

CHAPTER I

INTRODUCTION

A. Research Background

Fuzzy Inference System is a model to taking step in an uncertainty. Fuzzy is a process to change the real input (crisp) become linguistic variable with the use of membership function. Fuzzy Inference System give a model to help the decision making process. (Brown and Harris, 1994). Fuzzy Inference System is needed because as a human, we always face the uncertainty. As an investor, reduce the uncertainty is very beneficial because can reduce the risk or maybe can raise the profit. The others benefits of fuzzy are reflect the knowledge of the designer or expert, give the smooth transition among fuzzy membership, and easy to calculate.

Fuzzy Inference System used when someone faces the uncertainty and when someone wants to establish a model to help the decision making process. In this research, the decision-making is about decision making about stocks. Fuzzy Inference System can be used in any field of study. Actually, Fuzzy Inference System is from IT field, or Computer Engineering, and Industrial Engineering. As the time goes by, many developments occur in this model and in the next development it can be used in the financial field of study.

In Financial field of study, people who usually used this model are people who always get some problem with decision-making. For example Investors (in

term of stocks), usually they face some problem with decision to buy, hold, or sell their stocks. Not only for the Investor, but also Company itself can be used this model to forecast something, for example forecast the future price, the quantity or amount that must be produced. Fuzzy Inference System can be make with some steps, there are: Crisp Input, Fuzzification, Reasoning, Defuzzification, and Crisp Output result. Further information will be explained later.

Financial market is an institutional mechanism created by society to channel savings and other financial services to those individual and institutions willing to pay them. (Rose, 2000, p.4). The flow of funds through financial markets around the world divided into different segments, depending on the characteristic of financial claims being traded and the needs of different investors. One of the most important divisions in the financial market is between money market and the capital market. (Rose, 2000, p.10). Money market is the institution set up by society to channel temporary surpluses of cash into temporary loans of funds, one year or less to maturity. (Rose, 2000, p.10).

Capital market is the institution that provides a channel for the borrowing and lending of long-term funds (over 1 year). The capital market is designed to finance long-term investments by businesses, governments, and households. Financial instruments in the capital market have original maturities of more than one year and range in size from small loans to multimillion-dollar credit. (Rose, 2000, p.11).

Capital market trade financial instruments like stocks, bonds, warrants, rights, and various derivative products such as call and put options. Capital market

is expected to increase the economic activity because capital market is the funding alternative for the companies so that the companies can operate with the bigger scale and can increase the income of the companies and society wealth. (Darmadji and Fakhruddin, 2001, p.2). The advantages of capital market are expected that capital market can provide the long-term funding for the investment and enable the allocation of funding source optimally. Second, gives the investor a chance to invest and enable the diversification. Third, provide leading indicator for the economic trend in that country. Forth, spread the ownership of the companies until the middle class of the society. (Darmadji and Fakhruddin, 2001, p.2).

In Indonesia, Bapepam (Badan Pengawas Pasar Modal) is the highest authority in capital market. Bapepam make a supervision and coaching in capital market. In structural, Bapepam located below the Minister of Finance. The structure of capital market in Indonesia shown below:



Figure 1. Indonesian Capital Market Structure

Source: IDX

Indonesian capital market continues to expand amid changes in domestic and international economic and political landscapes. Anticipating those changes and ever-stronger globalization force, Indonesian capital market needs strategic directions as to solidify its position and role in the national and regional economies. In the last decade, Indonesian capital market has fluctuated significantly in the midst of political and economic dynamic in Indonesia. This market fluctuation is going on within an environment where international financial market shows rapid progress. Therefore, it is very important for Indonesian capital market to redefine what it plans to pursue in the future relative to global market development.

There are two types of capital market investor: Investor and Speculator. An investor is a party that makes an investment into one or more categories of assets with the objective of making a profit. (www.en.wikipedia.org/wiki/investor). This investor is a capital market investor who invests in long-term. On the other hand, speculator is a party that trade (buying, holding, selling) and short-selling of stocks, bonds, commodities, currencies, collectibles, real estate, derivatives, or any valuable financial instrument to attempt to profit from fluctuations in its price irrespective of its underlying value. (www.en.wikipedia.org/wiki/speculation). Speculator will trade in the short-term condition.

In Indonesia, not only investor or stockholder invests in Indonesian capital market, but also many speculators in Indonesian capital market. Many speculators

only take the benefit or advantage in trading. They are not concern in the wealth of the companies, the future of the companies, or only take the *profit taking*. Therefore, in Indonesia short-term forecasting hardly to implements because many speculator using fundamental analysis. Moreover, this research focuses on the long-term forecasting. However, the prediction in the Indonesian capital market still important since it is very useful for long-term investment or maybe for the real investor.

