Speculative Bubbles in Real Estate Market : Detection and Cycles

Recent trends in the real estate market and its analysis - 2017 edition - National Bank of Poland (NBP)

Dr. Firano Zakaria
zakaria.firano@um5.ac.ma

Dr. Filali Adib Fatine
f.filali@um5s.net.ma

جامعة محمد الخامس بالرباط
Université Mohammed V de Rabat
Mohammed V University of Rabat

NBP Narodowy Bank Polski

Synopsis

Introduction

- For Market efficiency theory, the prices remain to influence only by exogenous factors at the market and which are of fundamental nature.
- The speculative bubbles theory was developed in response to criticisms formulated against the paradigm of efficiency.

Synopsis

Policies implication

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2. To create a new device of follow-up of the prices on the real estate market
3. To contribute the financial stability policy
4. To facilitate utilization of the macro prudential instruments to regulate price at real estate market.

Synopsis

What approach we used?

- Using the price index real estate (IPAI), statistical and structural approaches were combined in order to detect the existence of a bubble on the Moroccan real estate market.

Synopsis

Euler Equation ... more solutions

- The speculative bubbles were defined according to several disciplinary approaches:
  - For the historian Kindleberger (1978) the bubbles are upward movements constant of the assets prices,
  - For the economists consider that the bubbles refer to the assets prices which exceed the fundamental value since the investors always believe that they can resell their assets at higher prices (Brunnermeier (2009), Barlevy (2007), Diba and Grossman (1988a), West (1987)).

Euler Equation ... more solutions

- The inclusion of the **resale possibility**, implies that the price can **deviate of its fundamental value (**abolition of the **transversality condition)**, according to the following design:

$$P_t = \delta(E_t P_{t+1} + E_t D_{t+1})^a$$

- For this reason, another component intervenes in the price determination to knowing the speculative bubble.

$$P_t = \sum \delta E_t D_{t+1} + B^b$$

[a] δ is the discount rate.
[b] B is bubble.

Euler Equation ... more solutions

- This solution is in conformity with the **assumption of rational expectation** and so that it is also accepted and allowed by the whole of the economic agents, it is necessary that this solution is rational and independent of the endogenous behaviors of the market.
- **So that the solution must be single, for this it is necessary that the equation above is in equivalence with the formula of Euler. For this purpose, it is necessary that the bubble follows a martingale process, according to which the future value of this martingale is its actual value**.

Synopsis

Outlook on empirical work

- Shiller (1979, 1981)⇒Volatility Test.
- West (1987)⇒Testing market efficiency hypothesis.
- Diba and Grossman (1988a, 1988b) and Evans (1991) ⇒Stationarity test, Bhargava test and the Engel-Granger.
- Donaldson and Kamstra (1996) ⇒ ARMA-ARCH-ANN
- Philips, Shi and Yiu, (2011) propose a generalization of the test ADF(sup ADF and GsupADF).
- Campbell and Shiller (1988) and Wu (1995) ⇒Kalman Filter

Synopsis

First Step

Statistical approach is based on a fundamental idea, according to which, the two generating processes **of the prices and the rent price must**be Co integrated.

1. First generation: Diba and Grossman (1988) "ADF and causality test".
2. Second generation: Blanchard and Al (1979, 1982), Bussetti-Taylor (2004), and Philips and Al (2011, 2012).

