Forecasting on the Collapse of Rational Speculative Bubble in Hang Seng, Nikkei 225 and S&P 500 in 2018

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Rational speculative bubble is a situation where the price of an asset exceeds its fundamental value. The burst of the rational speculative bubble may cause a negative impact towards the economy. If the bubble burst in the country which act as the world's main economy, it will cause a big impact, and this will also affect the developing countries. Currently, there are no specific way to prevent this bubble from occurring but if the existence is known, several measures can be taken, so that, the impact can be minimized. This study aims to shows the size of the rational speculative bubble in the world's main economy in four cycle. Also, the prediction on the size and the time of the bubbles burst of the fifth cycle will be discuss.

Keywords: economic bubbles; rational speculative bubbles; bubble burst

I. INTRODUCTION

The formation of bubble in the economic, is still unknown. But a lot of speculation arises among economists about the formation of this bubble. These bubbles are known as rational speculative bubbles. Some experts or economists argue that the factors leading to inflation are also factors towards the occurrence of bubbles. The economist assumes that when inflation happen, there are bubbles in the markets and some economist assume that the bubbles is the reason for inflation to be happen. Therefore, it can be said that bubbles and inflation will come together when triggered.

Most of the speculative rational bubble happen in a short du ration which is less than 10 years. The Great Depression that happen in 2008 to 2009 gave a negative impact towards the economy. The main cause of the financial crisis in 2008 was due to the uncontrolled of financial industry. Several banks can engage in the trading of hedge funds with derivatives.

To support the profitable sale of these derivatives the bank then claimed more mortgages. The bank creates interest-only loans, which are reasonable to subprime borrowers. In 2004, the Federal Reserve increased the rate of funds which is the same to the interest rate for resetting new mortgages. Housing prices began to fall as supplies exceeded demand. Homeowners are trapped in this situation because they cannot afford to pay the loan and at the same time homeowners cannot sell the house. This caused the derivative value to collapse, banks stopped lending to one another (Efsun Krm *et al.*, 2014). Finally, this situation triggered the financial crisis that led to the Great Depression.

The study that had be done about the history of bubble should be an example to the developing countries and reminder to the developed countries. No economist can be sure that developed countries will be spared from the threat of bubbles. The study about the speculative rational bubbles is important due to the impact of the bursting bubbles. This is because strong global economic influence for developed countries can influence the economy for developing countries. This statement is supported by (Stasys

Girdzijauskas *et al.*, 2009), stated that the bubble can be transferred from one country to another country because the collapse of the developed country's economy can affect the economic growth of the developing countries. (Michael D. Bordo *et al.*, 2010) also supported this statement by saying that during the banking crisis that took place in two developed countries, United States and German companies in 1974. During this crisis, the Franklin National bank had to close while the Germany Herstatt bank was still able to be saved. This crisis has showed the worst state of the developing countries to overcome this crisis. Thus, it shows that developed countries that hold the world's major economic markets are experiencing economic problems, although they do not affect the country, but they are able to raze the economic market for other countries especially for emerging economies. Thus, this study led to the stock market by the three countries with the largest economies of the world, namely, the United States, China and Japan. The stock markets are S&P 500 (United States), Hang Seng (HSI) (China) and Nikkei 225 (Japan). These three stock markets were chosen because of the economic influence held by these three countries globally. The illustration on the impact of the speculative rational bubbles when it burst is shown on Figure 1.
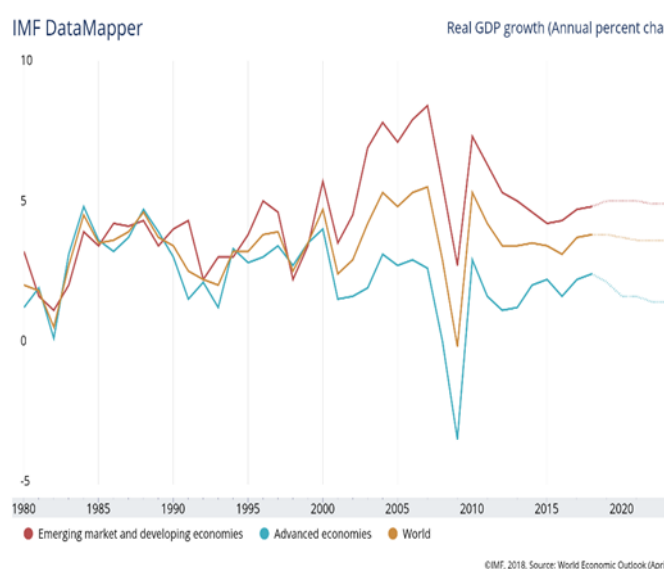