Price prediction is very important. Many market decision problems involve some anticipation or forecast of future prices. If we can predict the price prediction we can anticipate what happen in the future price so we can make a better decision. Moreover, if we make a better or right decision, it can improve the performance of the company and can improve the wealth of investor.

In the real world, the market will not really efficient or inefficient overall. More rational if the market is seen between them, where every decision and the events are not always directly affect the market. If all market participants believe that the market is efficient, no one will find a tremendous advantage, which is the main force to make the wheels of capital markets continue to run.(
<http://www.mahadanalearning.com/2nd/index.php/artikel/pasar-modal/131-efisiensi-pasar-apakah-it.html>).

There are investors that continually managed to beat the market, such as Warren Buffett, in which investment strategy focuses on undervalued stocks. These strategies are succeeded in generating billions of dollars, and give him many followers. There an investment manager who has a better record than any

other does, and there are securities that do more research than others do. Therefore, it is wrong when people said that performance could be random or unpredictable when there are obviously people are getting profits and beat the market. (<http://www.mahadanalearning.com/2nd/index.php/artikel/pasar-modal/131-efisiensi-pasar-apakah-itu.html>).

Studies in behavioral finance said that there are some predictable patterns in stock market. Investors tend to buy stocks that are undervalued and sell overvalued stocks, and in a market with many market participants, the results can be anything but efficient. In this era of information technology today, is increasingly gaining worldwide market efficiency. With the rapid of information technology enables information to spread quickly and online trading makes prices more quickly adjust to the news and information coming into the market.(<http://www.mahadanalearning.com/2nd/index.php/artikel/pasar-modal/131-efisiensi-pasar-apakah-itu.html?start=1>).

Forecasting- long denigrated as a waste of time at best and a sin at worst- became an absolute necessity in the course of the seventeenth century for adventuresome entrepreneurs who were willing to take the risk of shaping the future according to their own design. (Bernstein, 1996, p. 95). Forecasting is necessary. In spite of the inherent inaccuracies in trying to predict the future, forecast necessary drive policy setting and planning. Everyone requires forecast. The need for forecast cuts across all functional lines as well as all types of organization. Forecasts are absolutely necessary to move forward in today's ever-

changing and highly interactive business environment. (Hanke and Wichern, 2009, p. 2).

You do not plan to ship goods across the ocean, or to assemble merchandise for sale, or to borrow money without first trying to determine what the future may hold in the store. Ensuring that the materials you order are delivered on time, seeing to it that the items you plan to sell are produced on schedule, and getting your sales facilities in place all must be planned before that moment when the customers show up and lay their money on the counter. The successful business executive is a forecaster first; purchasing, producing, marketing, pricing, and organizing all follow. (Bernstein, 1996, p. 21)

The purpose of a forecast is to reduce the range of uncertainty within which management judgment must be made. (Hanke and Wichern, 2009, p. 9). Investor uses the forecasting as a tool to reduce the risk and uncertainty in the investment or in making a decision. Risk and uncertainty is a major problem in human life. Moreover, people always afraid with uncertainty because they will not know what happen. Therefore, people create some tools that emphasize on the creation of the certainty things. There is a tool called as a “Forecasting” in order to deal with the uncertainty, this tool will help people to compete with uncertainty and to decrease the uncertainty problem.

Many ways lead to Rome, that proverb also happen in the stock price forecasting. There are many models in the stock price forecasting. We can use many models or methods in order to forecast the movement in the stock price. Some of the methods or models in the stock price forecasting are stock price

forecasting use collective intelligence (Kaplan, 2001), stock price forecasting using hidden markov model (Hassan and Nath, 2005), forecasting stock price with the residual income model (Higgins, 2002), stock price forecasting by using neuro-fuzzy inference system (Abbasi and Abouec, 2009), etc. However, in this thesis we will analyze deeply about fuzzy inference system.

In this research, the researcher have managed to using fuzzy inference among the others method because Fuzzy set theory that implemented in financial decision is quite new for capital market, new comer on the stock price prediction, and fuzzy-sets theory used for taking step in an uncertainty. As we know that the fuzzy can be classified into a new area or new subject, and it is very interesting to research because it is use IT (Information Technology) engineering concept into the field of finance. Fuzzy use set of membership that easy to understand, it is more flexible, tolerant of imprecision, simple, fast, and adaptive. The function of this set of membership in the fuzzy logic are to reflect the expert knowledge, give the smooth transition among fuzzy membership, and easy to calculate. Researcher use Fuzzy computing because fuzzy inference systems incorporate human knowledge and perform inferencing and decision making. (Jang, Sun, and Mizutani, 1997).

