



USING ARIMA MODEL TO PREDICT THE CHANGE OF STOCK PRICE OF VINAMILK JOINT - STOCK COMPANY FROM 2016 TO 2018

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Abstract: The paper used ARIMA model to predict the change of stock price of Vinamilk joint-stock company. The stock price data have investigated from 2006 to 2015. Because this chain of figures was non-constant, we made most difference of the figures. Then, we got new chain of figure whose fluctuation trended around the average. Also, when looking into auto-correlation diagram and partial correlation diagram, after making the most difference, we got figure chain that had stationary because the figure fluctuated around the fixed average. Then, we continually used stata 12 software and determined ARIMA (0,1,1) model was the most suitable model to predict stock price of Vinamilk joint-stock company in the future. The results showed that the stock price of Vinamilk joint-stock company have tended to increase and stable in the next few years, with the increase level from 100 to 140. The result can be used as foundation for the investors who can feel secure for investigating for this stock.

Keywords: stock price, predict, ARIMA model, Box - Jenkins methodology

1. INTRODUCTION

Prediction plays important role in investment, especially in stock investment. Base on the prediction, the investor and planner will make the decision, plan and strategy. When the making stock investment, which has profitable and risk characteristic the investors usually use the large (even huge) amount of money, so that they are very interested in stock price movement prediction. If the price movement prediction is correct, it will make the success. On the contrary, it will make the loss even bankrupt. With respect to Vinamilk joint stock company (Vinamilk) - stock code is VNM - the price has been increased over the years. Vinamilk is appreciated as the best stock in Vietnam in basic and long term aspect. However, to reassure the investors when joint into the eventful stock market, our group have chosen the topic "Using the Arima model to predict the change of stock price of vinamilk joint stock company from 2016 to 2018". The topic has analyzed the stock price of Vinamilk on the market to make the prediction of the stock price and stock price trend in the future and find out the high productive ability. It is one of the most important content - determine which period of stock price development cycle - to help the investors have reason to consider before deciding stock investment which has the most effective.

2. THEORY BASIC AND STUDY METHOD

2.1. Theory basic

2.1.1. Some related concerns

- Stock: the certificate that confirms legal rights and benefits of those who own the stock to the property or capital of the issue organization, included: stock, bond, stock investment fund certificate and others stocks according to law regulations.

- Stock exchange (SE): the place of trading medium and long term stock, mostly stock and bond. In developed countries, the activities of SE mostly have done in centralize market, or stock trade department. Transactions that have done outside of the stock trade department are called over the counter (OTC). From the point of view of macroeconomics, SE is the important mobilize channel in the economy. With the investor, SE is the attractive investment channel beside others choices such as: bank deposit, gold, foreign currency, immovable...

- Holdings: the shares certificate in a company. It presents for the ownership part of this company. The person who owns the holdings is called shareholder and will be shared the profit or be bearded the loss of the company in percent of his holdings. The stock value of the company is reflected by the holding price on SE.

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Commonly, holding price will increase when the company has successful business and vice versa. The holdings on SE is the one which are posted a bill and traded. The over the counter (OTC) is the one which do not meet the requirement to be posted a bill or have enough requirements but are not posted a bill on SE. Holdings on SE have been selected, they have clearer and more adequate information than OTC. When comparing savings and bond, investing on holdings have more potential profit by far but higher risk level.

- Stock index: this is the meter of the average price of the trade holdings on the market. The investors could base on the stock index to define the effective of the investment.

2.1.2. The theory of ARIMA model

The topic has used the Autoregressive Integrated Moving Average (abbreviated to ARIMA) which was introduced by George Box and Gwilym Jenkins in 1976 (abbreviated to Box-Jenkins). This is the model for analyzing and predicting time chains, including:

- The model of p-degree auto-correlation, abbreviated to AR(p), is the model which describes linear dependent process on the late variables and random error. It is:

$$Y_t = \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + \dots + \varphi_p Y_{t-p} + \delta + \varepsilon_t \quad (1)$$

- The model of q-degree moving average, abbreviated to MA (q), is the full description process by linear with the weight of the current errors and its late values were described as:

$$Y_t = \mu + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \theta_2 \varepsilon_{t-2} - \dots - \theta_q \varepsilon_{t-q} \quad (2)$$

- The model of auto-correlation integrates with moving average has ARIMA form (p,d,q), is formed base on the integration of process (1) and (2) in. The general equation is written as:

$$Y_t = \varphi_1 Y_{t-1} + \dots + \varphi_p Y_{t-p} + \delta + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \dots - \theta_q \varepsilon_{t-q} \quad (3)$$

