

**OPTIMAL PORTFOLIO SELECTION DECISION
MAKING BEFORE AND AFTER MALAYSIA GENERAL
ELECTIONS USING GAME THEORY APPROACH**

BY

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**A thesis submitted in fulfilment of the requirement for the
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Sciences)**

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ABSTRACT

The change of the Malaysia government during its 14th general election (GE14) has motivated this research to study the general elections impact on the stock market performance. The aim is to determine the impact of Malaysia 13th and 14th general elections towards the chosen stocks in FBMKLCI by using the cooperative game theory approach. The players (sectors) are divided into three groups where each player will have several different strategies (stocks) for the game. The sectors involve are financial services, consumer products and services, and telecommunications and media. The stocks in the financial services sector are AMMB Holding Bhd, CIMB Group Holdings Bhd, Hong Leong Bank Bhd, Hong Leong Financial Bhd, Malayan Banking Bhd, Public Bank Bhd and RHB Capital Bhd. The stocks in the consumer products and services sector are PPB Group Bhd, Genting Bhd, Genting Malaysia Bhd and Petronas Dagangan Bhd. The stocks in the telecommunications and media sector are Axiata Group Bhd, Digi.Com Bhd and Maxis Bhd. The payoff for each sector and its coalition are calculated by averaging the stocks' returns. The value of the game for each sector is obtained by using Nash equilibrium solution concept. Then the values of the game are considered as characteristic functions to obtain the Shapley value solution concepts in cooperative game theory framework. The Shapley value percentages are calculated by normalizing its value with the grand coalition value. The Shapley value percentages for GE13 and GE14 are compared to indicate the impact of GE14 on investment. The aim continues to construct the optimal portfolio selection based on the Shapley value percentages for GE14 only and measure its performance by using Sharpe ratio for one year. The result shows that the Shapley optimal portfolio dominates the market portfolio and the naive diversification portfolio in the period from February 2018 until November 2018. This shows that Shapley optimal portfolio performs better during GE14.

خلاصة البحث

لقد شجع تغير الحكومة الماليزية خلال الانتخابات العامة الرابعة عشرة هذا البحث لدراسة تأثير الانتخابات العامة على أداء سوق الأسهم. كان الهدف هو تحديد تأثير الانتخابات العامة الثالثة عشرة والرابعة عشرة في ماليزيا على الأسهم المختارة في البورصة الماليزية FBMKLCI باستخدام طريقة نظرية اللعب التعاوني. تم تقسيم اللاعبين (القطاعات) إلى ثلاث مجموعات، وكان لكل لاعب العديد من الاستراتيجيات (الأسهم) المختلفة للعبة. شملت القطاعات كلا من الخدمات المالية، والمنتجات والخدمات الاستهلاكية، والاتصالات والإعلام. أسهم قطاع الخدمات المالية تضمنت كلا من: إيه إم إم بي القابضة المحدودة، مجموعة سي أي إم بي القابضة المحدودة، بنك هونغ ليونغ المحدودة، هونغ ليونغ للتمويل المحدودة، مالايان بانكينغ المحدودة، بابلك بانك المحدودة، وأر إتش بي كابييتال المحدودة. أسهم قطاع المنتجات والخدمات الاستهلاكية تضمنت كلا من: مجموعة بي بي المحدودة، شركة جننينغ المحدودة، جننينغ ماليزيا المحدودة، شركة بتروناس التجارية المحدودة. أسهم قطاع الاتصالات والإعلام شملت: مجموعة أزياتا المحدودة، ديجي دوت كوم المحدودة، وماكسيس المحدودة. تم حساب العائد لكل قطاع وأعضاء مجموعته عن طريق حساب متوسط عائدات الأسهم. تم الحصول على قيمة اللعبة لكل قطاع باستخدام مفهوم حل توازن ناش. ثم تم اعتبار قيم اللعبة كوظائف مميزة للحصول على مفاهيم حلول قيمة شيبلي في إطار نظرية اللعب التعاوني. تم حساب النسب المئوية لقيمة شيبلي عن طريق تسوية قيمته مع قيمة المجموعة الكبيرة. تم بعد ذلك تمت مقارنة نسب قيم شيبلي للانتخابات العامة الرابعة عشر والخامسة عشر للإشارة إلى تأثير الانتخابات العامة الرابعة عشرة على الاستثمار. استمر الهدف في إنشاء الاختيار الأمثل للمحافظ بناءً على نسب قيمة شيبلي للانتخابات العامة الرابعة فقط وقياس أدائها باستخدام نسبة شيبلي لمدة عام واحد. أظهرت النتائج أن محفظة شيبلي المثلى قد هيمنت على محفظة السوق وحافطة التنويع الساذجة في الفترة من فبراير 2018 حتى نوفمبر 2018. وهذا يدل على أن محفظة شيبلي المثلى قد أدت بشكل أفضل خلال الانتخابات العامة الرابعة عشرة.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science (Computational and Theoretical Sciences).

