Abstract: The main objective of this research is to investigate evidence of bubble price formation in the real estate sector of Ceará between the period of October-2007 and December-2010. The Post-Keynesian Theory based on the asset bubble speculative definition. The methodology applied was time series co integration. The model variables are as follows: home credit, interest rate (SELIC), customer confidence index, exchange rate by the purchase power parity, quantity of real estate unities thrown, quantity of real estate unities sold, average selling price per square meter and average construction cost per square meter. The Augmented Dickey-Fuller Test (ADF) identified unit root in all variables in level, however all variables are stationary when integrated of first order. The Johansen Test identified 1 (one) co integrating vector between the average selling price per square meter and the average construction cost per square meter. This result, according to the Post-Keynesian Theory, aborts evidence of real estate price bubble formation in the study region. The Johansen Test also detected co integration between home credit and average selling price per square meter, indicating that home credit has done sustainability for real estate price increase.

Keywords: Bubble, cointegration, construction, real estate sector, post-Keynesian theory

1. Introduction

Speculative bubble prices in assets have made a lot of debate among economists. Even though the Neoclassic Theory accepts bubble prices as mere theory curiosity and that they would occur under very specific conditions, the world economic history show us some recent episodes of bubble price in real estate such as: The Japan Crisis (decade of 80) and the American Crisis (2008-2009). On the other hand, the Post-Keynesian Theory views bubble formation as a consequence of the capitalism system and its formation are recurrent. This research makes a comparison of these two approaches and uses the Post-Keynesian Theory to investigate bubble price occurrence in the real estate sector of Ceará.

The speculative movement with real estate has spread over many central countries until reaching the emerging countries. Brazil due to many factors like: huge inflow of foreign capital, drastic drop of interest rates, greater share of home credit in economy, became exposed to such speculative movements with real estate. This however does not imply necessarily bubble price formation of real estate. The great American Crisis seems to have deeply damaged expectations of financial market investors as a whole. Such mistrust seems to have turn investors’ attention to the real economy. In the real side, real estate seems to be a safe port for new investments.

According to IPECE (2010), in the 2008 the civil construction industry contributed with 5.2% of GNP in Ceará and the real estate sector with 8.3% of the same ratio. Between 2007 and 2008 the civil construction...
industry have increased not less than 8.8% and the real estate sector about 5.6%. Considering the 2009-2010 period, the civil construction industry was the economic sector that showed the greatest increase among all sectors investigated, 15.6%. On the other hand, the real estate sector in the same period has increased 7.8%. The above data confirms the relevance of the civil construction industry and the real estate sector in the economy of Ceará. Moreover, this fast economic activity of these sectors have contributed to an increase greater than 47% in the selling price per square meter of the real estate unities in the research region between late 2007 and 2010.

The main objective of this academic work is to investigate the bubble price formation occurrence in the real estate sector of Ceará. As a secondary goal, this research focus on macroeconomic variables that may interfere in the real estate prices of the research region. The Post-Keynesian approach was adopted in order to identify bubble price formation as well as time series co integration methodology. Is there bubble price in the real estate sector in Ceará? Which macroeconomic variables are relevant for the real estate sector in Ceará? The relevance of the co integration methodology is in order to measure long term balance relations among real estate market variables.

This paper is divided into the following stages: beyond this introduction, presents the Neoclassic and the Post-Keynesian approaches and discuss relevant real estate data, in 1.1 these theories are discussed and compared. In 1.2 relevant researches about bubble price formation in real estate as well as macroeconomic relevant variables in price formation are presented. In 2 the time series co integration methodology is detailed. In 3 relevant empiric results are discussed. In 4 final remarks are addressed. Finally in 5 all references are listed.