2.2 Study method

2.2.1 Previous studies

Long-ago, ARIMA model was used widely to determine fluctuation trend of the studied object, and give prediction to make decision, policy. On the field of stock price prediction, there were several studies about this topic. Following, we introduce experimental researches which have been done on stock price prediction. Bui et al., (2010) used ARIMA model to predict the increasing or decreasing of VNINDEX stock price. It helps the investors know catch the trend of price fluctuation of holdings kinds on this market, and then make the most effective investment decisions. VN-Index data from 02/01/2009 to 30/3/2010 had 310 observed. The study used Dickey-Fuller testing to check the stationary of data chain, LB testing to check surplus, minimum square method to estimate model's parameters. The result found out suitable model for prediction was ARIMA (0.1.1) with 95% confidence. The prediction value estimated the real value. This proved that ARIMA model was effective in prediction and prediction value relatively accurate. However, this result was preference because aside from data information of stock price in the past, there were several factors which influenced stocks price which were not concerned such as investors' physiology, information of macroscopic policy change, business policy... Though, the study provide information for the investors, planners when making investment decision or determination. It also shows that effective application of ARIMA model in prediction.

Vu (2012) studied on method of exploit time chain in stock prediction. The general aims of this study were examining concept, role, application and techniques of data exploit, time chain data analysis in data exploitation applying in prediction in general and in SE prediction in particular. In this study, Vu applied ARIMA model to predict the increasing and decreasing of SE based on the data of 03 holdings codes: VNIndex, ABT, ACB. The data were taken from 21/8/2012 to 10/9/2012 and were used to predict closing prices for 10 following days. The study used closing prices of holdings codes in short time. Graph method was used to test stationary of data chain. Autocorrelation graph was used to recognize the model. The result from the study was accurate with reality (low error, from 0% to 2,25%). Although the study carried a heavy load in application technical method, the prediction was an examination research to Lear model theory. The result from this study proves that ARIMA model are effective and widely used in economy prediction, investment.

Those above studies once again affirm the effective application of ARIMA model in stocks prediction. The models was built simply, made easily and the result relatively accurate. However, the prediction model still has some limitations such as: this is a technical analysis model, it cannot make accurate prediction because it



only depends on 01 variation - time, whereas the prediction process depends on many elements. Though, those studies open deeply research direction that is building ARIMA model with multi-variable so that stock price index depends on different variable.

2.2.2 Data collection method

The data in this study was collected from SE from 2006 to 2015. The data were analyzed on Stata software.

2.2.3 Research method

The study found and analyzed financial data, stock data that related to the researching stock. After that, we used Stata software to determine the suitable ARIMA model, made the stock prediction and evaluated predicted result. This method includes 04 steps: identify testing model, estimate testing model, verify diagnose and predict.

Step 1: identify testing model: ARIMA model only apply for stationary chain. Model could be present as AR, MA or ARIMA form. The method to specify model is usually done by researching change direction of autocorrelation function ACF or partly autocorrelation function PACF.

Note: in this step, non-constant data chain has to be changed in to stationary chain before making the estimation of minimum square parameter. This change is done by calculating difference between observe value base on the assume that the different parts of time chain count as similar, except for the difference at average value. If this change is not successful, we will apply other change methods (such as logarithm change).

Step 2: estimating parameter: calculate starting estimate for the parameters: $a_0, a_1, \dots, a_p, b_1, \dots, b_q$ of the intended model. After that, building finally estimates by repeated process.

Step 3: Testing: after the parameters of general model are built, test the measure accurate and suitable of the model with the data. Testing the odd ($Y_t - Y^t$) and meaning, also the relation of parameters. If there is unsatisfied test, the model will recognize the above steps and do again.

Step 4: Predicting: when the model suitable to finding data, we will make prediction at the next time.

3. RESULT AND DISCUSSION

3.1 Primary introduction about Vinamilk Joint Stock Company (abbreviated to Vinamilk)

3.1.1 Beginning history of Vinamilk

After nearly 40 years of foundation and development, with brave in changing mechanism, wait in front for applying new technology, breakthrough, promote creative dynamism of a team, Vinamilk have grown and became economy light spot in the period of joining into WTO. Vinamilk have become one of the leader businesses in Viet Nam in all aspects; contribute to the development of Viet Nam and Vietnamese people.

Vinamilk was established on 20/8/1976, based on taking over 03 milk factories of the old regime:

- Thong Nhat milk factory (precursor is Foremost factory)
- Truong Tho milk factory (precursor is Cosuvina factory)
- Dielac powdered Milk factory.