Figure 1. Illustration on Real GDP Growth
Source: http://www.imf.org/

II. MATERIALS AND METHODS

In this study, the generalized Johansen-Ledoit-Sornette (JLS) model is used to find the rational speculative bubble size in the selected stock markets for five cycle (which is about 50 years). Data for the stock market are taken from 1965 to 2018. Then, the data are divided into five cycles, each cycle comprising 10 years. Just for the Chinese stock market, Hang Seng, its first cycle covers 7 years since the market only practiced open economic systems beginning in 1969.

According to (Nurharyanti Borhan *et al.*, 2017), this model was built by Johansen, Ledoit and Sornette to describe about the dynamic of rational speculative bubble and crashes. Generalized JLS model is the best model to find the size of the rational speculative bubble. This can be shown by a study by (Nurfadhlina Abdul Halim *et al.*, 2014). They conduct an analysis of the difference between generalized JLS model and standard JLS model. This analysis shows that generalized JLS model is a better model because standard JLS model just detect the financial bubble and forecast the period of the bubble collapse. However, the generalized JLS model can identify the period of bubble collapse and estimate the fundamental value of the bubble collapse.

In other study that was done by (Nurfadhlina Abdul Halim *et al.*, 2015) managed to find the size of the rational speculative bubble for Hong Kong market during year 2008. This study showed that generalized JLS model is the best model to determine the size of the rational speculative bubble. The bubble size obtained was in line with the economic collapse that occurred in Hong Kong in 2008.

By using generalized JLS, the intrinsic value can be estimated. This model not only can estimate the intrinsic value but also can detect the time of bubble crash and as well as crash non-linearity. This is the reasons generalized JLS model is preferred compared to the standard JLS, that only can identify and predict the financial bubbles and crash (Vincenzo Liberatore, 2010). The generalized JLS model can be shown as Equation 1.

$$p(t) = p_1 + exp(A + B(t_c - t)^\beta \{1 + C \\ cos\ cos(\omega\ log\ log(t_c - t) + \varphi)\})$$

(1)

Equation 1 is used to forecast the size of the rational speculative bubble for a time. Where $p(t)$ is the price for the time t. p_1 is the intrinsic value and $exp\ (A+\ B\ (t_c-\ t)^\beta\ \{1\ +C\ cos\ (\omega\ log\ (t_c-\ t)+\ \varphi)\})$ refers to the size of rational speculative bubble size or also known as $exp\ (FT_{\_LPPL})$. In this study, only $exp\ (FT_{\_LPPL})$ is used to estimate the size of speculative rational bubbles for major world markets which are HSI, S&P 500 and Nikkei 225. Equation 2 shows the equation of the rational speculative bubble size that referred as $h\ (t)$.

$$h(t) = exp(A + B(t_c - t)^\beta + C\ cos\ cos(\omega\ log\ log(t_c - t) + \varphi))$$

(2)

In Equation 2, $A, B, C, t, \beta, \omega$ and φ are the parameters where A, B and C are the linear parameters and t, β, ω and φ are the nonlinear parameters.

The value of ω was found by using three consecutive peaks. The notation for the peaks is h, n and f where $h<n<f$ (Nurharyanti Borhan et al., 2018). The formula to find ω is $\omega = 2\pi\backslash ln\ \rho$ where $\rho = (n-h)\ \backslash\ (f-n)$ and to calculate the value of φ, the formula of $\varphi = \pi- \omega\ \backslash ln\ (t_c-t)$ was used. The illustration on the calculation of ω value is shown in Figure 2.

