# Financial Bubbles : New Evidence from South Africa's Stock Market

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# Financial Bubbles : New Evidence from South Africa's Stock Market [*]

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### Abstract

We provide new empirical evidence of bubbles timing in the stock market of South Africa. We apply the generalized sup ADF (GSADF) unit root test of Phillips et al. (2015) to monthly share prices from January 1960 to July 2019, to detect explosive behaviors. Results indicate that, overall, South Africa's stock market has been exuberant during the period 1960-2019. We find strong evidence of three bubble episodes during the periods of April 1968 to July 1969, December 1979 to November 1980 and April 2006 to May 2008 in the stock market of South Africa. The last two bubbles correspond to the 1979 international oil crisis and the 2008 financial crisis suggesting that the south african stock market is still vulnerable to exogenous shocks.

*Keywords:* Bubble, Stock market, GSADF test, South Africa

*JEL codes:* C12 , G12

# 1 Introduction

A financial bubble refers to a significant increase in an asset price, outpacing its fundamental value (Garber, 1990; Flood and Hodrick, 1990; Case and Shiller, 2003; Shiller, 2015). Most of the empirical literature on bubble detection has focused on the real estate markets since it is sometimes argued that the real estate market is most likely to experience bubbles than the stock market (Fraser et al., 2008; Schwartz, 2009; Dreger and Zhang, 2013; Gelain and Lansing, 2014; Engsted and Pedersen, 2015; Engsted et al., 2016; Greenaway-McGrevy and Phillips, 2016; Caspi, 2017; Gomez-Gonzalez et al., 2018; Hu and Oxley, 2018; Bourassa et al., 2019; Rherrad et al., 2019). During the last decade, there has been a growing interest in the stock market bubbles in developed countries (Hu and Oxley, 2018; Hu et al., 2017; Deng et al., 2017). Yet, only few studies have investigated the episodes of stock prices exuberance in emerging countries (Joshi et al., 2006; Schnabl and Hoffmann, 2008; Ahmed et al., 2010). In the case of South Africa, there is no consensus about the bubbles episodes in the stock market. Indeed, Chang and Gupta (2014) apply a GSADF to Global Financial shares prices to detect a bubble in South African stock market and find evidence of bubbles during the period of 2006–2007 in the South Africa Stock market. In contrast, using data from 1954 to April 2015, Balcilar et al. (2016) only detected two bubbles between 1964 (January to May) and 1969 (January to June) in the South African stock market but not during the period 2006-2007. Balcilar et al. (2016) argue that using a longer sample is the reason why the GSADF test does no longer detect a bubble during the period 2006-2007. The objective of this paper is to investigate the presence of bubbles in the South African stock market, especially during the 2006-2007 period. We use a long sample of share prices as Balcilar et al. (2016) from OECD database.

Our paper contributes to the literature by applying the generalized sup ADF (GSADF) unit root test developed by Phillips et al. (2015) to the OECD monthly share prices from January 1960 to July 2019. The GSADF test enable us to detect explosive behaviors in South Africa's stock prices. Our results indicate that South Africa's stock market has been exuberant for the period from 1960 to 2019. We find evidence that the stock market of South African has experienced three bubble episodes from 1960 to 2019. The first bubble

occurred from April 1968 to July 1969 with a peak at April 1969. The second bubble occurred from December 1979 to November 1980 with a peak at September 1980. Finally, the third bubble lasted from April 2006 to May 2008 with a peak at October 2007. Our first two bubbles are consistent with the result of Balcilar et al. (2016). However, unlike Balcilar et al. (2016), our results confirm the finding of Chang and Gupta (2014) that the south African stock market have experienced a bubble during the period 2006-2007. We argue that the difference between our findings and Balcilar et al. (2016)'s may be explained to the difference in the measures of share prices indexes of the OECD and the Global Financial Database.

