Speculative Bubbles in Real Estate Market: Detection and Cycles


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Introduction

Research Interest

Methodology

Bubble...is also a solution!

Empirical studies

Modeling approach and Results
  Statistical approach
  Structural Approach

Speculative bubbles cycles

Macroeconomic factor and simulation model
Synopsis

1. Introduction
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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.
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Policies implication

1. To conduct the efficient monetary policy
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2. To create a new device of follow-up of the prices on the real estate market
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3. To contribute the financial stability policy
Policies implication

1. To conduct the efficient monetary policy
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.
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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.
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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.

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

\(^a\delta\) is the discount rate.  
\(^b\)B is bubble.
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.
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Outlook on empirical work

- Donaldson and Kamstra (1996) ⇒ ARMA-ARCH-ANN
- Philips, Shi and Yiu, (2011) propose a generalization of the test ADF(sup ADF and GsupADF).
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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 cointegrated.

1. First generation: Diba and Grossman (1988) "ADF and causality test".

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:

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

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

\[
SADF = \sup_{\tau \in [\tau_0, 1]} \text{ADF}_{\tau W}
\]

\[
SADF = \sup_{\tau \in [\tau_0, 1]} \left\{ \frac{\tau W \left[ \int_0^{\tau W} WdW - 1/2 \tau W \right] - \int_0^{\tau W} WdW(\tau W)}{\tau W^{1/2} \left[ \int_0^{\tau W} W^2 dr - [\int W(\tau) d\tau]^2 \right]^{1/2}} \right\}
\]
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

<table>
<thead>
<tr>
<th>Series</th>
<th>ADF probability</th>
<th>Lag used in ADF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log of outputs (LD)</td>
<td>0.0006</td>
<td>9</td>
</tr>
<tr>
<td><em>Log of the real assets prices (LP)</em></td>
<td>0.9507</td>
<td>9</td>
</tr>
<tr>
<td>D(LD)</td>
<td>0.0006</td>
<td>9</td>
</tr>
<tr>
<td>D(LP)</td>
<td>0.0000</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 2: Bhargava test

<table>
<thead>
<tr>
<th>Series</th>
<th>Bhargava stat</th>
<th>Observation number</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP-LD</td>
<td>-1.56</td>
<td>51</td>
</tr>
</tbody>
</table>
### Table 3: Johansen test

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Eigenvalues</th>
<th>Statistical test</th>
<th>Critical Value to 5%</th>
<th>Critical probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0.20</td>
<td>13.65</td>
<td>15.49</td>
<td>0.09</td>
</tr>
<tr>
<td>At most 1</td>
<td>0.05</td>
<td>2.78</td>
<td>3.84</td>
<td>0.09</td>
</tr>
</tbody>
</table>

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

### Table 4: Granger test

<table>
<thead>
<tr>
<th></th>
<th>Z-statistic</th>
<th>Critical probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log real prices</td>
<td>-7.147741</td>
<td>0.5323</td>
</tr>
<tr>
<td>Log rent</td>
<td>-6.648238</td>
<td>0.5748</td>
</tr>
</tbody>
</table>
Price Bubble at Moroccan Estate Market

Modeling approach and Results

Statistical approach

Table 5: BT test (2004)

<table>
<thead>
<tr>
<th>Log of price index of the real assets</th>
<th>1.4858</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical value</td>
<td></td>
</tr>
<tr>
<td>90%</td>
<td>0.5057</td>
</tr>
<tr>
<td>95%</td>
<td>1.0153</td>
</tr>
<tr>
<td>99%</td>
<td>5.9401</td>
</tr>
</tbody>
</table>

The breaking values were obtained using simulation (5000 iterations) on a sample of 51 observations and with an interval $\tau_0=0.1$.

Table 6

<table>
<thead>
<tr>
<th></th>
<th>SADF Test</th>
<th>GSADF Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log of real assets prices</td>
<td>0.7058</td>
<td>2.6392</td>
</tr>
<tr>
<td>Log of index of the rents</td>
<td>-1.2689</td>
<td>0.1204</td>
</tr>
<tr>
<td>Critical value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90%</td>
<td>2.7879782</td>
<td>1.1915780</td>
</tr>
<tr>
<td>95%</td>
<td>3.4615806</td>
<td>1.5360598</td>
</tr>
<tr>
<td>99%</td>
<td>3.5906605</td>
<td>2.1555409</td>
</tr>
</tbody>
</table>

The whole of the tests were carried out on a sample of 51 observations and with an interval $\tau_0=0.4$ the breaking values were obtained on the basis of 5000 Monte Carlo simulation.
Price Bubble at Moroccan Estate Market

Modeling approach and Results

Statistical approach

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.

\[
S_t = P_t^f + B_t
\]

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

- 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.