First Step

- Bussetti and Taylor (BT, 2004) propose statistics to test the assumption according to which a series is stationary compared to an alternative assumption which suggests that the series passes from a stationary regime to a regime I(1). The test is based on the calculation of the following statistics:

$$supBT(\tau_0) = sup_{\tau \epsilon [0,1-\tau_0]} BT_\tau$$

$$BT_\tau = \frac{1}{s_0^2 (T-\tau T)^2} \sum_{t=[\tau T]+1}^{T} (y_T - y_{t-1})^2$$

First Step

- PWY (2009, 2011) use a sup ADF (SADF) according to which usual test ADF is retorted on small fragments of the series in a sequential way, on several occasions, by prolonging each time the samples used (windows).

$$SADF = sup_{\tau w \in [\tau 0, 1]} ADF_{\tau w}$$

$$SADF = sup_{\tau w \in [\tau 0, 1]} \left\{ \frac{\tau w [\int_0^{\tau w} W dW - 1/2 \tau w] - \int_0^{\tau w} W dW (\tau w)}{\tau w^{1/2} [\int_0^{\tau w} W^2 dr - [\int W(\tau) d\tau]^2]^{1/2}} \right\}$$

First Step

- The new test suggested by PWY (2012) is called GSADF (generalization of sup ADF). Based on the same principle that the SADF, the GSADF are conceived to be overall and more flexible device, as regards fixing of the initial points and in the determination of the windows to be tested.

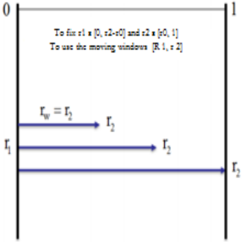


Figure 1: SADF test

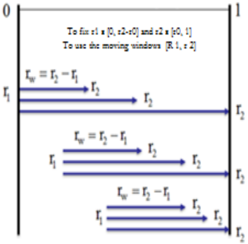


Figure 2: GSADF test

Table 1: Test ADF on the series of the prices and the outputs

Series	ADF probability	Lag used in ADF
Log of outputs (LD)	0.0006	9
Log of the real assets prices (LP)	*0.9507*	9
D(LD)	0.0006	9
D(LP)	0.0000	9

Table 2: Bhargava test

Series	Bhargava stat	Observation number
LP-LD	-1.56	51

Table 3: Johansen test

Assumption	Eigenvalues	Statistical test	Critical Value to 5%	Critical probability
None	0.20	13.65	15.49	0.09
At most 1	0.05	2.78	3.84	0.09

The test of the trace indicates that the series are not co-integrates with the threshold of 5%

Table 4: Granger test

	Z-statistic	Critical probability
Log real prices	-7.147741	0.5323
Log rent	-6.648238	0.5748

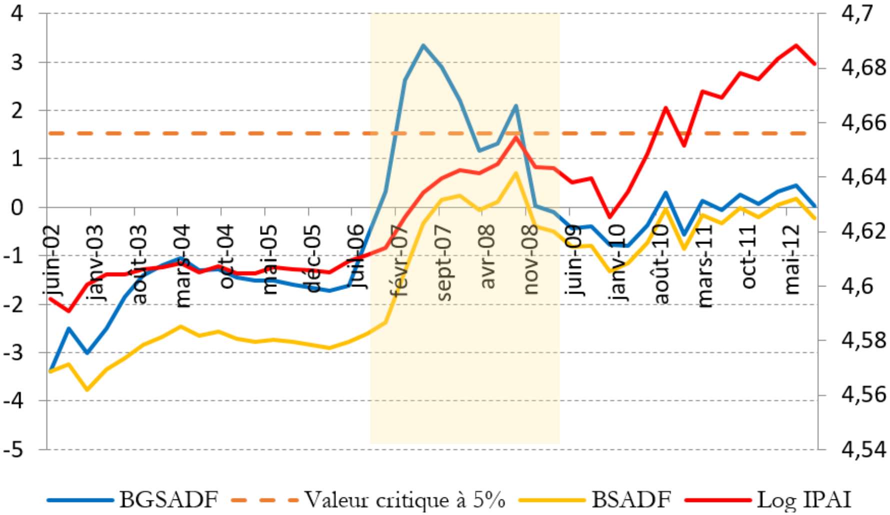
Table 5: BT test (2004)

Log of price index of the real assets	1.4858
Critical value	
90%	0.5057
95%	1.0153
99%	5.9401

The breaking values were obtained using simulation (5000 iterations) on a sample of 51 observations and with an interval τ0=0.1.