Figure 2. Illustration of the election of the consecutive

peaks

Source: (Nurharyanti Borhan et al., 2018)

The resulting value of ω by using the method of finding the value of three consecutive peaks is more than one. To find the best ω value, each ω value will be tested to get the value of another parameter and then the size of the bubble. The best ω value is selected when it is able to determine the bubble size that has a small Mean Absolute Percentage Error, MAPE.

The value of A, B and C can be estimate by using Ordinary Least Squares (OLS) method as shown in Equation 3 (Spela Jezernik Sirca et al., 2017).

$$\sum_{t=t_1}^{t_n} (ln\ lnp_t f_t\ ln\ lnp_t g_t\ ln\ lnp_t)$$
$$= \sum_{t=t_1}^{t_n} (1 f_t g_t f_t f_t^2 f_t g_t g_t f_t g_t g_t^2)(ABC)$$

(3)

The system of the Equation 3 is rewrite in the matrix form as $X^T y = (X^T X)\ \beta$, where

$$X = (1 f_t 1 g_t 1 \ldots \ldots 1 f_t n g_t n), y = (ln\ lnp_t 1 \ldots$$
$$ln\ lnp_t n)\ and\ \beta = (ABC)$$

(4)

Then, the solution of $\hat{\beta}$ is given by $(X^T X)^{-1} X^T y$. The linear parameter which are A, B and C are solved by using $\hat{\beta}$ formula.

III. RESULTS AND DISCUSSIONS

Table 1. Result on the Size of Speculative Rational

Bubble and MAPE

Cycle	First (1965-1975) (Size, MAPE (%))	Second (1976-1986) (Size, MAPE (%))	Third (1987-1997) (Size, MAPE (%))	Fourth (1998-2008) (Size, MAPE (%))	Fifth (2009-2018) (Size, MAPE (%))
S&P 500	113.91, 12.35	190.37, 1.39	871.27, 1.48	1521.47, 9.3	3000.96, 3.4
Nikkei 225	2967.68, 2.87	11375.95, 2.05	17896.69, 1.22	20090.86, 8.86	19691.1, 1.54
Hang Seng	1003.75, 3.83	1588.92, 2.94	15223.79, 0.3	17145.86, 3.14	24358.75, 1.17

Table I shows the size of rational speculative bubbles for S&P 500, Nikkei 225 and Hang Seng Index Market for the five cycles. From the table, the size of the rational speculative bubble was increased from one cycle to another cycle. The Great Depression happened in Cycle four,

although the bubble has burst, it does not mean that the bubble will not happen again. From the increasing size of the rational speculative bubbles, it can be said that, the economy is not in good condition.

(Kimberly Amadeo, 2017) said that the financial crisis happened in 2009 was a worst financial crisis after the great recession in 1929. As we can see in Table I, for Nikkei 225, the bubble size for the fifth cycle is less than the fourth cycle (which the worst financial crisis happened). This shows in early cycle of the fifth cycle, the post-recession still happened. This mean, the Nikkei 225 still in the state of recovery. The size of bubble in fifth cycle is less than the fourth cycle while first cycle to fourth cycle shows an increase from one cycle to another cycle. This might be because of the fifth cycle is still not fully viewable because the data taken for every stock market is until June 2018 and is not ending in December 2018.

Different things happened in the stock market which Hang Seng and S&P 500, the bubble sizes are increasing from one cycle to another cycle. Although the financial crisis happened globally, but its impact on each country is different. This also proves the fact from (Stasys Girdzijauskas *et al.*, 2009) and (Michael D. Bordo *et al.*, 2010) before. The economic crisis that took place in the fourth cycle did not have a major impact on the US and China. Consequently, stock market prices for the country continue to rise as well as the size of the rational speculative bubble.

The MAPE value obtained in this study shows that the generalized JLS model is successful in predicting the value of the rational speculative bubble size for the three selected stock markets. The small MAPE value also proved the statement of (Nurfadhlina Abdul Halim *et al.*, 2014), that this generalized JLS model is the best model for finding and predicting the size of the rational speculative bubble.

IV. SUMMARY

There is no proved showing that by taking an action, bubbles will disappear but at least when the size of the bubble is known, the community can take precautionary measures to minimize the impact that will be encountered. In this study, it is shown that the Generalized Johansen-Ledoit-Sornette model succeeded in forecast the size of the rational speculative bubble with small MAPE size.

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