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TESTING FOR BUBBLES IN THE INDIAN HOUSING MARKET: AN ARDL BOUNDS TESTING APPROACH

Sanja Samirana Pattnayak*

** Assistant Professor, Economics, Xavier School of Economics, Xavier University, Bhubaneswar, Odisha, India, E-mail: sanja@xub.edu.in*

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ABSTRACT

This paper examines whether recently high housing prices in Indian housing market are explained by fundamental factors such as GDP growth, easy credit availability, interest rate and stock market wealth. Using an Autoregressive Distributed Lag (ARDL) bounds test approach for a period of 1997:q2-2011:q1, we estimate a long-run equilibrium model that explains the real economic determinants of house prices and a short-run error correction model to represent house price changes in the short run. We find the existence of long-run equilibrium relationship between the house prices and their fundamentals. It implies that house price bubble if there is any, is not persistent. Instead, there is mean reverting behavior if deviations from co-integrating relationship to occur.

1. INTRODUCTION

The past decade was very dynamic for the real estate sector, particularly housing sector throughout the world and also in India. Since the market reforms were undertaken in India, real estate sector in general and the housing market in particular, has grown to become one of the major drivers of growth for the broader economy. Rising demand for housing, due to rapid income growth and urbanization, easily available financial options and low interest rate have led to a housing boom over the past decade with investment in residential properties is now accounting for over 10% of GDP. The sector's contribution to growth has become even more important following government-led investment program to expand the supply of affordable housing in the coming years.

Given the importance of the housing market to the economy as a whole, and particularly its roles in social policy (affordable housing) and as an investment class, this sector continues to attract more and more attention from both investors and policy makers. Much of this attention has focused on recent property price rise in the context of high market liquidity, rapid credit growth and low interest rate. In the view of many observers, these price increases could generate risks of house price bubbles, let alone could threaten economic and financial stability of the country. Aware of such risks, including the need to maintain housing affordability for lower and middle income class of Indian population, the authorities have adopted a series of measures such as increase in interest rate to cool the property market.

There could be a few possible explanations for such faster rise in house prices in Indian housing market. One such explanation could be attributed to declining trend of interest rate over the time. The low interest rate generally decreases the cost of financing and thus encourages house purchase decision of the household. So increase in demand with inelastic supply might cause house prices to rise. Rapid growth of bank financing in recent years in this sector could also be another reason that has led to more demand for housing and thus in turn has given rise to increase in house prices. Rising income could also be another factor which allows individuals living with parents or with relatives to form their own household and hence increase in demand for housing.

Although the surge in housing market in India is relatively a recent phenomenon, the issue of house price bubble has become an important subject of discussion in both the academic circle and popular media in India. The interest in the topic has assumed more importance because bursting of house price bubble can lead to serious economic and financial instability of the country. Our study attempts to respond to this important issue by looking into possible fundamental economic factors that could possibly explain the rising housing prices in India. The academic research on this issue for the Indian housing market is almost non-existent. Our research seeks to make an important contribution in this direction.

The broad finding of our research supports the existence of a long run relationship between housing prices and economic fundamentals. Our result also has important policy implications not only for the Indian housing market but also for the developing Asian economies such as China, Indonesia and Malaysia that are going through similar growth process in this sector. For example, India and China have been experiencing a period of rapid economic expansion such as high income growth, rapid urbanization and so on. Although the pace of changes taking place in these countries varies in degrees, they are very much similar in kind. So the policy implications that emerge from our research can well be applicable to other Asian economies experiencing similar growth process in this sector as well.

The organization of the paper is as follows. Section 2 provides a description about real estate and housing market condition in India. Section 3 provides definition of bubble and review of literature. Section 4 discusses basic model of the house price. Section 5 and 6 include data, methodology and empirical model respectively. Section 7 discusses results and section 8 provides the concluding observations with some useful policy implications.

2. REAL ESTATE AND HOUSING MARKET IN INDIA

The real estate sector has assumed growing importance with the liberalization of the Indian economy. The sector is growing at a rate of about 30% each year. Currently, the sector is worth about US$ 12 billion. This sector has become a major employment driver, being the second largest employer next only to agriculture. This has become possible due to backward and forward linkages that the sector forges with other sectors of the economy, particularly, with the housing and construction sector. About 250 ancillary industries such as cement, steel, brick, timber, building materials etc. are dependent on the real estate industry.

The recent surge in Indian outsourcing activities, including technical consultancy services, call centers and medical transcription have constituted about 10 million square feet of growth in real estate. The consequent increase in business opportunities and migration of the labour force has in turn, increased the demand for commercial and housing space, especially rental housing.

The fast paced growth in the Indian real estate sector is fuelled by multiple factors. The rapid expansion of the Indian industrial sector has created a huge demand for manufacturing and office buildings. The liberalization policies of the government of India have simplified the investment process by reducing the need for permissions and licenses for starting any large construction project. The government has also allowed foreign direct investment in the real estate sector, which has given a further push to the development of the real estate sector in India.

Currently, the share of housing sector to the overall GDP stands at 5 per cent per annum. With institutional credit for housing investment growing at a cumulative average growth rate (CAGR) of about 18-20 per cent per annum in next three to five years, the housing sector's contribution to GDP is most likely to increase to 6 per cent. Highlighting the importance of housing sector, the Economic Survey of India said that for every rupee that is invested in housing and construction, Rs0.78 gets added to the GDP investment in housing and real estate activities and thus can be considered a growth indicator for the entire economy.