Table 6	SADF Test	GSADF Test
Log of real assets prices	0.7058	2.6392
Log of index of the rents	-1.2689	0.1204
Critical value		
90%	2.7879782	1.1915780
95%	3.4615806	1.5360598
99%	3.5906605	2.1555409

The whole of the tests were carried out on a sample of 51 observations and with an interval r0=0.4 the breaking values were obtained on the basis of 5000 Monte Carlo simulation.


4
3
2
1
0
-1
-2
-3
-4
-5
4,7
4,68
4,66
4,64
4,62
4,6
4,58
4,56
4,54
juin-02
janv-03
août-03
mars-04
oct-04
mai-05
déc-05
juil-06
févr-07
sept-07
avr-08
nov-08
juin-09
janv-10
août-10
mars-11
oct-11
mai-12
BGSADF
Valeur critique à 5%
BSADF
Log IPAI

Economic Way

- The statistical tests are limited only to the econometric properties of the analyzed series, without taking account of an economic design and a definition more structural of the speculative bubbles.
- For this purpose, **economic approaches** (structural) were suggested in order to check in a relevant way the assumption of existence of bubble on real estate market.

Problem

West model: *test the assumption according to which the price is equal to the fundamental value, against the assumption that the price in addition to the fundamental value includes another component, which is the speculative bubble.*

$$S_t = P_t^f + B_t$$

$$S_t = P_t^f = \gamma D_t \text{ where } \gamma = \frac{b\theta}{1 - b\theta}$$

- D is AR(1) Process. The estimation of forward looking Euler equation is with GMM approach.

Economic Way

Kalman Filter : Wu (1995) on the basis of work of Campbell and Shiller (1988), could develop the euler equation under the assumption of **yield constancy and using a Taylor development**. Thus, a new linear representation of the prices can be considered[a]:

[a] g: Identity Matrix ; Y is Vector of dividende (D) lag and B is Bubble.

$$\Delta P_t = (1-\alpha)\sum_{i=0}^{n}\alpha^i\left[D_t + g\sum_{j=1}^{i}A^jY_t - D_{t-1} - \sum_{j=1}^{i}gA^jY_{t-1}\right] + \Delta B_t$$

Economic Way

A measure equations:

$$\begin{aligned} \Delta P_t &= \Delta D_t + \Delta Y_t + \Delta B_t \\ \Delta d_t &= \mu_t + \sum \delta \Delta d_{t-1} + \varepsilon_t \end{aligned}$$

A transition equations:

$$\begin{aligned} Y &= AY_{t-1} + \eta \\ \Delta B_t &= \gamma \Delta B_{t-1} + \mu \end{aligned}$$

Wald Result

Table 9: Wald test

Statistical test	Value	Probability
Chi-square	23.98319	0.0000

- The coefficient $\hat{\gamma} = \dfrac{b\theta}{1 - b\theta} = \gamma$ is different for the two estimation$\Rightarrow$ $Bubbles$.

Kalman Result

Table 10: Kalman filter estimation

Coefficients	Value
C(1)	0.136075 (0.00)
C(2)	0.430003 (0.00)
C(3)	0.699998 (0.00)
State variables	
ΔD	0.164742 (0.00)
ΔY	0.066667 (0.00)
ΔB	-0.736229 (0.00)
LogL	-1676067

Estimate using the maximum of probability 50000 iterations

Where $B_t = 1.69B_{t-1} - B_{t-2}$ thus, $B_t \succ B_{t-1} \succ B_{t-2} \succ B_{t-3} ... \succ B_{t-n}$.

