesis: Unit root (individual unit root process)
Series: LPRO1, LPRO2, LPRO3, HPI1, HPI2, HPI3, INT1, INT2, INT3, LGDP1, LGDP2, LGDP3
Date: 05/08/11 Time: 22:24
Sample: 1 40
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 8
Total number of observations: 450
Cross-sections included: 12

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-1.26147	0.1036

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Series	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
LPRO1	-2.6884	0.0851	-1.523	0.772	0	9	39
LPRO2	-3.0701	0.0375	-1.520	0.809	1	9	38
LPRO3	-1.6684	0.4388	-1.520	0.809	1	9	38
HPI1	1.6327	0.9993	-1.520	0.809	1	9	38
HPI2	-1.4707	0.5377	-1.523	0.772	0	9	39
HPI3	-1.3504	0.5932	-1.272	1.094	8	9	31
INT1	-3.8642	0.0051	-1.523	0.772	0	9	39
INT2	-3.2868	0.0224	-1.523	0.772	0	9	39
INT3	-2.7011	0.0829	-1.523	0.772	0	9	39
LGDP1	-1.3293	0.6041	-1.346	0.999	6	9	33
LGDP2	-1.3949	0.5749	-1.523	0.772	0	9	39
LGDP3	-0.6261	0.8528	-1.520	0.809	1	9	38
Average	-1.8182		-1.486	0.830			

The above result shows that all series are non-stationary

c- ADF FISHER Unit Root

ADF Fisher Unit Root Test on LPRO? HPI? INT? LGDP?

Null Hypothesis: Unit root (individual unit root process)
Series: LPRO1, LPRO2, LPRO3, HPI1, HPI2, HPI3, INT1, INT2, INT3,
LGDP1, LGDP2, LGDP3
Date: 05/08/11 Time: 22:25
Sample: 1 40
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 8
Total number of observations: 450
Cross-sections included: 12

Method	Statistic	Prob.**
ADF - Fisher Chi-square	40.9835	0.0167
ADF - Choi Z-stat	-1.21774	0.1117

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Intermediate ADF test results LPRO? HPI? INT? LGDP?

Series	Prob.	Lag	Max Lag	Obs
LPRO1	0.0851	0	9	39
LPRO2	0.0375	1	9	38
LPRO3	0.4388	1	9	38
HPI1	0.9993	1	9	38
HPI2	0.5377	0	9	39
HPI3	0.5932	8	9	31
INT1	0.0051	0	9	39
INT2	0.0224	0	9	39
INT3	0.0829	0	9	39
LGDP1	0.6041	6	9	33
LGDP2	0.5749	0	9	39
LGDP3	0.8528	1	9	38

There stationary because we reject the null and accept H_1

d- FISHER PP Unit root

Phillips-Perron Fisher Unit Root Test on LPRO? HPI? INT? LGDP?

Null Hypothesis: Unit root (individual unit root process)
Series: LPRO1, LPRO2, LPRO3, HPI1, HPI2, HPI3, INT1, INT2, INT3, LGDP1, LGDP2, LGDP3
Date: 05/08/11 Time: 22:28
Sample: 1 40
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett ke...
Total (balanced) observations: 468
Cross-sections included: 12

Method	Statistic	Prob.**
PP - Fisher Chi-square	62.6960	0.0000
PP - Choi Z-stat	-1.07196	0.1419

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results LPRO? HPI? INT?...

Series	Prob.	Bandwidth	Obs
LPRO1	0.0982	2.0	39
LPRO2	0.1508	8.0	39
LPRO3	0.7493	0.0	39
HPI1	1.0000	8.0	39
HPI2	0.5473	2.0	39
HPI3	0.9991	1.0	39
INT1	0.0045	1.0	39
INT2	0.0221	1.0	39
INT3	0.0869	3.0	39
LGDP1	0.9022	13.0	39
LGDP2	0.5960	3.0	39
LGDP3	0.0000	5.0	39

The above result shows that all series are stationary

e- using hadri

***H0*: Non stationary**

The maximum of variables accepted through the system is limited to few. As we cannot test all the variables in one batch, so we use different batches of variables as follow.

Hadri Unit Root Test on LPRO? HPI? INT? LGDP?