1.1. Speculative Bubble Price Formation Theories in Assets

Basically there are two different approaches that explain speculative bubble price formation in assets: the Neoclassic Theory and the Post-Keynesian Theory. The Neoclassic Theory states that speculative bubbles may appear under very particular circumstances. The efficient market hypothesis, over spread in the Neoclassic Theory, practically aborts the speculative bubble existence. According to Blanchard & Fisher (1989) the Neoclassic Theory about bubble price in assets has as the starting point the following equation.

$$Pt = \alpha E(P_{t+1}/t) + \alpha dt; \quad \alpha = [1/(1 + r)] < 1$$

Where $Pt$ is the price in the period $t$, $dt$ is the bonus paid in period $t$, $E(.)$ is the agent expectation made at period $t$ about price in period $t+1$, and $r$ is the interest rate for a riskless asset. In the Neoclassic Theory, agents make expectations under rational expectations hypothesis. In this theory all agents have the same information set what makes the following equation valid.

$$E[P_{t+1}/t] = E[P_{t+1}/I_t] \text{ and } I_t = \{P_{t-1}; d_{t-1}; z_{t-1}; t=0,1,2,\ldots\}$$

Where $I_t$ is the information set agents have at period $t$, $z_{t-1}$ is any other variable used for $P_t$ forecasting. Substituting (2) in (1) we get:

$$P_t = \alpha E[P_{t+1}/I_t] + \alpha dt$$

Equation (3) can be solved using recursive substitution method. After $n$ recursive substitutions equation (4) is reached.

$$P^*_t = \alpha \sum_{t=1}^{n} E[d_{t+1}/I_t]$$

Equation (4) represents the fundamental solution. Even though equation (4) also represents a solution for equation (3) it is not unique. In fact the asset price behavior can be expressed by equation (5).

$$P_t = P^*_t + b_t(5)$$
Equation (5) represents infinite solutions because the price in t is the sum of the price share that represents market fundamentals and $b_t$ that represents bubbles. Besides that, the Neoclassic Theory accepts the efficient market hypothesis that states that the forecasting error is null or $P_t = P^*_{t+1}$. In other words this theory aborts theoretically bubble price formation.

According to Dequech (1999) the Post-Keynesian Theory starting point is the way economic agents make their expectations about future asset bonus. These expectations are made in a Knight-Keynes uncertainty environment. Each agent tries to follow the average behavior of the others agents believing they have more information than he has Banerjee (1992). In this environment it is not possible separate market fundamental to the bubbles suggested by the Neoclassic Theory. Dymsky (1998) defines bubble price when the price/cost of production ratio increases over time continuously, what is quite appropriate for the Knight-Keynes environment.

Under the Post-Keynesian view, bubble price can be explained in an income and employment cyclic fluctuations environment, occurring inevitably in the expansion phase of the economy. According to Dymsky (1998), bubble price will be a result of two factors: the confidence state cumulative increase and liquidity preference reduction made by economic agents. Basically the main difference between the Neoclassic and the Post-Keynesian theories is that in the first the bubble price occurrence in the market is an exogenous process and its frequency is random and in the second, asset price fluctuations are endogenous and very likely. Curado (2006) states clearly and objectively that the Post-Keynesian approach, based on empirical findings, is much more useful to explain fluctuations in asset prices than the Neoclassic Theory.

1.2. Speculative Bubble Price

Oreiro (2001) presents the Post-Keynesian Theory about bubbles in asset prices and their relation with the financial fragility concept. The author makes comparisons between the Neoclassic and Post-Keynesian Theories. In the conventional theory, bubble is the part of the price that does not reflect market fundamentals and in the Post-Keynesian Theory it is not possible separate the part that follow market fundamentals from the part that does not. Curado (2006) analyzed asset price fluctuations and made comparisons between rational speculative bubbles and the Keynesian contribution. Besides comparing bubble price theories conclude that according to empirical evidences that the Keynesian view is more useful to explain asset price fluctuations than the rational bubble literature.

Bezerraet al (2010)studied evidences of speculative price bubble formation in the real estate sector of the city of Natal in the northeast of Brazil in the period 2005-2007. The massive inflow of foreign capital into this city and the rapid price increase has motivated this research. They conclude that the foreign capital has done sustainability for fast price increase and according to research results; evidences of speculative bubble price were found. Santos & Cruz (2000) analyzed the real estate market dynamics in special focus to the Great São Paulo. They conclude that the real estate market presents strong cyclic behavior, the elasticity of new home unities is unitary, interest rate have negative impact to real estate demand and finally income have strong correlation to real estate demand.