After two years (in 1978), the company was moved to food product industry department for management and the company's name was changed to I sweet and milk coffee conjugate company. In 1992, it was changed into Viet Nam Milk Company belonging to directly manage of light industry Ministry.

In 1996, it made joint venture with Quy Nhon freezing joint stock Company to establish Binh Dinh milk joint venture Company. This joint venture made the good condition for the company to successfully penetrate Middle region of Viet Nam

In 2003, marking an important landmark is the establish of Vinamilk joint stock company based on the decision number 155/2004 QĐ-BCN on 01/10/2003 of the industry Ministry about changing state-owned business Viet Nam milk company belonging to industry Ministry to Viet Nam milk joint stock company.

In 04/2014: the company merged Saigon milk factory (SAIGONMILK), increased total charter capital of the company to 1.509 billion dong.

In 06/2005: the company bought contributes money of partner in Binh Dinh Milk Company and merged in to Vinamilk. Stocks of Vinamilk officially traded on stock trade center of Ho Chi Minh city on 19/01/2006 with 159 million stocks posted a bill.

In 09/2007: bought holdings and controlled 55% of Lam Son milk company

In 2008: inaugurated Tien Son milk factory in Ha Noi

In 09/2009: inaugurated cow farm in Nghe An

In 2010: made joint venture to build milk processing factory in New Zealand with the contributed capital at 19,3 charter capital. Received transference 100% capital from Vietnam F&N company, change name into Vietnam



powder milk. Bought 100% of remain holdings in Lam Son milk company. Inaugurated and operated soft drink in Binh Duong

In 06/2012: Operated Da Nang milk factory

In 2013: became parent company (96,33% charter capital) of limited liability Thong Nhat Thanh Hoa cow company. Bought controlling holdings (70%) at Driftwood Dairy Holding Corporation (California, Mỹ)

3.1.2 Business activities of Vinamilk

According to the choice results of the 100 strongest brand names, Vinamilk is the numer 1 of food brand name of Viet Nam. It holds top market share, reaches development rate at 20 - 25% per year. It was trusted by the customers and was chosen the top product of Vietnam high quality products for 8 years (from 1997 to 2004). Domestic sale increases in average 20-25% per year. Vinamilk maintains the leading role in domestic market and effectively competition with foreign milk trade name. One of Vinamilk success is that diversifying products to satisfy the needs of every target customer: baby, children, teenage, adult, people with special need.

The current market share of the company is more than 50% in Viet Nam milk branch. It has market capitalization value at second place in Vietnam stocks market

Table 1: Business activities of Vinamilk from 2005 to 2015

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Growth rate	CAGR
Total revenue	5659	6289	6675	8381	10820	16081	22071	27102	31586	35187	40223	7.1	22%
Profit Before Tax	603	663	955	1371	2731	4251	4979	6930	8010	7613	9367	15.5	32%
Profit After Tax	605	660	963	1249	2376	3616	4218	5819	6534	6068	7770	12.2	29%
Total Asset	3898	3610	5425	5967	8482	10773	15583	19698	22875	25770	27478	7	22%
Total Equity	2247	2684	4224	4666	6455	7964	12477	15493	17545	19800	20924	9.3	25%
The Debt	1651	917	1201	1301	2027	2809	3105	4205	5307	5970	6554	4	15%

Source: Vinamilk financial report

Over the years, sale development level and profit of the company increase regularly. In 2015, the company got remarkable increasing level.

Total revenue achieved 40.223 billion dong, increasing 14% when comparing with 2014 and reach 105% comparing to the plan of shareholders general assembly.

Profit before tax achieved 9.367 billion dong increasing 23% when comparing with 2014 and reach 114% comparing to the plan of shareholders general assembly

Profit after tax achieved 7.770 billion dong increasing 28% when comparing with 2014 and reach 114% comparing to the plan of shareholders general assembly.