Null Hypothesis: Stationarity
Series: LPRO1, LPRO2, LPRO3, HPI1, HPI2, HPI3, INT1, INT2, INT3, LGDP1, LGDP2, LGDP3
Date: 05/08/11 Time: 22:29
Sample: 1 40
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 480
Cross-sections included: 12

Method	Statistic	Prob.**
Hadri Z-stat	10.2446	0.0000
Heteroscedastic Consistent Z-stat	7.30309	0.0000

* Note: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null.
** Probabilities are computed assuming asympotic normality

Intermediate results on LPRO? HPI? INT? LGDP?

Series	LM	Variance HAC	Bandwidth	Obs
LPRO1	0.6903	0.343913	4.0	40
LPRO2	0.3375	0.115139	4.0	40
LPRO3	0.5017	0.177709	5.0	40
HPI1	0.7802	727.3727	5.0	40
HPI2	0.3044	411.9583	5.0	40
HPI3	0.6106	2370.990	5.0	40
INT1	0.3306	2.129452	3.0	40
INT2	0.1294	7.775368	4.0	40
INT3	0.1252	7.419020	4.0	40
LGDP1	0.7702	0.020567	5.0	40
LGDP2	0.7567	0.015831	5.0	40
LGDP3	0.4345	0.044534	3.0	40

The above result shows that all series are non- stationary

The model

Using these results, we proceed to test HPI, GDP, INT and INF for cointegration in order to determine if there is a long-run relationship to control for in the econometric specification.
We first implement the following equation:

$HPI_{it}=\alpha + \beta GDP_{it}+\gamma INT_{it}+\delta LPRO_{it}+\mu_i+\eta_{it}$

where:

- HPI_{it} is the House Price Index dependent variable for country i in year t,
- GDP_{it} is Gross Domestic Product variables for country i in year t,
- INT_{it} Long Run Interest Rate variables,
- $LPRO_{it}$ Stock Return for the property sector variables,
- μ_i is a Country Specific effect and
- η_{it} is a white-noise error term.

where it allows for cointegrating vectors of differing magnitudes between countries, as well as country (a) and time (d) fixed effects. Reports the panel cointegration estimation results are given below. All results indicates that all are the statistics are significantly accept the null of no cointegration. Thus, it can be seen that the HPI, GDP, INT, LPRO do not move together in the long run. That is, there is no long-run steady state relationship between HPI and tested variable for a cross-section of countries after allowing for a country-specific effect.

We therefore remodel our equation by allowing LPRO as dependent variable and introduce another dependent variable, i.e. Inflation. The following equation are obtained

$LPRO_{it}=\alpha + \beta GDP_{it}+\gamma INT_{it}+\delta HPI_{it}+ \delta INF_{it} + \mu_i+\eta_{it}$

where:

- $LPRO_{it}$ is the Stock Return for the property sector as dependent variable for country i in year t,
- GDP_{it} is Gross Domestic Product variables for country i in year t,
- INT_{it} Long Run Interest Rate variables,
- HPI_{it} House Price Index for the property sector variables,
- INF_{it} Inflation as variables,
- μ_i is a Country Specific effect and
- η_{it} is a white-noise error term.

where it allows for cointegrating vectors of differing magnitudes between countries, as well as country (a) and time (d) fixed effects. DOLS reports the panel cointegration estimation results. Except for the group 2 and group 3 statistics, all other statistics significantly reject the null of no cointegration. Thus, it can be seen that the LRO, GDP, INT, HPI and INF move together in the long run. That is, there is a long-run steady state relationship between Property Sector stock return and GDP, INT, HPI and INF for a cross-section of countries after allowing for a country-specific effect. The next step is an estimation of such a relationship.

Reports the results of the individual and panel DOLS. The panel estimators with and without common time dummies are shown at the bottom of the table. The coefficients of LPRO and other variables are statistically significant at the 5% level, and the effect is positive as expected by the theory.

The elasticity of Return for stock and House price together with GDP, Interest and Inflation are significantly smaller than 1, but the growth effect of Stock Return are larger than the economic variables. This implies Stock Return is an important ingredient for property prices development.

On a per country basis, the significant relationship only applies to Malaysia.