According to Deutsche Bank research the key drivers of housing demand are robust income growth, easy financing options, low interest rate and strong population growth. According to this report, approximately 4.7 million housing units would have to be completed by 2030. This figure is based on additional demand of 2.7 million units (keeping household size at current level of 5.4 persons) constant and annual replacement demand of 2 million dwellings. The report also suggests that it is highly likely that the household size will shrink due to sustained economic growth and more and more Indians going for fewer children. Given this scenario, the household size will be reduced to 3.7 to 4.7 persons and as a result 5.9 to 8.7 million dwellings including replacement demand would have to be constructed each year.

3. BUBBLE AND HOUSING MARKET: A REVIEW OF LITERATURE

An asset price bubble can be defined as a price acceleration that cannot be explained in terms of the underlying fundamental economic variables (Flood and Hodrick, 1990, Case and Shiller, 2003). According to Kindleberger (1987), "A bubble may be defined as a sharp rise in the price of an asset in a continuous manner, with the initial rise generating expectations of further rises and inducing new buyers particularly speculators who are interested in profits from trading in the asset rather than its use or earning capacity". Garber (2000) defines bubble as deviation from "fundamentals". He states, "The definition of bubble often used in economic research is that part of asset price movement that is unexplainable based on what we call fundamentals".

According to Rosser (2000) "A speculative bubble exists when the price of something does not equal its market fundamentals for some period of time for reasons other than random shocks. Fundamental is usually argued to be a long-run equilibrium consistent with a general equilibrium". He further, admits that this equilibrium is frequently unobservable. As he puts it, "The most fundamental problem is determining what is fundamental".

House price bubble is also defined as a situation when price growth is not supported by changes in its fundamentals (Stiglitz, 1990). Glindro et.al (2009) draw a distinction between price growth and price overvaluation, and between cyclical and bubble components of overvaluation in the context of the housing market. The former distinction simply explains the increase in the fundamental value of the property, which is driven by income growth, interest rate, credit availability and various other factors. According to them a bubble is necessarily related to over valuation of the house price, but not the other way round. The reasons they mention being frictions in the housing market, including lags in housing supply and imperfections in credit market. These factors may cause house prices to deviate from their fundamentals in the short run. According to them the cyclical component of house price overvaluation can be explained by the serial correlation and mean reversion of house price dynamics. The unexplained part is known as the bubble that is more likely to be driven by overly optimistic expectations in the housing market.

The most important and non-fundamental element that drive price increases is the belief that prices will continue to rise in the future (Shiller, 2005). Therefore, prices are high because the agents expect that they can sell the asset at a higher price in the future. In other words, the price evolution is affected by psychological components. The bubble might show a high degree of persistence, as the agents will not change their expectations frequently. In particular, they are not so sure with respect to the time when the market changes its perception.

Earlier empirical studies on the relationship between house prices and fundamentals show mixed results. While most of the studies have been devoted to developed economies such as the U.S., Ireland, U.K. Spain, France and OECD countries, very few studies have looked at this issue for developing Asian economies such as China, Taiwan, Malaysia, Indonesia and India. There is barely any academic research which examines this relationship between house prices and underlying fundamentals for the Indian housing market. Our paper is an attempt in this direction.

Using aggregate data, McCarthy and Peach (2004) did not find bubble in the U.S. housing market. According to them, changes in housing price are explained by movement in personal income and mortgage rate. Shiller (2005) and Gallin (2006) in contrast, using both aggregate and panel data on home prices, personal income and building cost found that changes in fundamentals don't explain the growth of the house prices for 95 U.S. cities after 2000. Therefore, they found bubble in the U.S. housing market.

Another stream of literature using micro-data looked into the house price dynamics in the U.S. housing market. For instance, Himmelberg, Mayer and Sinai (2006) studied the relationship for 46 Metropolitan Statistical Areas (MSA). They found that high price-to-income ratio and price-to-rent ratios are explained by real long term interest rates and they did not find bubble in the U.S. housing market. Another study by (Smith and Smith, 2006) showed that house prices are below their fundamental values obtained from house rents where prices and rents were taken from a sample of matched single-family homes. Case and Shiller (2003) believed in the existence of a speculative bubble in some regional U.S. housing markets. Their belief was based on the survey of consumers' attitude towards housing. In some other related studies, Gallin (2006) and Mikhed and Zemcik (2007) using panel data for the U.S. MSA have analysed house price and its relationship with underlying economic fundamentals. While the former study used income, the latter used rent as the only fundamental factor to explain the growth of house prices. Both studies concluded that house prices cannot be explained by either of two variables. Paz (2003) using panel data and Generalized Least Square (GLS) technique for Spanish provincial capital found that house prices are mostly determined by factors such as wages, migration and productive structures. The results in particular, suggested a stronger relationship between wage earnings and residential prices. Egert and Mihaljek (2007) studied the determinants of housing prices for 19 OECD and eight transition economies of Central and Eastern European (CEE) economies. Using panel Dynamic OLS (DOLS) methodology, they found that fundamentals such as real income, real interest rate and demographic factors strongly explain house prices in both OECD and CEE economies.

Deng et al. (2012) studied local residential land markets across 35 major Chinese cities and find residential land values have skyrocketed in China over 2003-2011 sample periods. Even with the recent pullback in land prices in 2011 observed in many markets, the average annual compound rate of real, constant quality land price growth still is above 10% in the typical market and exceeds 20% per annum in eleven cities. Wu et al. (2012) found a more than doubling of real constant quality house prices across 35 major Chinese cities over the past decade, with about 60% of that increase occurring since the first quarter of 2007. They suggest that pricing seems very risky in the sense that only modest declines in expected appreciation are needed to generate large drops in house values. They argued that urban economic history teaches us that demand-side fundamentals tend not to change so discretely.