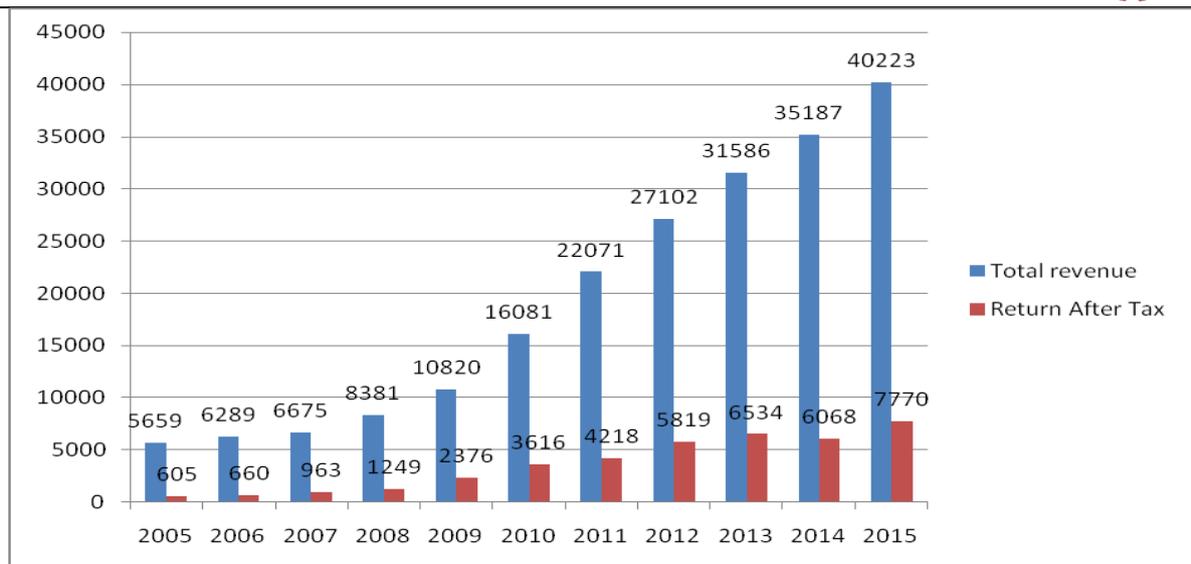


Figure 1: Graph of the development of revenue and profit of the company From 2005 to 2015

Source: Vinamilk financial report, 2005-2015

In general, revenue and profit of Vinamilk have increased regularly over the year with high and stable level. Vinamilk is setting the aim to reach 3 billion USD revenue and get into the Top 50 biggest milk companies in the world in 2017. Vinamilk was chosen by Forbes magazine in the Top 50 company having the best of posting a bill.

Although the stock market background of Vietnam in 2015 had fluctuation, vinamilk stock price have been stable and developed strongly. It takes effective part in the stable and development of stock market, brings benefits for the country, shareholders and workers.

In 2016, the progress of innovation and integration of Vietnam economy, especially TPP agreement becomes effective, will open many chance but also set up difficulties for businesses in Viet Nam, vinamilk in there. In order to complete 2016 plan, target plan of 5 years 2012 - 2016, holds fast to vinamilk branch name is the leading business of Viet Nam, gets into the Top 50 biggest milk companies in the world in 2017, in the violent compete background, it needs the high determination and try the best of Vinamilk leader and employee.

3.2 Prediction of stock price of Vietnam milk joint stock company (Vinamilk)

3.2.1 General about the prediction figures

The used figures in this study are the stock price of Vinamilk (stock code VNM) from 2006 to 2015:

Table 2: The stock price of Vinamilk from 2006 to 2015

Number	Year	Price	Fluctuation
1	2006	125	
2	2007	166	32.80%
3	2008	83	-50.00%
4	2009	75	-9.64%
5	2010	86	14.67%
6	2011	86.5	0.58%
7	2012	88	1.73%
8	2013	135	53.41%
9	2014	95.5	-29.26%
10	2015	128	34.03%

Source: Vinamilk financial report, 2005-2015

In general, VNM stock price fluctuated (increase-decrease) irregularly over the years. The most decreasing is in 2008 (50% decreased) and the most increasing is in 2013 (53% increased).