Step 2: Cointegration

5.1 - Pedroni residual cointegration test

Series: HPI? INT? GDP? PROPTSTOCK? CPI?
Date: 05/08/11 Time: 19:21
Sample: 1 40
Included observations: 40
Cross-sections included: 3
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
Automatic lag length selection based on SIC with a max lag of 9
Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-0.896142	0.8149	-0.804911	0.7896
Panel rho-Statistic	1.718898	0.9572	1.564605	0.9412
Panel PP-Statistic	2.402211	0.9919	1.980017	0.9761
Panel ADF-Statistic	1.569391	0.9417	1.577931	0.9427

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	2.258990	0.9881
Group PP-Statistic	2.731115	0.9968
Group ADF-Statistic	2.091237	0.9817

Cross section specific results

Phillips-Peron results (non-parametric)

Cross ID	AR(1)	Variance	HAC	Bandwidth	Obs
1	0.662	2.829905	2.702227	2.00	39
2	0.823	15.37298	15.50442	3.00	39
3	0.947	24.71473	46.31633	3.00	39

Augmented Dickey-Fuller results (parametric)

Cross ID	AR(1)	Variance	Lag	Max lag	Obs
1	0.662	2.829905	0	9	39
2	0.823	15.37298	0	9	39
3	0.842	13.99029	1	9	38

There is no cointegration according to PP-Statistic only.

KAO Test

Kao Residual Cointegration Test
Series: HPI? INT? GDP? PROPTSTOCK? CPI?
Date: 05/08/11 Time: 19:30
Sample: 1 40
Included observations: 40
Null Hypothesis: No cointegration

Trend assumption: No deterministic trend
Automatic lag length selection based on SIC with a max lag of 9
Newey-West automatic bandwidth selection and Bartlett kernel

	t-Statistic	Prob.
ADF	1.065151	0.1434
Residual variance	16.85764	
HAC variance	15.94558	

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID?)
Method: Panel Least Squares
Date: 05/08/11 Time: 19:30
Sample (adjusted): 3 40
Included observations: 38 after adjustments
Cross-sections included: 3
Total pool (balanced) observations: 114

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID?(-1)	-0.041969	0.040398	-1.038890	0.3011
D(RESID?(-1))	0.312414	0.079679	3.920914	0.0002

R-squared	0.116887	Mean dependent var	0.305321
Adjusted R-squared	0.109003	S.D. dependent var	4.317511
S.E. of regression	4.075413	Akaike info criterion	5.665210
Sum squared resid	1860.207	Schwarz criterion	5.713213
Log likelihood	-320.9169	Hannan-Quinn criter.	5.684691
Durbin-Watson stat	1.853351		

The above findings concludes that there is no cointegration between the variables

Fisher test

Johansen Fisher Panel Cointegration Test
Series: HPI? INT? GDP? PROPTSTOCK? CPI?
Date: 05/08/11 Time: 19:33
Sample: 1 40
Included observations: 40
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 1

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None	38.17	0.0000	34.73	0.0000
At most 1	11.54	0.0731	15.82	0.0148
At most 2	2.308	0.8893	1.066	0.9830
At most 3	4.001	0.6766	3.319	0.7679
At most 4	8.136	0.2283	8.136	0.2283

* Probabilities are computed using asymptotic Chi-square distribution.

Individual cross section results

Cross Section	Trace Test Statistics	Prob.**	Max-Eign Test Statistics	Prob.**
Hypothesis of no cointegration				
1	86.2102	0.0014	45.2786	0.0015
2	85.7053	0.0016	40.7211	0.0065
3	84.3879	0.0022	43.1218	0.0030
Hypothesis of at most 1 cointegration relationship				
1	40.9315	0.1909	25.4290	0.0920
2	44.9843	0.0908	30.3571	0.0215
3	41.2662	0.1803	22.7168	0.1859
Hypothesis of at most 2 cointegration relationship				
1	15.5025	0.7467	8.7498	0.8521
2	14.6272	0.8036	7.1299	0.9486
3	18.5494	0.5257	10.1961	0.7260
Hypothesis of at most 3 cointegration relationship				
1	6.7527	0.6066	5.5253	0.6746
2	7.4973	0.5206	5.7500	0.6455
3	8.3533	0.4284	7.4538	0.4369
Hypothesis of at most 4 cointegration relationship				
1	1.2274	0.2679	1.2274	0.2679
2	1.7472	0.1862	1.7472	0.1862
3	0.8994	0.3429	0.8994	0.3429

**MacKinnon-Haug-Michelis (1999) p-values

The test shows that there are at least one co-integration groups

The test was further analysed using LPRO (Property Stock Returns) as dependent variables Pedroni Residual Cointegration Test