The rest of the paper is organized as follows. Section 2 presents the data used in this paper. Section 3 presents our empirical model for detecting the episodes of bubbles and investigating bubble migration. Section 4 shows and discusses our empirical results, and Section 5 concludes the paper and suggests some avenues for future research.

## 2    Baseline model of asset-pricing

The standard asset-pricing model is written as follows :

$$
P_t = \sum_{i=0}^{\infty} \left( \frac{1}{r_f} \right)^i E_t \left( D_{t+i} \right) + B_t \tag{1}
$$

where $P_t$ denotes the stock price at time t, $D_{t+i}$ is the dividend obtained from the share at time $t+i$, $B_t$ is the bubble component, and $r_f$ is the risk-free interest rate. The stock market fundamental price $P_t^f$ is the difference between the stock price and the bubble-component $P_t^f = P_t - B_t$ where $B_t$ satisfies the submartingale property, as:

$$
E_t \left( B_{t+1} \right) = (1 + r_f) B_t \tag{2}
$$

If $B_t = 0$, the stock price equals the fundamental price, and there is no explosive behavior. If $B_t \neq 0$ and given the submartingale property, the stock market contains a bubble (LeRoy, 1973).

# 3 Data and Methodology

## 3.1 Data

The data used in this paper are retrieved from OECD (OECD, 2019). The OECD database contains monthly information on share price from January 1960 to July 2019 in OECD and non OECD countries including South Africa. The OECD share price index is built using the prices of common shares of companies traded on national or foreign stock exchanges[1]. According to OECD (2019), the share price index is calculated based on the stock exchange across the country, using the closing daily values for the monthly data, and they are computed as simple arithmetic averages of the daily data. Figure (1) presents the evolution of the share price (base=2015) in South Africa since January 1960 to July 2019. In Figure (1), we observe that the South-African share price index has increased sharply since 1960. The growth has accelerated since 2003, and then has registered a deceleration between 1999 and 2001. A new period of acceleration of price has taken place since 2004.
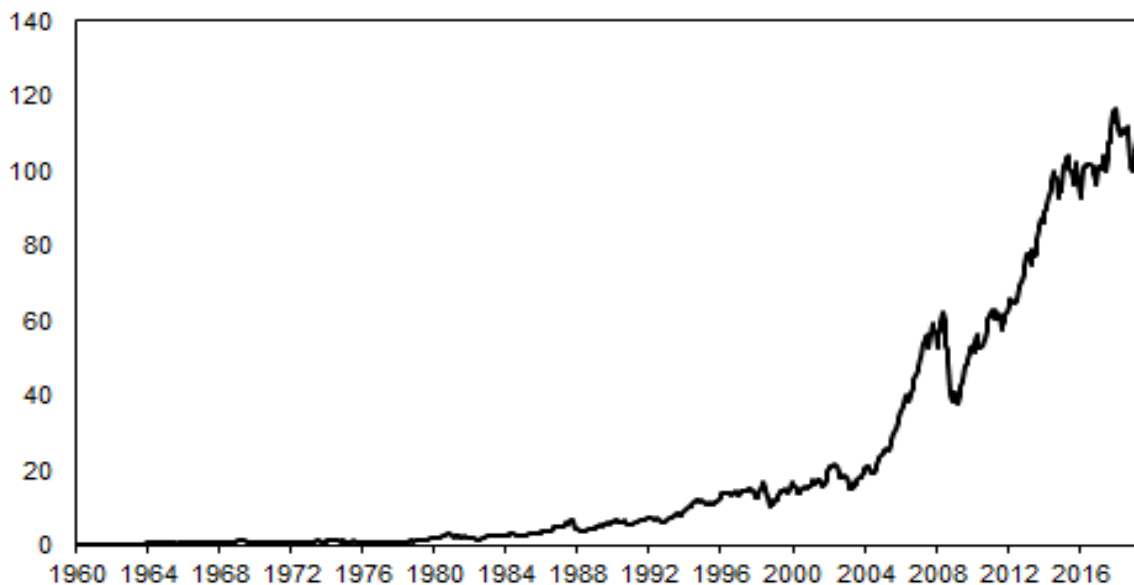