Ashvin et al. (2010) using Chinese data in a panel regression framework studied the relationships between movement in residential property prices and the underlying market fundamentals. Their results suggested that house prices are not significantly overvalued in China as a whole in the first half of 2010. They, however, argue that there are sign of over valuation in some cities' mass market and luxury segments. Ashvin and Porter (2010) for Hong Kong also show that the current level of prices in Hong Kong does not seem to be significantly higher than would be explained by underlying fundamentals.

The above literature based on different country experience and different time periods reveals that house prices are either demand determined or supply determined or a combination of both. Market fundamentals play important role in determining house prices both at macro and micro level. Our paper is an advance in this direction where there is hardly any study that has made an attempt to look into much discussed issue of bubble in the Indian housing market.

4. BASIC MODEL OF THE HOUSING MARKET

In this section, we postulate a widely used reduced form equilibrium model of the supply and demand for the housing services. A possible model that can explain how house price is related to market fundamentals is a structural model of housing supply and demand of the type prescribed by Gallin (2006); McCarthy and Peach (2004); Malpezzi and Maclennan

(2001); and Jud and Winkler (2002). According to this model, the long-run demand for new houses is determined by the housing price per-se, income of the household, user cost of housing capital (interest rate), population growth and alternative investment such as stocks. So following this we can write the demand equation as follows:

$$Q_d(t) = V(t)' \beta_d + u_d(t) \tag{1}$$

Where $V(t)$ implies the vector of demand shifting factors, including the house price. The coefficients of the variables are denoted by the parameter vector β_d. The term $u_d(t)$ is referred to as the structural error term in demand equation. Similarly, the long-run supply equation can be written as follows:

$$Q_s(t) = S(t)' \beta_s + u_s(t) \tag{2}$$

where $S(t)$ includes the vector of supply shifting factors such as construction costs, land cost and credit availability or housing loans available for the consumers and the house price. The coefficients are denoted by the parameter vector β_s. The term $u_s(t)$ refers to disturbances related to supply schedule.

In equilibrium, house price is expressed as a function of both demand and supply determinants. We can write this price equation as:

$$P_t = \alpha_0 + \alpha_1 D_t + \alpha_2 S_t + \varepsilon_t \tag{3}$$

where P_t is the equilibrium house price, D_t and S_t denote demand and supply shifting factors without house prices and ε_t is an error term. This equation tells us that house price can deviate from its fundamentals (demand and supply determinants); however, these deviations should not be persistent. In other words, house price and fundamentals should be co-integrated or that the error term ε_t should be stationary. An important point of this model is the choice of demand and supply determinants. Economic theory, however, does not provide a finite set of variables which can be considered in a single model. Our strategy is to estimate an autoregressive distributed lag (ARDL) model for price as a function of some economic fundamentals. The details regarding the estimation procedure is discussed in section six.

5. DATA AND SOURCES

This study uses quarterly data to understand price dynamics in Indian housing sector. The data were sourced from the Handbook of Statistics on Indian Economy of Reserve Bank of India (RBI) for the period 1997:Q2 to 2011:Q1 and Economic Survey of India. The choice of time period for this study is based on the availability of the data series.

The following variables were used in our model: house price index (***hpi***), real income (***gdp*** at constant prices), interest rate (***int***), bank credit (***cr***), and stock prices (derived from ***bse*** Sensex Index) to account for the wealth effect arising from asset price inflation. The quarterly data on national housing price index is not available for the period 1997Q2 to 2011Q1. Our choice of housing price index is based on monthly Consumer Price Index (CPI) for the industrial workers estimated by labour bureau, Government of India. We have converted house price index (***hpi***) and stock prices (***bse***) into quarterly in order to make them consistent with GDP which is available quarterly for the economy.

All the values except ***gdp*** (real ***gdp*** figures are available) have been appropriately deflated to obtain the real values of these variables. We have not included variables such as population, urbanization and other qualitative variables since it is difficult to obtain them on quarterly basis. One might consider this as an extent of limitation of this study.

6. METHODOLOGICAL FRAMEWORK

(i) Bound Testing Approach

We employ autoregressive distributed lag (ARDL) bounds testing approach suggested by Pesaran *et al.* (2001) as we think it to be the most appropriate specification to carry out the cointegration analysis among housing prices, bank credit, interest rate, income and stock prices.

The use of the bounds technique is based on three important reasoning. First, Pesaran *et al.* (2001) advocated the use of the ARDL model for the estimation of level relationships because the model suggests that once the order of the ARDL has been recognised, the relationship can be estimated by using OLS. Second, unlike other widely used co-integration techniques, bounds test allows a mixture of I(1) and I(0) variables as regressors, that is, the order of integration of appropriate variables may not necessarily be the same. This is because in the presence of mixture of stationary series and series containing a unit root, standard statistical inference based on conventional likelihood ratio tests is no longer appropriate. Harris (1995), points out that the trace and maximum eigenvalue tests from the Johansen procedure may lead to erroneous inferences when I(0) variables are present in the system since stationary series are likely to generate spurious co-integrating relations with other variables in the model. Therefore, the ARDL technique has the advantage of not requiring a specific identification of the order of the underlying data. Third, this technique is suitable for small or finite sample size (Pesaran *et al.*, 2001). Moreover, a dynamic error correction model (ECM) can be derived from ARDL by linear transformation (Banerjee et al. 1993) by employing (ARDL) bounds testing approach for cointegration. The ARDL modeling approach to cointegration involves estimating the following conditional error correction model:

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 x_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \sum_{j=0}^{q} \beta_j \Delta x_{t-j} + \varepsilon_t \tag{4}$$

where a_0 is the drift component and ε_t is a white noise error term. We obtain optimal lag length for each variable by estimating $(p+1)^k$ number of regression, where p the maximum number of lag length to be used and k is the number of variables in the equation. The optimal lag length of the first difference regressors is determined by using Schwarz-Bayesian Criteria (SBC) to ensure an absence of serial correlation in estimated residuals. First of all, we estimate the eq. (4) using OLS and then examine for the presence of co-integration by restricting all estimated coefficients of lagged level variables equal to zero. That is the null of $H_0 : \alpha_1 = \alpha_2 = 0$ against an alternative hypothesis: ($H_1 : \alpha_1 \neq 0$ and $\alpha_2 \neq 0$). According to these authors, the lower bound critical values assumed that the explanatory variables are integrated of order zero, or I(0), while the upper bound critical values assumed that are integrated of order one, or I(1). Therefore, if the computed *F*-statistic is smaller than the lower bound value, then the null hypothesis is not rejected and we conclude that there is no long-run relationship among variables of interest. Conversely, if the computed *F*-statistic exceeds the upper bound value, we can safely conclude that a long run relationship exists regardless of whether the underlying orders of integration of the variables are zero or one. On the other hand, if the computed *F*-statistic falls between the lower and upper bound values, then the results are inconclusive. After confirming the existence of a long run relationship between the variables in the model, the long run and short run models can be derived using SBC or the AIC criterion.

In the next step, if there is an evidence of long-run relationship (co-integration) of the variables, the following long-run model is estimated.

$$y_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \sum_{j=0}^{q} \beta_j \Delta x_{t-j} + u_t \tag{5}$$

It involves selecting the order of the ARDL (*p, q*) model using SBC or AIC criteria. When the variables are cointegrated, there exists an error correction representation. In the last step, we obtain the short run dynamic parameters by estimating an error correction model (ECM) associated with long run estimates and can be used to carry out the Granger non-causality tests. The general form of the model can be specified as follows:

$$\Delta y_t = \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \sum_{j=0}^{q} \beta_j \Delta x_{t-j} + \phi ecm_{t-1} + \upsilon_t \tag{6}$$

The coefficients β_i and β_j are short run dynamic coefficients and ϕ is the speed of adjustment. The lag lengths are selected by general to specific approach.

7. RESULTS AND DISCUSSION

We know that ARDL approach to co-integration does not require the pre-testing of the variables, included in the model, for unit root unlike other techniques such as the Johansen approach (Pesaran *et al.*, 2001). However, Ouattara (2004) points out that if the order of integration of any of the variables is greater than one, for example an I(2) variable, then the critical bounds provided by Pesaran *et al.* (2001) are not valid. They are computed on the basis that the variables are I(0) or I(1). In other words, it is necessary to test for unit root to ensure that all the variables satisfy the underlying assumption of the ARDL methodology before proceeding to the estimation stage.

(i) Unit root tests

To test the order of integration of the variables we use the standard tests for unit root, namely the Augmented Dickey-Fuller (ADF) and KPSS test (Kwiatkowski *et al.*, 1992) of stationary hypothesis respectively. Compared with the ADF tests, the KPSS test has the best overall performance in terms of sample size and power. The test regression includes both constant and trend for the log levels and for the first differences of the variables. We have reported the unit root test results in Table 1. The result shows that all variables are I(1) except interest rate which is I(0), hence validate the use of bounds testing for co-integration.

In the next step, having established the order of integration of variables included in the model is to examine the long run relationship among the variables included in the model. If co-integration exists, we proceed to estimate equation (7) for the period 1997q2-2011q1. We used general to specific modeling approach guided by the short data span and SBC criterion respectively to select a maximum lag order for the conditional ARDL-VECM. The calculated *F*-statistics for the long run model confirms the existence of the co-integration among variables. To follow the procedure of ARDL bounds test, we chose different orders of lags for the variables as evidence of previous researches reveal that the results of the *F*-test are sensitive to the lag imposed on each of the first differenced variable (Bahmani-Oskooee & Brooks, 1999). This is confirmed by imposing up to four lags on all first differenced variables. Table 2 reports the results of the calculated *F*-statistics when each variable is considered as a dependent variable (normalized) in the ARDL-OLS regression.

$$\Delta hpi_t = \theta_0 + \theta_1 hpi_{t-1} + \theta_2 cr_{t-1} + \theta_3 \text{int}_{t-1} + \theta_4 gdp_{t-1} + \theta_5 bse_{t-1}$$