Fuzzy inference system is important because determinant factor in creating price equilibrium in capital market is information and important factor in forecasting are current data and historical price which are include as an information, all the things is about information and neuro-fuzzy is a powerful problem-solving methodology with the use of information processing. Second, it

is universal approximators with the ability to solicit interpretable IF-THEN rules. (<http://en.wikipedia.org/wiki/Neuro-fuzzy>). One determinant factor in creating price equilibrium in capital market is information, and part of this is historical price data. In Fuzzy, it is a powerful problem-solving methodology with wide applications in industrial control and information processing. It provides a simple way to draw definite conclusions from vague, ambiguous or imprecise information. It resembles human decision making with its ability to work from approximate data and find precise solutions. (<http://www.zaptron.com/literature/neurofuzzy.htm>).

Fuzzy sets theory is a theory used for taking steps in an uncertainty. It could transform many concepts, variables, ambiguous and imprecise systems into mathematical models and paves the way for argumentation, inference, control and decision making in an uncertainty. A static or a dynamic system which uses fuzzy sets, fuzzy logics and/or analogous mathematical framework is called a fuzzy system. There are a few membership functions in this system which based on them the degree of membership of a variable in the domain (0,1) is determined. The most significant functions are triangular membership function with three parameters, trapezoidal membership function with four parameters, generalized bell membership function with three parameters, Gaussian curve membership function with two parameters, Gaussian combination membership function with four parameters, and sigmoidal membership function with four parameters. (Abasii and Abouec, 2009)

There are 3 models in the Fuzzy Inference system, the first one is Mamdani Fuzzy models, proposed as the first attempt to control a steam engine and boiler combination by a set of linguistic control rules obtained from experienced human operators. (Jang, Sun, and Mizutani, 1997, p.74). Second, TSK models or Sugeno Fuzzy Models, proposed by Takagi, Sigeno, and Kang in an effort to develop a systematic approach to generating fuzzy rules from a given input-output data set. (Jang, Sun, and Mizutani, 1997, p.81). Third, Tsukamoto Fuzzy Model, the consequent of each fuzzy if-then rule is represented by a fuzzy set with a monotonical MF, with a result the inferred output of each rule is defined as a crisp value induced by the rule's firing strength. (Jang, Sun, and Mizutani, 1997, p.84).

In this research, TSK Fuzzy Model is used because there are some advantages and reasons. First, Mamdani FIS required fourteen times more processing time than the TSK FIS. To be specific, the average time taken by the Mamdani FIS to produce one result was 4.6×10^{-4} seconds while for the TSK FIS, it was 3.2×10^{-5} seconds. The TSK FIS was found to be robust in the sense that the noise present in the input data did not seem to have any effect on the functioning of the system. More importantly, TSK FIS also produced totally different results as the input data became too much different from the original noise free data. Thus, TSK FIS reacted more strongly. (Piolet, 1996, p.1). Second, TSK FIS works better in terms of processing time, more robust and better sensitivity. (Jassbi et. al., 2006). Third, observed that the correlation of Mamdani FIS and Sugeno FIS to the experimental data was 0.85 and 0.84 respectively.

Thus, they concluded that Mamdani FIS model permitted easy variation and adjustment of the parameters. (Meitzler and Sohn, 2005). Forth, made the following observations, TSK FIS results were more accurate since the results that were generated were closer to what was expected. TSK FIS was found to be more dynamic to input changes. With respect to the boundary cases, TSK FIS was far more accurate than Mamdani FIS. They also observed that TSK FIS was faster than Mamdani FIS. On the other hand, Mamdani FIS displayed consistency in results and showed expressive power. However, the authors concluded that they would mostly choose TSK FIS over Mamdani FIS.

Every model has its limitation, called as an error. In this research, error is a differences between the real fluctuation compared with forecasting stock price fluctuation. In this research, to know whether the model is applicable or not, errors indexes used. Many errors indexes such as Mean Absolute Deviation, Mean Square Error, Mean Absolute Percentage Error, and Mean Percentage Error.

This research has a design. The design is to make a model (Fuzzy Inference System model) to make a decision. Furthermore, this research will make a decision making model in term of Financial field of study. This model will forecast the stock price fluctuation which is can be used as a based of determination to make a decision needed by the Investor. Therefore, Investor can make a decision whether to sell, buy or hold their stocks. The model is replicated from the previous research by Abbasi and Ebouec, and the model will implemented in Indonesia. This research will give the result where Fuzzy

Inference System can be implemented in Indonesia or not especially in Indonesian Capital Market.