**Figure 1:** *Share prices index from January 1960 to July 2019*

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[1]see OECD (2019)

## 3.2 Testing for bubbles

This paper uses the right tail unit root tests of Phillips et al. (2015) to analyze the explosive behavior of stock prices in South Africa. The procedure of Phillips et al. (2015) estimates the following auto-regressive specification:

$$\Delta y_t = \alpha + \beta y_{t-1} + \sum_{i=1}^{K} \gamma_i \Delta y_{t-i} + \epsilon_t \tag{3}$$

where $y_t$ is the stock price at period t, $\alpha$ is the intercept, $K$ is the optimal lag order, and $\epsilon_{c,t}$ is the error term.

In the GSADF procedure, the estimation of Equation 1 is repeated on sub-samples of data in a recursive fashion and is based on global backwards supremum ADF statistics of the form:

$$GSADF(r_0) = \sup_{r_2 \in [r_0,1] \, r_1 \in [0, r_2 - r_0]} ADF_{r_1}^{r_2} \tag{4}$$

The null hypothesis of the GSADF test ($H0 : \beta = 0$) is the absence of a bubble. The alternative hypothesis is ($H1 : \beta > 0$) which implies an explosive behavior for the time series. If the GSADF test rejects the null hypothesis, then there is evidence of at least one bubble in the market.

In order to determine the origination and collapse of each bubble, Phillips et al. (2015) suggest to perform the Backward sup ADF test (BSADF) defined as the sup value of the ADF statistic sequence:

$$BSADF_{r_2}(r_0) = \sup_{r_1 \in [0, r_2 - r_0]} ADF_{r_1}^{r_2} \tag{5}$$

where $r_2 - r_1$ is the optimal window size; $r_0$ is the minimum window size; $r_1$ is the starting point, which varies from 0 to $r_2 - r_0$; and $r_2$ is the ending point, which varies from $r_0$ to 1. Following Phillips et al. (2015), the minimum window size $r_0$ is determined according to the formula $0.01 + \frac{1.8}{\sqrt{T}}$ .

# 4 Results

Table (1) presents the results of the GSADF test. The test indicates that, overall, the stock market of South Africa has been exuberant during the period 1960-2019. In fact, the GSADF statistic (2.704) is significant at 5 percent indicating that the null hypothesis of no bubble in the South Africa's stock market is rejected. This result implies that the South Africa's stock market contains at least one bubble during the period 1960-2019.

| Period | Optimal lags | GSADF | Interpretation |
|---|---|---|---|
| January 1960- July 2019 | 1 | 2.704385** | Presence of bubble |
| Test critical values | 99 percent level | 2.802361 | |
| | 95 percent level | 2.214062 | |
| | 90 percent level | 1.973588 | |

significance at 5 percent(**)

**Table 1:** *GSADF test for bubble detection in the South African stock market*

Now, we focus on timing these bubbles using the Backwards SADF statistic. The Backwards SADF allows to identify the origination and collapse of each bubble. Recall that, according to Phillips et al. (2015), the asset market contains a bubble whenever the estimated Backwards SADF statistic outpaces its critical value. Figure (2) presents the Backwards SADF sequences and the critical value for South Africa's stock market. We find evidence that the stock market of South Africa has experienced three bubble episodes from 1960 to 2019. The first bubble occurred from April 1968 to July 1969 with a peak at April 1969. The second bubble occurred from December 1979 to November 1980 with a peak at September 1980. Finally, the last bubble episode occurred, from April 2006 to May 2008 with a peak at October 2007.