Table 1: Unit root tests

Variable	*ADF test statistic*				*KPSS test statistic*			
	Level		*1st Difference*		*Level*		*1st Difference*	
	Constant	*Constant & Trend*	*Constant*	*Constant & Trend*	*Constant*	*Constant & Trend*	*Constant*	*Constant & Trend*
hpi	-0.267(2)	-3.276(2)	-10.904***(0)	-10.851***(0)	1.449(3)	0.360(0)	0.200(1)	0.123(2)
cr	-0.409(3)	-1.511(3)	-3.871***(2)	-6.352***(0)	0.900(6)	0.223(2)	0.188(1)	0.184(1)
gdp	1.375(4)	-1.906(4)	-19.684***(1)	-19.578***(1)	0.908(6)	0.225(4)	0.242(3)	0.210(3)
int	-2.816(0)	-3.372(0)	-8.093***(0)	-8.016***(0)	0.437(1)	0.093(4)		
bse	-3.959**(0)	-5.918***(0)	-5.540***(0)	-5.502***(0)	0.788(5)	0.170(3)	0.408(4)	0.038(3)

Notes: i. ADF test specifies the existence of a unit root to be the null hypothesis. In contrast, the null hypothesis under the KPSS test states that there exist a stationary series.

ii. The numbers within parenthesis followed by ADF statistic represent the lag order. The numbers within parenthesis followed by KPSS statistics represent the bandwidth selected based on both Newey-West and Andrews method using Bartlett Kernel and Quadratic Spectral are also calculated for KPSS statistic.

iii. ***, ** and * are 1%, 5% and10% of significant levels, respectively.

Table 2: ARDL Bounds Test for the existence of long run relationship

*Computed F-statistics=5.254145***		
Lower Bound Value	*Upper Bound Value*	*Critical Value*
4.214	5.520	1%
3.149	4.293	5%
2.703	3.697	10%

Notes: Symbols '***' and '**' indicate that the *F*-statistic exceeds the upper bound corresponding to the 1% and 5% significance levels, respectively, as reported in Narayan (2004, 2005) for sample size (*n = 51).*

$$+\sum_{i=1}^{p}\alpha_1\Delta hpi_{t-i}+\sum_{j=0}^{q}\alpha_2\Delta cr_{t-j}+\sum_{k=0}^{r}\alpha_3\Delta \text{int}_{t-k}+\sum_{l=0}^{s}\alpha_4\Delta gdp_{t-l}+\sum_{m=0}^{t}\alpha_6\Delta bse_{t-m}+\varepsilon_t \quad (7)$$

where ***hpi***, ***gdp***, ***cr***, ***int*** and ***bse*** are log transformed house price index, real gross domestic product, housing credit, interest rate and stock prices. The lagged level terms represent the long-run relationship while the terms with the summation signs correspond to the error correction dynamics. The optimal lag structure of the first difference regressand selected by the SBC or AIC criterion. After regression of Equation (7), the null hypothesis of no co-integration or no long run relationship, $H_0=\theta_1=\theta_2=\theta_3=\theta_4=\theta_5=0$ is tested against its alternative $H_1 : \theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq \theta_5 \neq 0$.the Wald test (*F*-statistic) is computed to test the long-run relationship between the concerned variables. The calculated F-statistic exceeds the upper bound critical value at 5 per cent level. In other words the null hypothesis of no cointegration can be rejected, indicating the existence of a long-run relationship among series. Hence the conditional long-run relationship could be produced from the reduced form solution of Eq. (7). Table 3 reports the coefficients of the explanatory variables and their significance.

Table 3: Estimated Unrestricted ARDL Model

Variable	*Coefficient*	*T-value*	*Probability*
hpi(-1)	-0.164835***	-2.7055	0.0107
gdp(-1)	0.411476***	2.5896	0.0142
cr(-1)	0.158383***	2.5731	0.0148
int(-1)	-0.105832***	-4.3331	0.0001
bse(-1)	0.067240***	2.9144	0.0064
Δ *hpi*(-1)	-0.436798***	-3.5401	0.0012
Δ *hpi*(-2)	0.190619	1.5443	0.1320
Δ *gdp*(-1)	0.80225***	3.4986	0.0014
Δ *gdp*(-2)	0.759785***	3.4902	0.0014
Δ *gdp*(-3)	-0.541166***	-2.7374	0.0099
Δ *gdp*(-4)	-0.553236***	-2.7672	0.0092
Δ *cr*(-1)	0.034620	1.4680	0.1516
Δ *cr*(-2)	-0.019798	-0.8299	0.4125
Δ *int*(-1)	-0.050017*	-1.7633	0.0871
Δ *bse*(-1)	-0.048895***	-2.5866	0.0143
Δ *bse*(-2)	-0.034359***	-2.6086	0.0136
Δ *bse*(-3)	-0.021340**	-2.3730	0.0236
Constant	-3.263241**	-2.3235	0.0265
Diagnostic Test Statistics			
Breusch-Godfrey serial correlation test	1.651[0.207](1 lag); 1.383[2 lags).		
Jarque-Bera- normality test	0.113624[0.944772]		
Heteroscedasticity- (ARCH) test	1.311710[0.2521		
Adjusted R^2	0.77		

Notes: ***, ** and * are 1%, 5% and10% of significant levels, respectively. 2. Diagnostic test statistics are Lagrange multiplier statistic for test of residual serial correlation, Normality based on a test of skewness and kurtosis of residuals and Heteroskedasticity Based on the regression of squared residuals on squared fitted values. These statistics are distributed as Chi-squared variates with degrees of freedom in parentheses. Values in square bracket are probability value.

(ii) Long run analysis

The long-run tests results reported in Table 4 (refer to notes below Table 4 on estimation of elasticities) reveal that income, credit availability, interest rate and stock price are the major determinants which affect the movement in house price in India. The long run elasticity of housing price with respect to interest rate is 0.64. It is negative and highly significant indicating that for 1% decline in interest rate will lead to 0.64% increase in housing price. Theoretically, from the supply side, interest rate reflects the opportunity cost of the property-related investment. If interest rate is high (low), then the opportunity cost will also be high (low). Hence, willingness to invest in property sector will be discouraged (encouraged), thus, leading to decreased (increased) property supply. Looking from the demand side, interest rate also reflects the cost of the credit borne by the households. Therefore, the rate and demand for property/house tend to move in opposite direction.