3.2.2 Testing the stationary of prediction chain

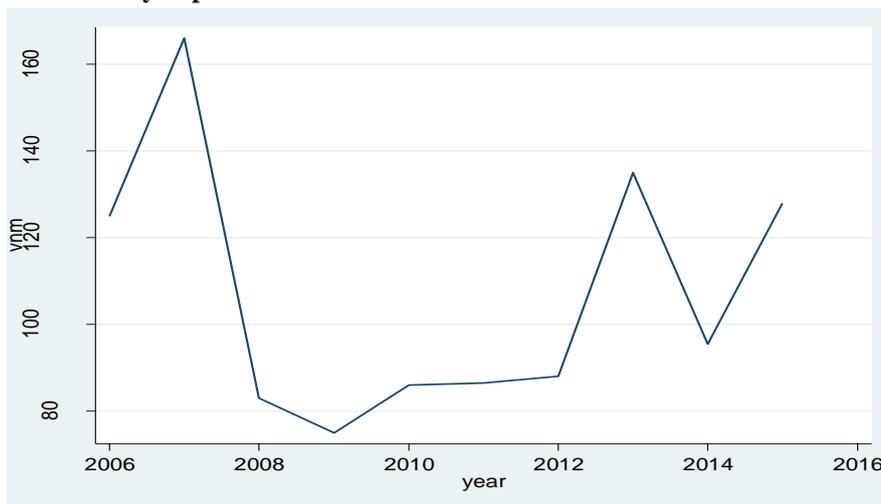


Figure 2: The fluctuation of VNM stock price from 2006 to 2015

Source: Vinamilk financial report, 2006-2015

Figure 2 presents the situation that the fluctuation of VNM stock price over the years has an unstable trend. Figure 3 has a sine graph form but irregular and has an increase-decrease trend in period. From the figure, we could assume that the chain data of VNM stock price is a non-stationary chain.

This data chain is similar to all most economic data chain (at beginning) which doesn't have stationary (the chain has average simple and variance change by time). To repair, we can make a difference so that the time data chain will become the stationary chain. (Q. Giam et al., 2009)

Stationarity is viewed as a tool to analyze data chain which has characteristics over time. To make the used model have an unshakable statistical meaning, the data time chain has to be tested stationary. A time data chain is stationary when the figure is random which has average sample and variance constant over time. The data chain which is used in the ARIMA model is assumed stationary. So, to predict stock price of the company in following years, we have to test whether the data chain used in the model is stationary.

Besides, we might use a correlogram, autocorrelation function or partial autocorrelation function as a basis for the above explanation.

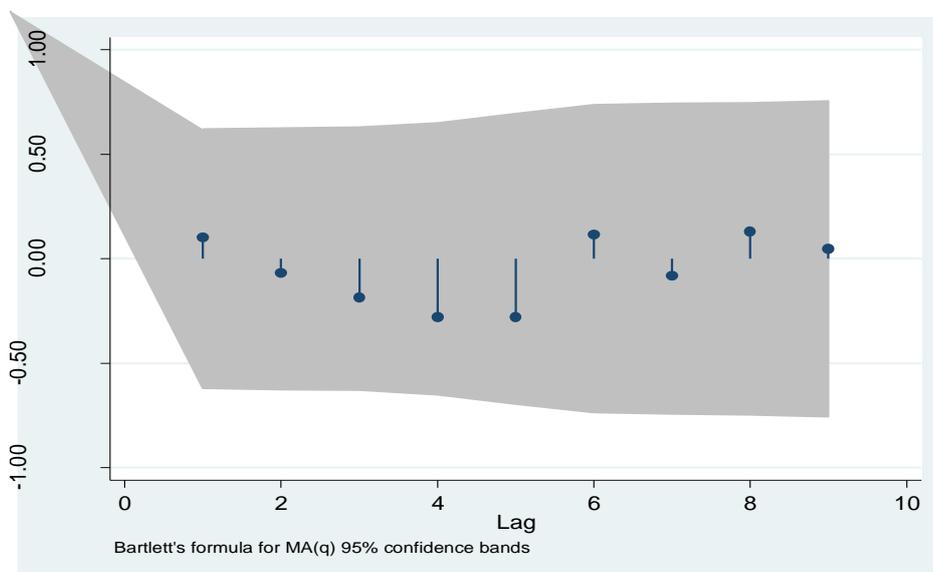


Figure 3: Autocorrelation Function (ACF)