This Fuzzy Inference System will give a model to forecast the fluctuation of stock price, which can be used to make a decision. This research will make a Fuzzy model first. This model can help to forecast the stock price fluctuation. After make a model, the model must be tested. The real stock price fluctuation will compared with the forecasted stock price fluctuation. With this test we will get the error estimation, and we can see the implementation of this model in the Indonesian Capital Market. Therefore, we can conclude whether the Fuzzy Inference System model can be implementing in Indonesia or not.

1. Problem Statement

Based on the descriptions above and explanations on the background, the writer formulates the following issues:

Does "Fuzzy Inference System" forecasting model can implemented in Indonesia?

2. Scope of the Problem

In order to limit the scope of the discussion on the issue and to obtain a clearer direction for the writer in discussing this problem so the writer has set limit on the following issues:

1. This research will only be conducted on the stock price of the company which is always include LQ45 during 2000-2010, have a financial

statement for year 2000- 2010, and one of the largest company in its sector.

2. A tool to help this forecasting in this study is the Fuzzy Inference System. In addition, it is represented by the use of trade volume, Dividend Per Share (DPS), Price to Earning Ratio (R/E), and also closing price to become a independent variable to measure this forecasting.

3. Originality of the Research

Different method described by Abasii and Abouec (2009). They mentioned:

In a bid to respond the research question two time periods are determined:

- a. Long – term period includes stock price information from 1997 to 2004 and
- b. Short – term period includes stock price information from the year 1997 to 2004 which are divided into four seasonal quarters.

In the long – term period, four variables include trade volume, DPS, P/E and closing price are deemed as independent variables and stock price fluctuation as a dependent variable. In "ANFIS", trial and error test is used in order to identify the pattern. Therefore, different pattern with respect to membership functions and testing and training data are designed as well as with respect to the level of error of testing data, an optimum model been selected. Training data are data which the system uses them for learning and model design. Testing data are used for made model test. Training error is a

deviation that exists between the observed data in the training period and system outputs. Testing error is a deviation, which exists between real value in the testing period and system outputs. Since in this research, time series methods are used, stock price fluctuation is resulted from annual and extraordinary General meeting decisions of the company must be adjusted. In a sense, influential factor on expected price fall subsequent to meeting decisions should be eliminated in a way that adjusted price fluctuations could be resulted from market supply and demand. Thus, all stock prices subsequent to the meetings would increase as much as dividend Per Share (DPS) because the highest decrease of stock price subsequent to the meetings resulted from DPS payment.

The least testing error is related to triangular membership function, after that it will show that the best model neuro – fuzzy for forecasting LQ45 stock price is a model with four input variables or three input.

In a short – term value DPS variable in terms of its fix value in year is not deemed as input. Since "ANFIS" is an intelligent system, the variables with a fixed value do not affect the calculations. Therefore, in this type of modeling, three input variables including trade volume, P/E and closing price are deemed as independent variables and stock price fluctuation as a dependent variable. The selection of optimal model is made with respect to the level of testing error data. After that, we will see the outcome. However, this research will not used short-term period because condition in Indonesia. Many speculators in

Indonesia that use fundamental analysis and many information that make some stocks fluctuation in a short-term hardly to predict.

B. Objectives and Benefits of the Research

This study is designing and rendering a stock price forecast model with the help of Fuzzy Inference System.

1. Benefits of the Research

The benefits of this research study hopefully will be able to:

1. for the writer

This study is important to make a better understanding about forecasting the stock price that is expected to sharpen the power of scientific thought and to increase scientific competence in the disciplines served.

2. for Reader and investor

This research is expected to provide a broader knowledge of the community who involved in the financial business world. This research expected to designing and rendering a stock price forecast model with the help of Fuzzy inference System.

C. Research Report Outline

The writing is divided into five chapters, which are:

Chapter I Introduction

This chapter will discuss the introduction about the research. The introduction consists of research background, problem statement, scope of there search, objective of the research, benefit of the research, and research report outline.

Chapter II Theoretical Background and Previous Research

This chapter contains the related theoretical background, previous research and the hypothesis development.

Chapter III Research Methodology

This chapter describes the population and sample used in this research, data and data gathering, variable and variable measurement, method of analysis and hypothesis testing.

Chapter IV Data Analysis

This chapter provides and presents the data analysis and discusses the result obtained in this study.

Chapter V Conclusion and Suggestion

This chapter consists of conclusion, limitation of the research, and suggestion for further research.