It should be borne in mind that during the 1980's and early 1990's, financing option for real estate in India, was fairly unorganized and riddled with bureaucratic complex procedures. The lending rate stood at all-time high of 17 percent during 1995 to 1996 which upset the inflow of capital into the real estate sector. Realising the contribution of real estate sector for the broader economy major steps was taken and as a result interest rates were reduced gradually and significantly along with lenient lending policies. Lending rates which recorded an all-time high of 17 percent in 1995 to 1996 and reached an all-time low of 7.5 percent during 2005 and continued to be at that level until recently when the Central Bank of India moved rates up to contain inflation.

Table 4: Long-run and Short-run Elasticities

Variables	*Dependent variable HPI*	
	Long-run	*Short-run*
gdp	2.50***	0.47**
cr	0.96***	0.03***
int	-0.64***	-0.05***
bse	0.41**	-0.10**

Notes: (i) ***, ** and * denotes significance at the 1, 5 and 10 percent level respectively.

(ii) The degree responsiveness of house price (hpi) w.r.t GDP, credit (CR), interest rate (INT) and stock prices (BSE) in the long-run is calculated by dividing the estimated coefficient of lag one level independent variables by estimated coefficient of lag level dependent variable and multiplied by negative sign (based on results from Table 3). Short-run elasticities are obtained from the estimated coefficients based on results in Table 5.

In September 2011, the RBI raised its policy lending rate by 25 basis points to 8.25%, the 12th interest rate hike since March 2010, when the RBI moved rates up from 4.75% to 5% to contain inflation. The RBI's prime lending rates are also heading up, having been dropped to 7.50% (low) and 8% (high) in July 2010, from 11% and 12% respectively. As of March 2011, prime lending rates are 8.25% (low) and 9.50% (high). The increase in interest rates is already being felt in the construction sector, which grew by only 1.2% in Q2 2011, an 8.2% drop from the previous quarter.

Bank credit is considered to be another important factor which drives the house price and the finding is in line with some literatures (Collyns and Senhadji, 2001). Our results suggest that the magnitude of the long run elasticity of house price with respect to bank credit is 0.96 which implies that 1% increase in bank credit will lead to 0.96% increase in house price. It suggests that commercial banks and private financial institutions play a significant role in making financial options available to the property sector. There is a rapid growth in bank financing in this sector. Recently, the Economic Survey of India called for greater attention to asset-price bubbles in real estate and stock markets. It reports that focus mainly has to be on credit-induced bubbles that create positive feedback loop with business cycle implications. It emphasized that there is scope for sharpening of monetary policy and macro prudential tools to deal with such asset bubbles and their implications for the economy. Particularly, in the event of a liquidity surplus (easy availability of credits/loans) coupled with low interest rates, flow of credit for purchasing assets increases in the expectation of price appreciation.

Our results also reveal that the long run elasticity of house price with respect to real GDP growth is 2.50 and it is positive and highly significant. It implies that 1% increase in GDP growth will lead to 2.50% increase in house price in the long run. It implies that a robust economic growth tends to underpins high demand for houses, which in turn augments growth in home values (Ho and Wong, 2008, Glindro et al, 2009). In recent years there has been an escalation in the demand for housing, courtesy of the economic boom. More and more people are opting to buy homes for reasons such as safe investment option for the future, as a tax saving tool or simply because they need a roof over their heads. With a projected shortage of 20-25 million homes for Indians, builders and real estate developers are struggling to keep pace. As the demand outstrips supply, it gives rise to rise in house price more than proportionate to rise in income.

We also find that stock price has positive impact on house price. The long run elasticity thus estimated is at 0.41. It is positive and significant and it indicates that 1% increase in stock price will lead to 0.41% increase in house price. These findings are consistent with the literatures in which households' expectations are an important determinant of house price (Poterba, 1991). We can argue that being both investment and consumption goods, housing price may be affected by stock market fluctuations through well known 'wealth effect'. The unexpected gains in stock prices reflects increasing share of the stocks in the investment portfolio and wealth. In the end it induces households to rebalance their portfolios by investing in or consuming more housing services. It then translates into higher housing prices. This so-called wealth effect, thus, posits a causal direction from stock prices to house prices. Our results suggests the presence of wealth effect since in the long-run house prices make adjustments once there are shocks in other variables in the system including stock prices. In other words, there is a unidirectional long-run causality from stock prices and other variables to house prices. Meanwhile, it is evident from our results that the significant responses of house prices to stock prices come with lags but not immediately.

There may be other factors specific to government policies and demographic trends, which can affect the overall development of the residential real estate sector. Meanwhile, there is a reason to believe that the existence of a long-run equilibrium relationship between real house prices and their fundamentals implies that a house price bubble, if there is any, is not persistent. Instead, there is mean reverting behaviour if deviations from the cointegrating relationship occur.