In terms of intensity, the second bubble is the most severe bubble that South Africa's stock market has experienced. This bubble corresponds to the 1979 oil crisis and oil sanctions against the apartheid government in South Africa (Crawford, 1999). This time concordance is consistent with Arouri et al. (2011) who highlight the volatility transmission of world oil prices to stock markets. In the case of South Africa, it is likely that the oil embargo amplifies the effect of the international oil crisis (Crawford, 1999), leading to this bubble on the stock market between December 1979 to November 1980. In terms of

duration, the third bubble is the longest bubble that the South African stock market has ever experienced since 1960. This bubble occurred during the 2008 international financial crisis with affected all the economic partners of South Africa including Great Britain, China and United tates. Given the interdependence of stock markets between the emerging stock markets and the developed countries (Wong et al., 2004; Moore and Wang, 2014; Abdennadher and Hellara, 2018), the South African stock market has collapsed during this period.
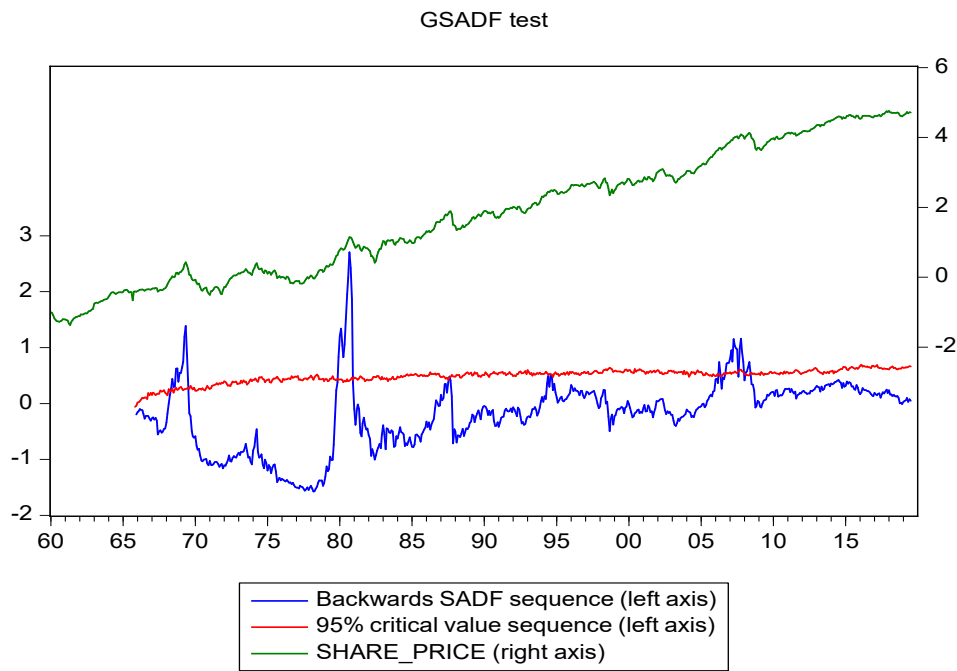


**Figure 2:** *Real estate bubble detection using GSADF*

# 5   Conclusion

This paper contributes to document the episodes of stock market bubbles in South Africa. We used monthly data from January 1960 to July 2019 to identify the timing of bubbles in the stock market. Our empirical methodology applied Phillips et al. (2015)'s GSADF test for explosive behavior detection. We found strong evidence that, overall, South African stock market has been exuberant during the period of January 1960 to July 2019. In fact,

the stock market has experienced three historical bubbles, the first one from April 1968 to July 1969, the second one from December 1979 to November 1980 and the last one from April 2006 to May 2008. The results suggest that the south Africa's stock market has been affected by the 1979 international oil crisis and the 2008 financial crisis. In contrast with Balcilar et al. (2016), our results confirm the finding of Chang and Gupta (2014) that the south African stock market have experienced a bubble during the period 2006-2007. The differences in the results may be related to the measure of prices index. Therefore, an interesting avenue for future research will be to investigate whether the financial bubbles have migrated from the developed countries to South Africa's stock market or the South Africa's stock market bubbles are originated and fueled by internal factors.

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