Herring & Watcher (2002) investigated the relation between speculative bubble prices in the real estate sector with bank crisis. The consequences to the real economy depend on banks presence in the financial system of each country. Especially among the BRICs banks hold over 80% of total national assets. In these conditions, speculative bubble prices in the real estate sector may be very harmful to the real economy of these countries. Mishkin (2007) studied in this paper the roll of the civil construction in the monetary transmission mechanism and explore this knowledge in the monetary policy conduction. The author concludes that changing short time interest rates affect the real estate sector at least through six transmission channels: the cost of capital, future expectations of real estate prices, real estate offer,
2. Time Series of Co-integration

The stationary condition is the main requirement for time series analysis. The valid conditions of minimum squares are only valid in the presence of stationary time series Enders (1995). The unit root test was applied to check stationary conditions of data series in this research. The following series were used in this work: acquisition home credit, interest rate (SELIC), consumer confidence ratio, real estate unities thrown, exchange rate by the purchase power parity, quantity of real estate unities sold, average selling price per square meter and average construction cost per square meter. If a time series has unit root then it is not stationary and the differentiation process is required. In order to test the null hypothesis of unit root existence the Augmented Dickey-Fuller (ADF), where Ho represents $\delta=0$, was applied. Besides ADF test, the Phillips-Perron test may be applied for the same objective. Suppose $Y_t$ e $X_t$, time series I(1), stationary in first difference, the residues of equation (6) are also I(1), what is similar to say that those time series are not stationary in level.

$$Y_t = \alpha + \beta X_t + \varepsilon_t \quad (6)$$

According to Granger e Newbold (1986) there are some cases in which equation (6), for two I(1) time series, which may result in a stationary combination I(0). When this happen $Y_t$ e $X_t$ are so called co-integrated or shows a long term balance. The co-integration equation may be represented in (7) and $\beta$ is the co-integration parameter.

$$\varepsilon_t = Y_t - \alpha - \beta X_t = 0 \quad (7)$$

According to Enders (1995) the most suitable test to detect time series co-integration is the Johansen Test. The model proposed by Johansen (1988) apud Kanas (1998) uses trace and eigenvalue statistics in order to detect time series co-integration existence. The Johansen Test proposes the following VAR specification model:

$$\Delta Y_t = \Pi Y_{t-1} + \sum \Gamma_i \Delta Y_{t-1} + \beta X_t + \varepsilon_t \quad (8)$$

$X_t$, is the deterministic variable vector. According to Enders (1995), the critic point in the Johansen Test is to find the matrix $\Pi$ rank. This rank $r$ indicates the number of independent co-integration vectors. So, if $r=0$, those time series are not co-integrated. In case of $r=1$ this indicates 1(one) co-integration vector between those time series. For those cases where $1 < r < n$, may happen multiple co-integration vectors among time series.

3. Empirical Results

3.1. Data, Stationary Condition and Co-Integration

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2 The unit root test shows the following model $Y_t = \rho Y_{t-1} + u_t$, where $u_t$ is the stochastic error term that follow the Classical Hypothesis: zero mean, stable variance and is not correlated.

3 The new time series will have the following format: $\Delta y_t = y_t - y_{t-1}$. 

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The research data was collected from IPEA, SECOVI/Ce, BACEN e SINDUSCON/Ce. This work used monthly data and covered the time span between October-2007 and December-2010. All-time series are in natural logs. The following time series were collected with respective source:

- Volume of acquisition home credit (R$ Millions) – CRE. Source: BACEN.
- Interest Rate (SELIC) %p.a. – SELIC. Source: IPEADATA.
- Consumer Confidence Ratio – ICC. Source: IPEADATA.
- Purchase Parity Power Exchange Rate – PPP. Source: IPEADATA.
- Number of Real Estate Unities Thrown – UNL. Source: SECOVI/Ce.
- Number of Real Estate Unities Sold – UNV. Source: SECOVI/Ce.
- Construction Cost Index – CUB. Source: SINDUSCON/Ce.
- Average Selling Price per Square Meter – PMQ. Source: SECOVI/Ce.

The stationary condition was tested in all-time series in order to make possible the application of the co integration test, Johansen Test. The co integration methodology is only applicable using time series not stationary in level. The ADF test was applied and the results are showed in Table 1.