(iii) Short run Dynamics

Following the estimation of the long run coefficients, we proceed to estimate the error correction model. The paper adopts the general to specific approach to arrive at the parsimonious estimate by eliminating jointly insignificant variables. The model can be written as follows:

$$\Delta hpi_t = \beta_0 + \sum_{h=1}^{m} \beta_h \Delta hpi_{t-h} + \sum_{i=1}^{n} \beta_i \Delta cr_{t-i} + \sum_{j=1}^{p} \beta_j \Delta gdp_{t-j} + \sum_{k=1}^{q} \beta_k \Delta \operatorname{int}_{t-k} + \sum_{l=1}^{r} \beta_l \Delta bse_{t-l} + \phi ecm_{t-1} + \upsilon_t \quad (8)$$

All the variables are same as previously defined. The error correction term in eq. (8) shows the speed of adjustment or correction to restore equilibrium in the dynamic model. In particular, the ECM coefficient shows how quickly variables converge to equilibrium. This coefficient is expected to have a negative sign and a highly significant error correction term is a strong confirmation of the existence of a stable long run relationship. Estimation results is based on the SBC and AIC are presented in Table 5. The value of R^2 is 0.78 suggesting that such error correction model fits the data reasonably well. More importantly, the error correction coefficient has the expected negative sign and is highly significant. This helps reinforce the finding of a long run relationship among the variables, as Granger *et al.* (2000) suggests, a significant error correction term is indicative of long-run causality.

Furthermore, the coefficients of lagged differences of interest rate and own price are highly significant but coefficients of GDP, credit and BSE (sensex index) are significant at 10% level. The significance of the coefficients is indicative of short-run causality running from interest rate, bank credit, GDP and stock price to property price. The results of the Granger non-causality tests are reported in Table 6. The size of the coefficient of the error correction term (-0.457) suggests a relatively high speed of adjustment from the short run deviation to the long run equilibrium price. More precisely, it indicates that around 45 per cent of the deviation from long run price is corrected every period.

(iv) Diagnostic and Stability Tests

Finally, we conduct the diagnostic tests such as serial correlation, normality, heteroscedasticity, and structural stability of the estimated ARDL model. As shown in Table (3) and Table (5), all models pass the above diagnostic tests. The tests show that

Table 5: The Error Correction representation of the ARDL model

Variable	*Coefficient*	*T-values*	*Probability*
ecm(-1)	-0.457855	-3.308579	0.0019
Δ *hpi*(-2)	0.839528	7.493315	0.0000
Δ *hpi*(-4)	-0.251839	-2.438151	0.0190
Δ *gdp*(-1)	-0.063655	-1.806772	0.0154
Δ *cr*(-2)	-0.037457	-1.686997	0.0988
Δ *int*(-1)	-0.053815	-2.734009	0.0090
Δ *bse*(-1)	0.011943	1.708359	0.0948
Constant	0.010925	2.848977	0.0067
Diagnostic test statistics			
Breusch-Godfrey serial correlation test	1.832717[0.1758](1 lag); 1.914494[0.3839](2 lags).		
Jarque-Bera normality test	0.241[0.886]		
Heteroscedasticity-(ARCH) Test	0.336656[0.5618]		
Adjusted	0.78		

Note: 1. ***, ** and * are 1%, 5% and10% of significant levels, respectively. 2. Diagnostic test statistics are Lagrange multiplier statistic for test of residual serial correlation, Normality based on a test of skewness and kurtosis of residuals and Heteroskedasticity Based on the regression of squared residuals on squared fitted values. These statistics are distributed as Chi-squared variates with degrees of freedom in parentheses. Values in square bracket are probability value.

Table 6: Causality Test

Direction of causality	*T value*
Credit causes price	2.84 [0.0916]*
GDP causes price	2.58 [0.0001]***
Interest rate causes price	7.47 [0.0063]**
BSE causes price	2.91 [0.0876]*

Notes: The ***, **, * denotes significance at the 1%, 5% and 10% percent level. Values in square bracket are probability value.

there is no evidence of autocorrelation and the models pass the normality and the test proved that the error is normally distributed. Finally, when analysing the stability of the long-run coefficients together with the short-run dynamics, the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUM) are applied. Following Pesaran and cited in Bahmani-Oskooee (2001), the stability of the regression coefficients is evaluated by stability tests and they can show whether or not the regression equation is stable over time. The null hypothesis is that the coefficient vector is the same in every period and the alternative is simply that it is not (Bahmani-Oskooee, 2001). CUSUM and CUSUMQ statistics are plotted against the critical bound of 5% significance.

According to Bahmani-Oskooee and Wing NG (2002), if the plot of these statistics remains within the critical bound of the 5% significance level, the null hypothesis (i.e. that all coefficients in the error correction model are stable) cannot be rejected. As shown Figure 1 and 2, the plot of both the CUSUM and the CUSUMQ residuala are within the