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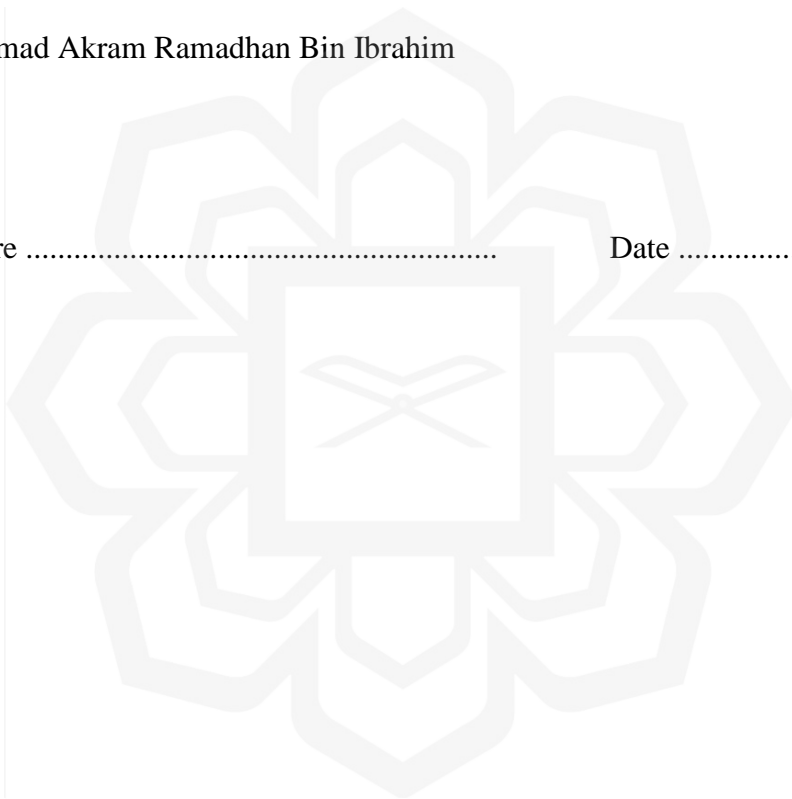
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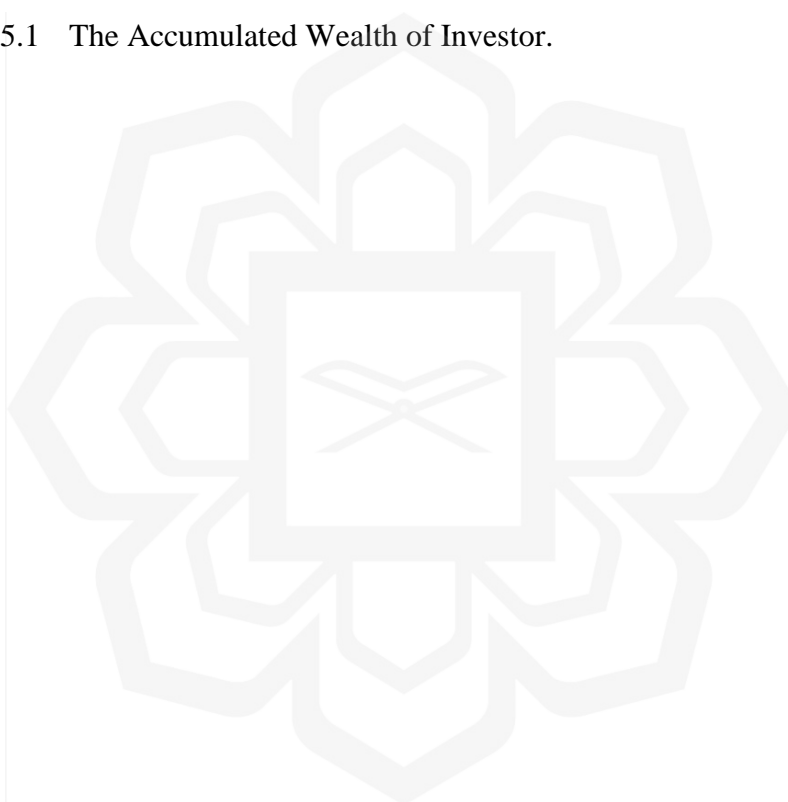
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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND ON GAME THEORY