<table>
<thead>
<tr>
<th>Time Series</th>
<th>Specification</th>
<th>Critical Values</th>
<th>ADF Statistics</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>LnCRE</td>
<td>Level</td>
<td>-2,6307</td>
<td>+2,0000</td>
<td>1%</td>
</tr>
<tr>
<td>LnSELIC</td>
<td>Level</td>
<td>-2,6326</td>
<td>-1,1888</td>
<td>1%</td>
</tr>
<tr>
<td>LnICC</td>
<td>Level</td>
<td>-2,6272</td>
<td>+0,9482</td>
<td>1%</td>
</tr>
<tr>
<td>LnPPP</td>
<td>Level</td>
<td>-2,6289</td>
<td>+1,9609</td>
<td>1%</td>
</tr>
<tr>
<td>LnUNL</td>
<td>Level</td>
<td>-2,6289</td>
<td>-0,1990</td>
<td>1%</td>
</tr>
<tr>
<td>LnUNV</td>
<td>Level</td>
<td>-2,6443</td>
<td>+1,1410</td>
<td>1%</td>
</tr>
<tr>
<td>LnCUB</td>
<td>Level</td>
<td>-2,6272</td>
<td>+2,4058</td>
<td>1%</td>
</tr>
<tr>
<td>LnPMQ</td>
<td>Level</td>
<td>-2,6369</td>
<td>+3,3377</td>
<td>1%</td>
</tr>
</tbody>
</table>

Source: Own research.

According to ADF Test all-time series are not stationary in level what make suitable the co integration analysis. The next step is to apply the Johansen Test between the most relevant time series of this work, construction cost and real estate price. Bubble formation occurrence may happen when real estate prices increase continuously in comparison to construction costs. Table 2 shows the results of the Johansen Test.

<table>
<thead>
<tr>
<th>Tests</th>
<th>Vectors</th>
<th>Auto-Value</th>
<th>Statistics</th>
<th>Critical Value (5%)</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace Test</td>
<td>1</td>
<td>0,4068</td>
<td>21,3111</td>
<td>15,4947</td>
<td>0,0059</td>
</tr>
</tbody>
</table>
In both tests applied, 1(one) 5% significance co integration vector was found. Therefore, a long term balance relation between both time series is found. So real estate prices increase followed by construction production costs. According to the Post-Keynesian Theory, speculative price bubble may occur when real estate prices cannot be explained by construction production costs behavior. The Johansen Test was also applied to each variable in relation to price variable in order to identify which are price determinant in the study region. Table 3 presents trace and max eigenvalue test results.

<table>
<thead>
<tr>
<th>Test</th>
<th>Vectors</th>
<th>Variable</th>
<th>Test Statistics</th>
<th>Critical Value (5%)</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace</td>
<td>1</td>
<td>LnCRE</td>
<td>20,7104</td>
<td>20,2618</td>
<td>0,0434</td>
</tr>
<tr>
<td>Max Eigenvalue</td>
<td>1</td>
<td>LnCRE</td>
<td>16,8280</td>
<td>15,8921</td>
<td>0,0356</td>
</tr>
<tr>
<td>Trace</td>
<td>0</td>
<td>LnSELIC</td>
<td>6,8097</td>
<td>20,2618</td>
<td>0,9089</td>
</tr>
<tr>
<td>Max Eigenvalue</td>
<td>0</td>
<td>LnSELIC</td>
<td>3,9347</td>
<td>15,8921</td>
<td>0,9605</td>
</tr>
<tr>
<td>Trace</td>
<td>0</td>
<td>LnICC</td>
<td>25,1418</td>
<td>25,8721</td>
<td>0,0614</td>
</tr>
<tr>
<td>Max Eigenvalue</td>
<td>1</td>
<td>LnICC</td>
<td>21,3911</td>
<td>19,3870</td>
<td>0,0253</td>
</tr>
<tr>
<td>Trace</td>
<td>0</td>
<td>LnPPP</td>
<td>16,3776</td>
<td>20,2618</td>
<td>0,1575</td>
</tr>
<tr>
<td>Max Eigenvalue</td>
<td>0</td>
<td>LnPPP</td>
<td>11,2819</td>
<td>15,8921</td>
<td>0,2316</td>
</tr>
<tr>
<td>Trace</td>
<td>0</td>
<td>LnUNL</td>
<td>15,9562</td>
<td>20,2618</td>
<td>0,1764</td>
</tr>
<tr>
<td>Max Eigenvalue</td>
<td>0</td>
<td>LnUNL</td>
<td>12,5299</td>
<td>15,8921</td>
<td>0,1573</td>
</tr>
<tr>
<td>Trace</td>
<td>0</td>
<td>LnUNV</td>
<td>17,9381</td>
<td>20,2618</td>
<td>0,1012</td>
</tr>
<tr>
<td>Max Eigenvalue</td>
<td>0</td>
<td>LnUNV</td>
<td>14,5019</td>
<td>15,8921</td>
<td>0,0816</td>
</tr>
</tbody>
</table>