Source: Stata results

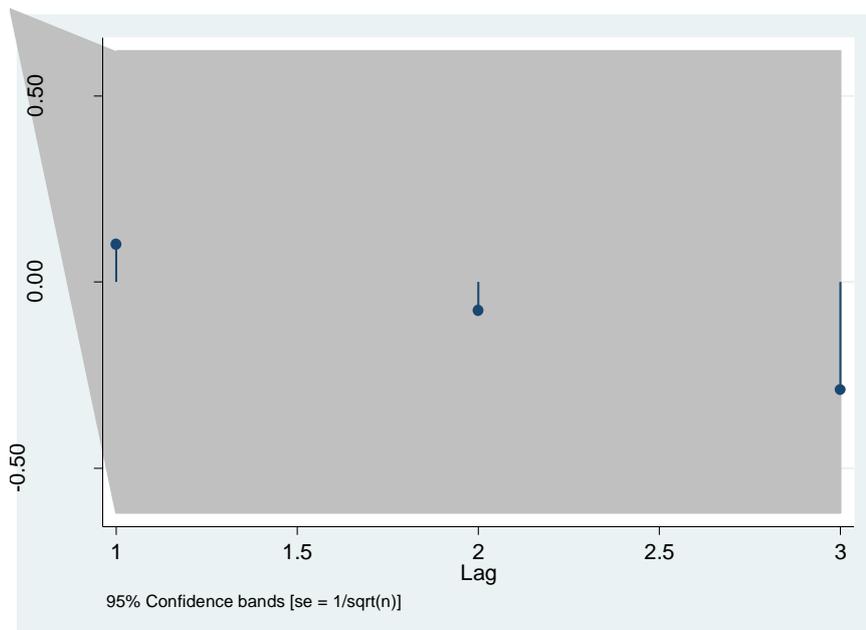


Figure 4: Partly Autocorrelation Function (PACF)

Source: Stata results

However, after making difference first degree of the data chain we get new data chain, VNM stock price fluctuation have trend of turning around an average value (figure 4). This is the evidence of stationary data chain.

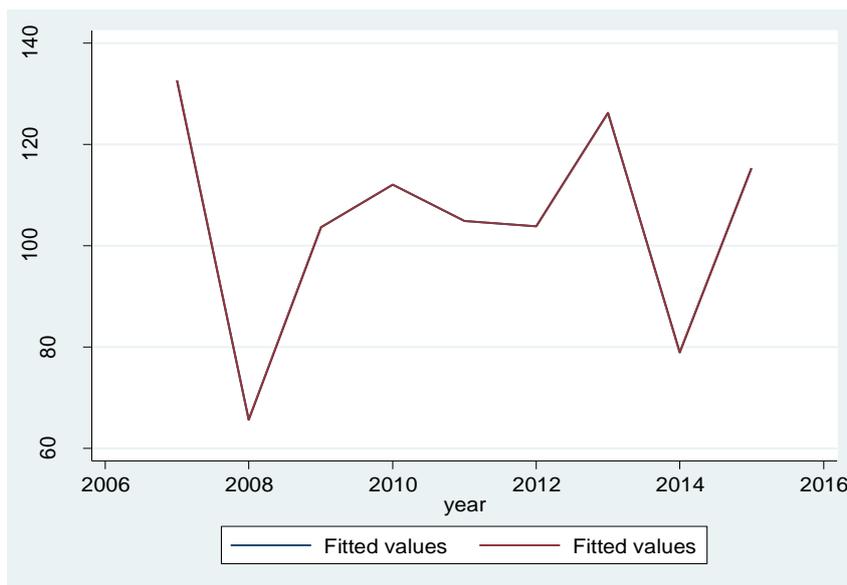


Figure 6: Stationary chain after making difference first degree

Source: Stata results

Moreover, looking in to the ACF and PACF after making difference first degree, we get stationary data chain because the data fluctuation around certain average value.

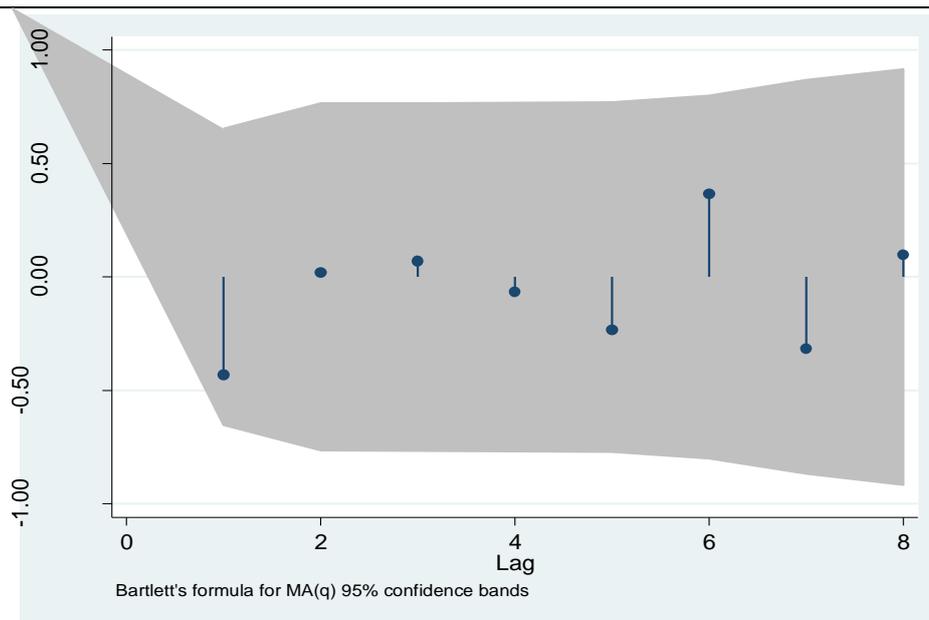


Figure 6: Autocorrelation function after making difference first degree

Source: Stata results

3.4 Building ARIMA model for Vinamilk' stock price

In order to build the ARIMA model, we use data chain including 10 views from 2006 to 2015