Pedroni Residual Cointegration Test
Series: LPRO? HPI? INT? LGDP?
Date: 05/08/11 Time: 21:24
Sample: 1 40
Included observations: 40
Cross-sections included: 3
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
User-specified lag length: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-0.303321	0.6192	-0.549647	0.7087
Panel rho-Statistic	0.011083	0.5044	0.679298	0.7515
Panel PP-Statistic	-0.975146	0.1647	0.003549	0.5014
Panel ADF-Statistic	-1.615935	0.0531	-0.145303	0.4422

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	1.332881	0.9087
Group PP-Statistic	0.431147	0.6668
Group ADF-Statistic	0.122841	0.5489

Cross section specific results

Phillips-Peron results (non-parametric)

Cross ID	AR(1)	Variance	HAC	Bandwidth	Obs
1	0.459	0.051750	0.035609	5.00	39
2	0.823	0.005014	0.006444	3.00	39
3	0.876	0.003880	0.005446	2.00	39

Augmented Dickey-Fuller results (parametric)

Cross ID	AR(1)	Variance	Lag	Max lag	Obs
1	0.319	0.049300	1	--	38
2	0.770	0.004451	1	--	38
3	0.925	0.002508	1	--	38

Kao test

Kao Residual Cointegration Test
Series: LPRO? HPI? INT? LGDP?
Date: 05/08/11 Time: 21:28
Sample: 1 40
Included observations: 40
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
User-specified lag length: 1
Newey-West automatic bandwidth selection and Bartlett kernel

	t-Statistic	Prob.
ADF	-2.782749	0.0027
Residual variance	0.025694	
HAC variance	0.015474	

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID?)
Method: Panel Least Squares
Date: 05/08/11 Time: 21:28
Sample (adjusted): 3 40
Included observations: 38 after adjustments
Cross-sections included: 3
Total pool (balanced) observations: 114

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID?(-1)	-0.387246	0.076078	-5.090105	0.0000
D(RESID?(-1))	0.104538	0.089188	1.172098	0.2436

R-squared	0.191122	Mean dependent var	0.006991
Adjusted R-squared	0.183900	S.D. dependent var	0.164996
S.E. of regression	0.149055	Akaike info criterion	-0.951616
Sum squared resid	2.488346	Schwarz criterion	-0.903612
Log likelihood	56.24209	Hannan-Quinn criter.	-0.932134
Durbin-Watson stat	1.999482		

There is cointegration between the variables

There is cointegration when LPRO as dependant variable

Johansen Fisher Cointegration Test

Johansen Fisher Panel Cointegration Test
Series: LPRO? HPI? INT? LGDP?
Date: 05/08/11 Time: 21:34
Sample: 1 40
Included observations: 40
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 1

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None	11.72	0.0684	11.32	0.0788
At most 1	4.414	0.6208	3.776	0.7070
At most 2	3.873	0.6939	2.540	0.8640
At most 3	9.593	0.1429	9.593	0.1429

* Probabilities are computed using asymptotic Chi-square distribution.

Individual cross section results

Cross Section	Trace Test Statistics	Prob.**	Max-Eign Test Statistics	Prob.**
Hypothesis of no cointegration				
1	46.9666	0.0605	26.8171	0.0625
2	35.9688	0.3979	21.0924	0.2707
3	43.6132	0.1183	22.2967	0.2055
Hypothesis of at most 1 cointegration relationship				
1	20.1494	0.4128	11.6532	0.5821
2	14.8764	0.7880	7.3088	0.9408
3	21.3165	0.3382	15.1808	0.2764
Hypothesis of at most 2 cointegration relationship				
1	8.4962	0.4140	6.1162	0.5983
2	7.5676	0.5127	4.8751	0.7575
3	6.1356	0.6795	5.9499	0.6197
Hypothesis of at most 3 cointegration relationship				
1	2.3799	0.1229	2.3799	0.1229
2	2.6925	0.1008	2.6925	0.1008
3	0.1857	0.6665	0.1857	0.6665

**MacKinnon-Haug-Michelis (1999) p-values

The findings shows that only Malaysia has a cointegration variables, no cointegration for the others.