Source: Own research.

The co integration results show that only home credit is co integrated to the price variable. In other words, real estate price increase in Ceará seems to be sustainable by home credit availability. Due to low savings population ratio, home credit seems to be a key variable in the real estate market in Ceará. The home credit availability induced higher economic activity in the real estate market what provoked real estate price increase. The max eigenvalue test between LnICC and LnPMQ also found 1(one) co integration vector besides the trace test did not find any co integration vector. These results allowed conclude that there is no certain about co integration between those variables. This research reassures that only home credit is co integrated to the price variable.

This research built a time series variable that measures the relation between real estate price and construction cost. This variable was called margin and defined as: margin = PMQ/CUB. The margin variable is able to measure how many times real estate prices are greater than construction costs. Figure 1 presents this variable graph across the research period. The margin variable, already defined, presents an oscillatory behavior around its average $\mu=4.60$ with standard deviation $\sigma=0.87$. For bubble price occurrence this variable must presents continuous growth across the research period. The margin graph
show some strong real estate speculative periods, especially during June and December 2008. In those months certainly, real estate sector felt American Crisis shocks. For the rest of the research period the margin variable presents smooth movements around its average and not showing tendency.

![Figure 1 Margin Variable Graph](image)

Source: Own research.

4. Conclusions

This academic work investigated evidences of bubble price occurrence in the real estate market in the State of Ceará between the period of October-2007 and December-2010. The Post-Keynesian Theory about speculative bubble price occurrence in assets was adopted. The time series co integration methodology with Johansen Test was applied. The results obtained indicate that there is co integration between real estate price and cost of construction time series. The Johansen Test was also applied to others macroeconomic variables of this research and identified only home credit co integrated to real estate price variable. This result shows that real estate price and home credit have long term balance relation. This also suggests that the real estate price rising across the research period was boosted by home credit. This research used the margin variable also applied by Bezerra et al(2010). However, this research concluded that real estate prices were priority induced by home credit and not by foreign resources. In the same way as Balarine (2008), this work points out home credit availability for demand as a relevant factor for real estate projects success.

Finally, this research applied Post-Keynesian concepts like Oreiro (2001) and Curado (2006), reaching a conclusion that during the research period the real estate market in Ceará suffered strong speculative episodes; however real estate prices and construction costs suffered variations in a long term balance way. This result aborts the possibility of bubble price occurrence in the research region. Conclusively the real estate market in Ceará seems to be pushed by home credit availability. It is also evident that in this market, speculative behavior is very likely not provoking necessarily bubble price formations as during the study period. Due to the above conclusions and real estate profitability, the real estate and the construction sectors have reliable and strong investment opportunities in the State of Ceará.

References


About the Author

Professor Marcelo M. Melo works at Universidade Federal do Ceará (UFC) where undertakes academic research in finance, monetary economics, applied macroeconomics and growth & development. At the time, he is running 2(two) research projects: The Role of Credit in the Brazilian Economy: An Empirical Study and An Empirical Analysis of the Construction and the Real Estate Sectors in Ceará-Brazil. The present paper “Is There Bubble Price in the Real Estate Sector of Ceará? A
Post-Keynesian Approach” is one of the works developed from the second research project. Professor Marcelo M. Melo is lecturer of the following disciplines of the Economic Sciences and Finance courses: Mathematics Economics, Macroeconomics, Capital Markets and Financial Engineering.

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