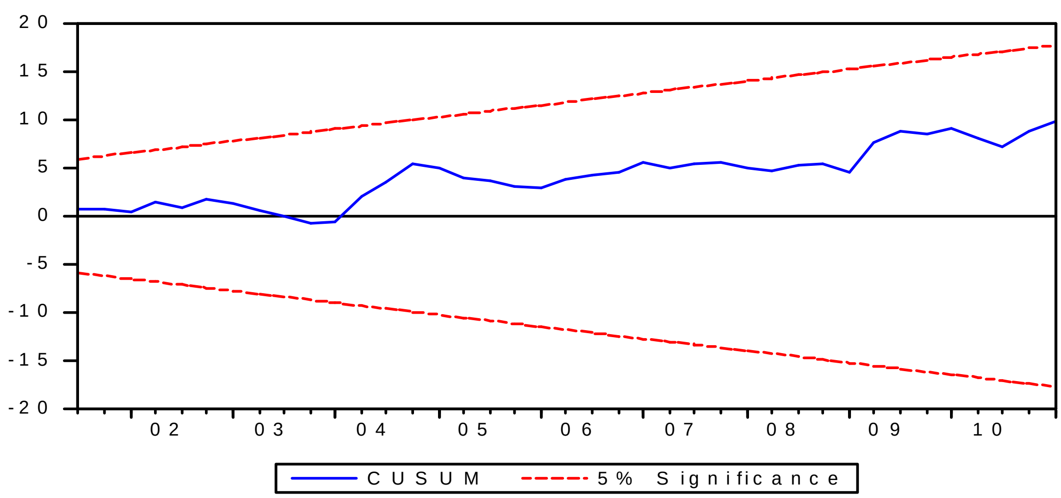

Figure 1

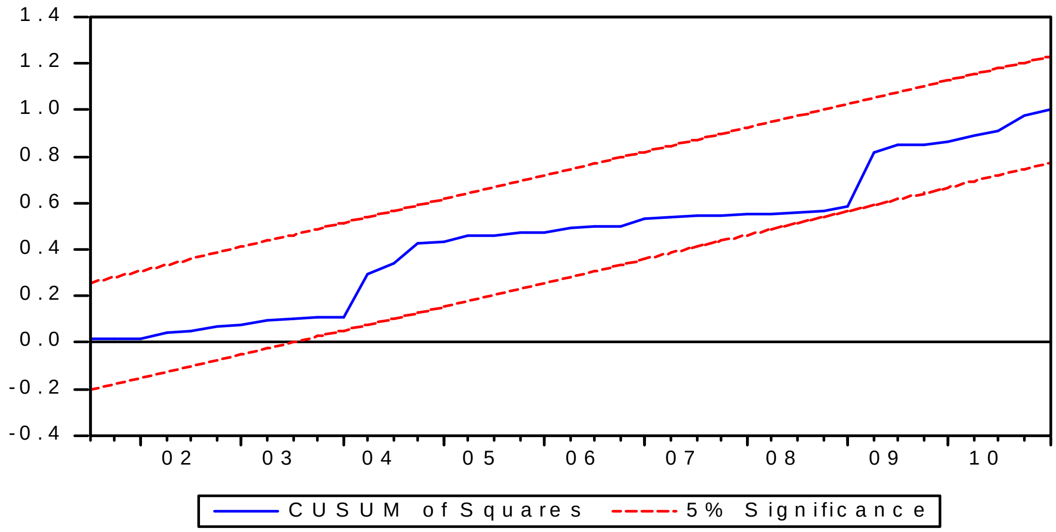

Figure 2

boundaries. That is to say that the stability of the parameters has remained within its critical bounds of parameter stability and hence confirm the stability of the long-run coefficients of the price function.

8. CONCLUSION AND POLICY IMPLICATIONS

This paper using data on house prices and a set of fundamentals such as real GDP, credit availability, interest rate and stock market wealth examine bubble in Indian housing market. The findings based on the ARDL bounds testing approach indicate the existence of long run equilibrium relationship between housing prices and economic fundamentals. The long run elasticity obtained from the estimated model indicates that the real GDP has a significant and positive impact on the housing price. The increased demand for housing arising due to strong economic growth along with easy availability of housing credit and relatively low interest rate have led to demand for houses more than existing supply and this as a result has given rise to rising housing prices. The significant and positive stock index implies wealth effect. It also has positive impact on housing prices in the long run.

The highly significant error correction term indicates that the speed of adjustment of housing prices in the short run to its deviations from long run path is around 45% each period. It means that a house price bubble if there is any, is not persistent. Instead, there is mean reverting behaviour if deviations from co-integrating relationship to occur. The Granger non-causality test between housing prices and its determinants suggest that all determinants granger cause housing price both in short and long run.

The study in the end brings out the some policy implications. Our analysis suggests that besides real income growth, credit growth and low interest rate have significant impact on the recent rise in housing prices. In most of the international cases, huge growth in bank and non-bank finance was grossly responsible for bubble in housing market. Recently released monthly sector-wise bank credit by RBI shows that housing loan has been growing at a rapid pace. The loan growth has particularly been higher since 2010 onwards. Banks also offered teaser home loans in this period at low fixed interest rates which prompted more and more people to opt for home loans. Housing prices rose sharply during this period. This situation may warn of dangers of building up of a systemic credit risk and the instability of the financial system as a whole.

In order to reduce housing deficit in the country, the government in budget 2012 has proposed the creation of Mortgage Risk Guarantee Fund to enable provision of credit to economically weaker section and low-income group of the society. Some key policy measures such as External commercial borrowing is proposed for low cost affordable housing projects. Credit Guarantee Trust Fund is proposed to ensure better flow of institutional credit for housing loans. The government has also proposed Tax Deduction at Source (TDS) on purchase of property to restrict the usage of black money which seems to be one of the major factors for rapid rise in house prices in some of the big Indian cities like Delhi, Mumbai, Chennai Kolkata Pune and Bangalore.

International Monetary Fund (IMF) in a recent report has said that there was no evidence of systematic bubbles in the housing market in the Asia-Pacific region in the short term but it expressed its concern that if current economic conditions continued to persist, asset bubbles in the region could form in the medium term, fuelled partly by an element of speculation in the market. As typically happens in housing bubbles many purchases may have been buying in the expectation of price appreciation rather than for dwelling purposes. We really need to wait and watch!!

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