Step 3: **Estimating Long-run relationship with Dynamic OLS**

The result from Kao test has shown, if it is dependent variable, then there is cointegration. Therefore, we proceed to the next step with LPRO ***as dependent variables.***

LONG RUN :DOLS

LPRO HPI INT LGDP INF

```
-----------------------------------------------------------------------------
DOLS Hom. Panel data Coint. Estimation results       Number of obs=      120
Group variable: id code Number of groups   =          3
Wald chi2(4)  =        640.23                Obs per group: min =        40
Prob> chi2    =         0.000                avg =       40    max =       40
R-squared     =         0.4032
Adj R-squared    =   -3.5371
-----------------------------------------------------------------------------
      LPRO   |    Coef.         Std. Err.       t       P>|t|      [95% Conf. Interval]
-------------+---------------------------------------------------------------
       HPI      |-.0054084     .117306    -2.87   0.003   -.0266124      .0157956
       INT      | .0216982    .8115173     1.67   0.049   -.1249897      .1683861
LGDP  |-.4039881    11.49638    -2.19   0.016   -2.482045      1.674069
```

INF	10.56828	44.11176	14.94	0.000	2.594742	18.54181

According to DOLS applied to LPRO, The House Price Index (HPI), Long term Interest, LGDP and Inflation have a significant impact over Stock Exchange Property Sector Return.

Discussion of the empirical results

Changes in House price are influenced by GDP, Inflation, Long run Interest rate and Stock Exchange Return and the empirical results presented in this annex highlight which factor are more influential. The aim is to capture the feedback effects between house price changes and other economic variables or that the house price itself due to speculation. Then the additional influence of mortgage finance characteristics is explored. The analysis covers 3 countries for quarterly data during the period 2001 to 2010 which covers two episodes: the 2004–07 global liquidity expansion (the “boom”), and the 2007–09 crisis period (the “bust”).

This study also examines empirically the extent to which house prices are driven by credit and whether and how differences across countries in housing finance systems affect house price dynamics. The data are for 3 countries in the, i.e. Malaysia, Thailand and Singapore from the first quarter of 2001 to the last quarter of 2010.

The annex examines empirical relationships between house prices and potential drivers using panel regressions that allow for exploiting variation in both the cross-section and time series dimensions of the sample, while controlling for differences across countries using country-fixed effects.

The dependent variable in all regressions is quarterly change of the nominal house price index, which is regressed on a range of potential drivers of house prices. Some of the exercises examine housing busts. Based on quarterly data for the 3 countries during the period examined, the earlier analysis identifies episodes of nominal house price declines lasting more than a year (busts). The analysis conducted earlier in volatility of house price to interest rate shows little correlation in the case of Malaysia[9].

The results show that the relation between credit and prices remains statistically strong when fundamental drivers are included and that inclusion of the additional controls does not change the magnitude of the effect. The effect of the growth of bank loans to households on house price swings is similar in magnitude and sign to that of real GDP growth (equation). The growth of population has a quite large effect, but it is less statistically significant than that of GDP growth. It may compete with household credit, since higher population growth would tend to lead to household formation and new household borrowing. Inflation does not seem to play a role in house price dynamics.

[9] Refer to M-Garch paper in Commentary to Islamic Pricing Beanchmark

Additional exercises verify that the relationship between credit and prices is robust to the inclusion of further control variables, such as short- and long-term interest rates and unemployment. A third set of exercises investigates how different characteristics of housing finance affect the magnitude of house price swings. These exercises exploit both the cross-sectional and time series dimensions of the dataset by allowing changes through time (e.g., in income) to interact with differences across countries (in housing characteristics), resulting in a large number of observations. Since the effects of housing finance characteristics on house prices would work through an effect on credit, credit growth is dropped from the regressions.

Conclusion and policy recommendation

This paper discussed current housing finance practices in three emerging economies, as well as the impact of those practices on financial stability. National authorities and policymakers may find this analysis helpful as they reassess the structure and health of their housing finance systems, with particular attention given to those features that contribute to financial stability.

Country-specific housing finance systems vary significantly and have sometimes been shaped by pivotal historic events. Today's housing finance systems are determined by a range of factors, including the products offered to investors (floating or fixed interest rates over various maturities); the use of prepayment penalties; funding (deposits versus capital markets); the degree of lender recourse to defaulted borrowers' other assets and income; and government participation, including tax breaks. While different systems can work well to provide stable housing finance, a number of best practices emanate from the discussion and empirical analyses. They focus on enhanced underwriting and supervision; better calibrated government participation; and better-aligned incentives in capital-market mortgage funding.

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