Step 1: Identification (determine p, d, q value)

In the above section, we have VNM stock price chain have stationary at difference first degree, so $d=1$

To determine p, Box and Jenkins (1976) suggested identification method as: a stationary data chain has p degree autocorrelation if (i) the autocorrelation coefficients decrease gradually as hat sharp or sin form, (ii) the partly autocorrelation coefficients decrease suddenly to 0, meaning after p lag.

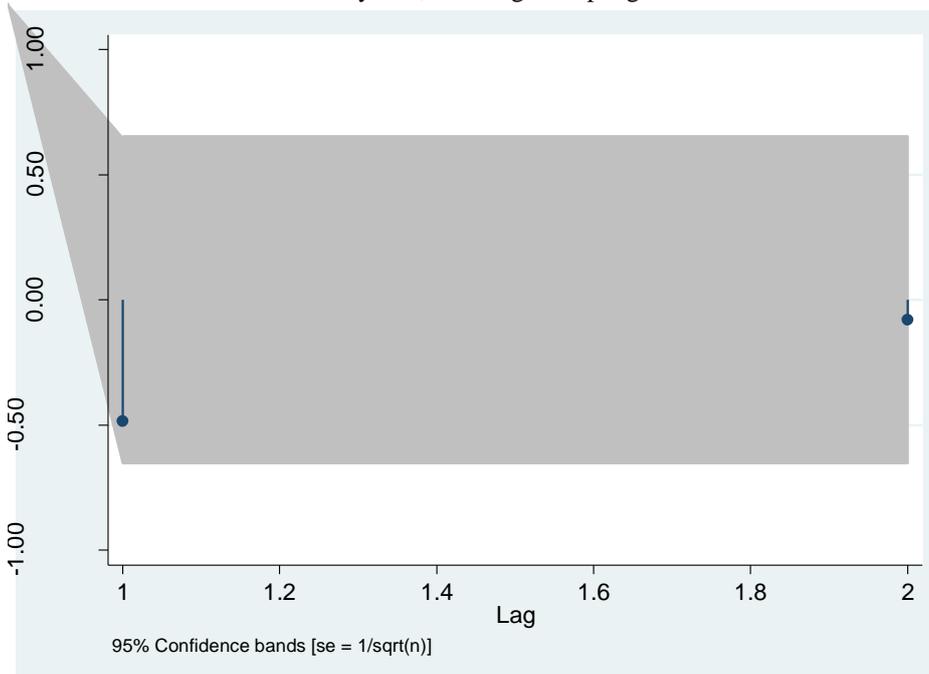


Figure 7: PACF after making difference first degree

Source: Stata result



Figure 7 shows the PACF of FDA chain. It shows that there is a coefficient different from 0 and meaningful at 1 lag. It decreases suddenly to 0 significant. So, p gets value 1 or 0

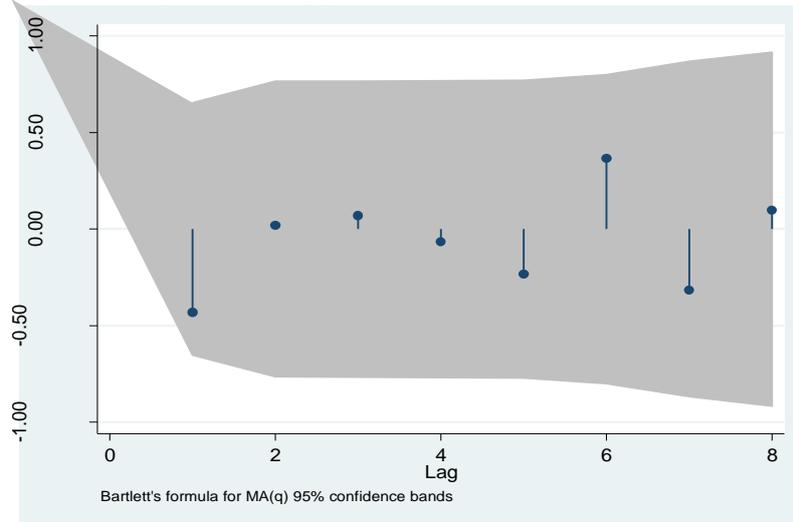


Figure 8: ACF after making difference first degree

Source: Stata result

Similarly to p determination, looking into the autocorrelation function of stock price chain, we know that p might get 1 (Figure 8)

As a result, there are two ARIMA possibly suitable: ARIMA (0,1,1) and ARIMA (1,1,1)

Step 2: Estimating model

Using Stata software to estimate the coefficient ARIMA (p,1,q) as we identify above.