Bubble process

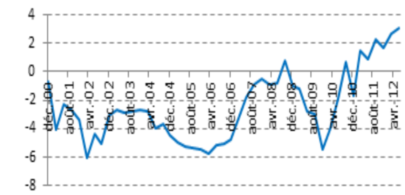


Figure 5: Development of the bubble on the Moroccan real estate market

Kalman Result

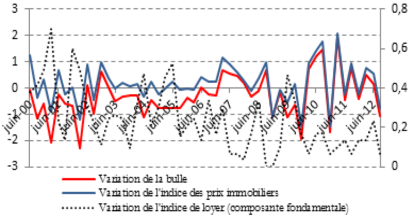


Figure 4: Presentation of the basic components and speculative of the real prices

Synopsis

Datation and Cycle

- Several work suggested using the Markov switching model to test the phases of boost and bust of the bubbles.
- By adopting the formulation of Blanchard et al. (1982), we considers that the process of bubble is controlled by two types of phase: a first ascending phase and a second depression:

$$\begin{cases} B_{t+1} = B_t(\frac{1+r}{\pi}) + \mu_t \\ B_{t+1} = \mu_t; \ (1-\pi) \end{cases}$$

Bubble process

Table 12: Identification of the Markov regimes

States	Mean	variance
Boost (E2)	0.047453 (0.09)	2.118854 (0.00)
Bust (E1)	-3.903149 (0.00)	1.290944 (0.01)

Probability of transition

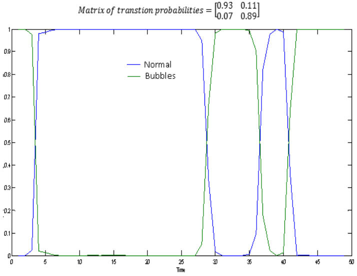


Figure 5: Probabilities of transition from a normal state in an explosive state of the real estate bubble between 2000 and 2012

Bubble process

Table 13: duration of bubbles cycles

states	Expected duration
Boost (E2)	9.11 quarters
Bust (E1)	14.55 quarters

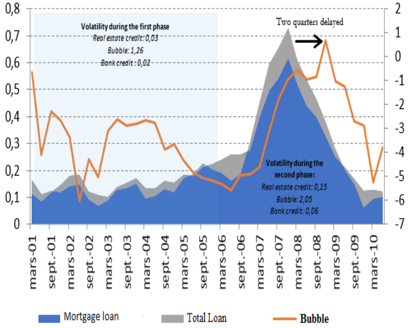


Figure 6: Development of the bank credits, the real estate credits and the real estate bubble between 2001 and 2010

Synopsis

Problem

What is the problem?⇒ identification of macroeconomics variables able to influence the processus of bubbles.

Solution

Developing a small economic model to explain the evolution of bubble process:

$$B_t = \sum_{i=1}^{m} \beta_{1i} (Loan)_{t-i} + \sum_{i=1}^{p} \beta_{2i} MASI_{t-i} + \sum_{i=1}^{q} \beta_{3i} TPIB_{t-i} + \sum_{i=1}^{l} \beta_{4i} TMP_{t-i}$$
$$+ \sum_{i=1}^{m} \beta_{1i} (REER)_{t-i} + \sum_{i=1}^{m} \beta_{1i} (INF)_{t-i} + \varepsilon_t$$

Results of Bubble model

Variable	Coefficient	Prob.
B(-1)	0.798320	0.0000
Loan(-2)	2.333632	0.3631
INF(-1)	-34.54191	0.0098
PIB(-2)	24.28416	0.0008
REER(-4)	-13.15379	0.0837
TMP	182.7952	0.0000
RM(-3)	4.019517	0.0272
R-squared	0.623068	0.553633
Scale	1.027847	1.056470
R-squared statistic	309.7109	0.000000

Simulation macro model

For the simulation exercise we adopt this step:

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Simulation macro model

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1. Initially, we develop an univariate temporal models to predict the evolutions of the factors of threshold and lever included in the models,
2. The second time, using a model of simulation, forecasts the future trend of bubble.
3. We chose after the estimate of this model to a Fan chart in order to take account of uncertainty related to this stimulation exercise.

Fan chart of Bubble process in Real Estate Market