$$
\Delta P_t = (1 - \alpha) \sum_{i=0}^{n} \alpha^i [D_t + g \sum_{j=1}^{i} A^j Y_t - D_{t-1} - \sum_{j=1}^{i} g A^j Y_{t-1}] + \Delta B_t
$$
Economic Way

A measure equations:

\[ \Delta P_t = \Delta D_t + \Delta Y_t + \Delta B_t \]
\[ \Delta d_t = \mu_t + \sum \delta \Delta d_{t-1} + \epsilon_t \]

A transition equations:

\[ Y = AY_{t-1} + \eta \]
\[ \Delta B_t = \gamma\Delta B_{t-1} + \mu \]
Wald Result

Table 9: Wald test

<table>
<thead>
<tr>
<th>Statistical test</th>
<th>Value</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-square</td>
<td>23.98319</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

The coefficient

\[
\hat{\gamma} = \frac{b\theta}{1 - b\theta} = \gamma
\]

is different for the two estimation \( \Rightarrow \text{Bubbles} \).

Kalman Result

Table 10: Kalman filter estimation

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>0.136075 (0.00)</td>
</tr>
<tr>
<td>C(2)</td>
<td>0.430003 (0.00)</td>
</tr>
<tr>
<td>C(3)</td>
<td>0.699998 (0.00)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>State variables</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta D )</td>
<td>0.16474 (0.00)</td>
</tr>
<tr>
<td>( \Delta Y )</td>
<td>0.066667 (0.00)</td>
</tr>
<tr>
<td>( \Delta B )</td>
<td>-0.736229 (0.00)</td>
</tr>
<tr>
<td>LogL</td>
<td>-1676067</td>
</tr>
</tbody>
</table>

Where \( B_t = 1.69B_{t-1} - B_{t-2} \)

thus, \( B_t \succ B_{t-1} \succ B_{t-2} \succ B_{t-3} \ldots \succ B_{t-n} \).
Price Bubble at Moroccan Estate Market

Modeling approach and Results

Structural Approach

Bubble process

Kalman Result

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

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

\[
\begin{align*}
B_{t+1} &= B_t \left( \frac{1 + r}{\pi} \right) + \mu_t \\
B_{t+1} &= \mu_t; \quad (1 - \pi)
\end{align*}
\]
Table 12: Identification of the Markov regimes

<table>
<thead>
<tr>
<th>States</th>
<th>Mean</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boost (E2)</td>
<td>0.047453 (0.09)</td>
<td>2.118854 (0.00)</td>
</tr>
<tr>
<td>Bust (E1)</td>
<td>-3.903149 (0.00)</td>
<td>1.290944 (0.01)</td>
</tr>
</tbody>
</table>

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

Table 13: duration of bubbles cycles

<table>
<thead>
<tr>
<th>states</th>
<th>Expected duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boost (E2)</td>
<td>9.11 quarters</td>
</tr>
<tr>
<td>Bust (E1)</td>
<td>14.55 quarters</td>
</tr>
</tbody>
</table>

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

\[
B_t = \sum_{i=1}^{m} \beta_{1i} (\text{Loan})_{t-i} + \sum_{i=1}^{p} \beta_{2i} MASI_{t-i} + \sum_{i=1}^{q} \beta_{3i} TPIB_{t-i} + \sum_{i=1}^{l} \beta_{4i} TMP_{t-i} + \\
+ \sum_{i=1}^{m} \beta_{1i} (\text{REER})_{t-i} + \sum_{i=1}^{m} \beta_{1i} (\text{INF})_{t-i} + \varepsilon_t
\]
### Results of Bubble model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B(-1)</td>
<td>0.798320</td>
<td>0.0000</td>
</tr>
<tr>
<td>Loan(-2)</td>
<td>2.333632</td>
<td>0.3631</td>
</tr>
<tr>
<td>INF(-1)</td>
<td>-34.54191</td>
<td>0.0098</td>
</tr>
<tr>
<td>PIB(-2)</td>
<td>24.28416</td>
<td>0.0008</td>
</tr>
<tr>
<td>REER(-4)</td>
<td>-13.15379</td>
<td>0.0837</td>
</tr>
<tr>
<td>TMP</td>
<td>182.7952</td>
<td>0.0000</td>
</tr>
<tr>
<td>RM(-3)</td>
<td>4.019517</td>
<td>0.0272</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.623068</td>
<td>0.553633</td>
</tr>
<tr>
<td>Scale</td>
<td>1.027847</td>
<td>1.056470</td>
</tr>
<tr>
<td>R-squared statistic</td>
<td>309.7109</td>
<td>0.000000</td>
</tr>
</tbody>
</table>
Simulation macro model

For the simulation exercise we adopt this step:

1. Initially, we develop an univariate temporal models to predict the evolutions of the factors of threshold and lever included in the models,
Simulation macro model

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2. The second time, using a model of simulation, forecasts the future trend of bubble.
Simulation macro model

For the simulation exercise we adopt this step:

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