Step 3: Testing

To test the suitable characteristic of the model we base on the Schwarz standard (BIC) and root mean square error (RMSE) which are as few as possible. After estimating ARIMA models we have the collective statistic results: (table 3)

Table 3: collective statistic results standards of testing ARIMA models

ARIMA model (p,d,q)	BIC	(R ²)	RMSE
(1,1,1)	89.50717	0.4739	25.841
(0,1,1)	88.16524	0.4739	25.841

Source: Stata result

So, ARIMA (0,1,1) is the most suitable model because it has the BIC value smaller (RMSE of 2 ARIMA models are equal)

Step 4: Prediction

The prediction for the following years of VNM stock price base on the ARIMA model (0,1,1) shows as following graph

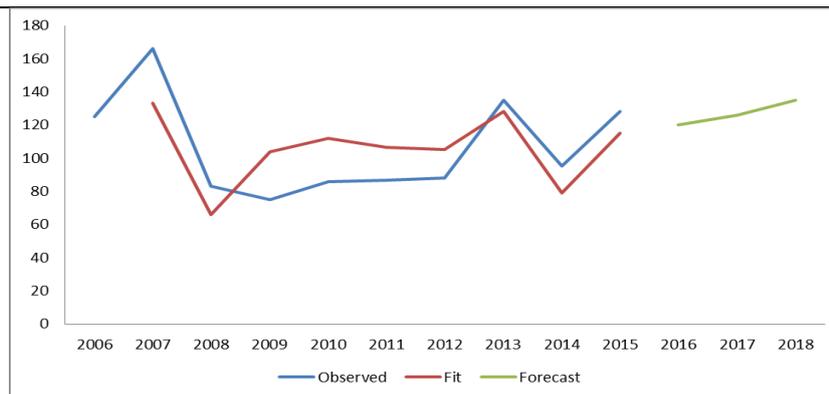


Figure 9: Result of VNM stock price prediction from 2016 to 2018

Source: Stata result

In sum of, Vinamilk stock price has increasing trend and stable over year with the increasing level from 100 to 140. This result might be used as basic for the investors so that they feel secure when continually investing for VNM stock.

4. CONCLUSION

The paper describes VNM price stock from 2006 to 2015 and successful in using ARIMA (0,1,1) to predict the price fluctuation of VNM. The prediction paper about market index of Vu Thi Guong “Exploiting data time chain technique applying in stock prediction” has been applied effectively, could help the investors predict the decrease-increase ability of stock kinds in the market. However, Vu Thi Guong applied theory basic examining on three stock chain (VNIndex, ABT, ACB) base on the history data of each chain (including 257 views in the past) and predicted closing price of 10 following days, applying sort term. Our study conducted on data of each year, so the prediction and the data will reflect the long term fluctuation, not only in short term but also many years afterward. This will help the investors use the prediction to make decision on which stock has better trend. Also, our research used Stata software - which is stable and become popular in quantitative research. Besides, the result from the prediction model could help the managers make the general judge on competition situation of the stock companies in following time. However, to make VNM stock price strong, the managers have to set the stable development goals. Operation risk have to be managed, judged, defined timely the issue and repaired. A comprehensive plan has to be done including: improving and enhancing company manage, building up effective working framework of organization with the manage practice and mordent process.

Vinamilk have domestic production activities, diversified distribution, effective marketing program, effective catching market needs, product development catch the market requirement. The reckless but effective steps in enhancing distribution activity and quality of service have brought the remarkable result.

In farm field, Vinamilk has the policy of developing professional cow farms system, suitable to international standard and Vietnam law. The products are quality ensured, food safety and suitable competitive price, asymptotic to the international average producing price.

Continually promoting the commitment on safety working condition and health care, diversified development staff, respecting on difference, without discriminatory treatment, ensuring the rights as assign in law, labor value is recorded and compensate, staff developing.

Keep the commitment and guideline: “Vinamilk commit bringing to the society the top high quality nutrition source by the respect, love and high responsibility for human life and society”.

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