Game theory is one of the branches under the field of operations research in applied mathematics. It started to gain prominence after the book written by Neumann and Morgenstern (1944) entitled 'Theory of Games and Economic Behavior' was published. The study of game theory is about mathematical models of the strategic interactions between rational players that concern with the actions of decision makers who realize that every step taken will give an impact to each other. It means that the game theory is not applicable for the unrelated and unrational decision makers. Game theory can be divided into two categories; non-cooperative and cooperative games. Non-cooperative game is a game where the competition occurs among players. In contrast, cooperative game is a game where the player will gain benefit in joining binding agreement among players.

Game theory that involves two intelligent adversaries with contradicting objectives in making decisions to compete with each other is called as non-cooperative game theory. Zero-sum game is an example of non-cooperative game theory where a gain of one player is the loss for another player. Their sum of the payoffs will be zero if the total received payoffs of the players are added up and the total losses payoffs are subtracted. In a conflict, each of the two players may have a finite or infinite number of strategies where each strategy associates with their payoff interests (Taha, 2007). Conversely, cooperative game theory describes about fair allocation game, instead of a

fight game. A group of players, that is called coalitions, it can be seen as a competition between players that have mutual benefit to agree together rather than between individual player. The coalition intends to achieve higher payoff instead of when they act individually. One of the solution concepts in a cooperative game theory used in this research is Shapley value. It calculates the weightages of each cooperation which in turn is used as the basis in allocating the weight to individual stock in the optimal portfolio (Tataei et al., 2018).

Game theory consists of three basic elements which are the players, strategies and payoffs. The players must be two or more either as individuals, organisations or nature itself (Kelly, 2003) which will make sense to the game, who are making decision in a game. Nature is a sham-player who takes random actions with specified probabilities. There are two assumptions in order to implement a game theory which are rationality and mutual independence. A player is said to be rational when they maximize their interests in a game and vice versa. Eventhough, in reality and complex situation, players seem more to be unrealistic in making any decisions such as emotion and pressure in life. The second assumption is mutual independence. It means that any decision chosen by any player will only affect their payoffs respectively.

A strategy profile is an ordered set that consist of all available strategies for all players in the game. The strategies refer to the information and available actions to be taken by group of individuals. Lastly, the meaning of the payoff is the outcomes to each of the players associate to their chosen strategies. Some examples of payoff are profit, revenue or utility. The essential idea is each player wants to maximize their payoff by choosing plans or strategies that depend on the known information to against their opponents. Their combination in choosing those strategies are called as equilibrium which represents the outcome of the game's stability or saddle point.

1.2 INVESTMENT AND PORTFOLIO SELECTION

An investment is the present commitment of money or other assets in the anticipation of reaping long term benefits in the future (Bodie et al., 2014). Financial assets which are intangible assets, they have no physical presence but in high liquidity, meaning that it can be converted into cash faster and easily. The assets such as stocks and bonds are financial assets values that depend on real assets and generate net income to the economy and allocate income among investors. The problem is aiming on the question on how can we invest based on percentage allocation to each investment tools in selecting a portfolio. Individuals can make a choice either to consume their wealth today or to invest for the future, some individuals are concerned on cash, property and debt planning to avoid young-age bankruptcy, it is best to allocate money to invest for better rewards in future. One of the way to grow money by placing wealth in financial assets.

The financial market is a trading marketplace which involves securities like equities, bonds and derivatives. Stock prices as act as a benchmark for the firm to raise capital where investor's appraisal of a firm's performance based on the fluctuation of the prices, and encourage investors to invest in a firm if those prices are high. The stock market encourages investors to allocate their capitals in firms that have convincing prospects. An investment portfolio is a collection of investment assets owned by investors. These investors can either be individual investors or institutional investors. There are two type of decisions in constructing portfolios, firstly, is the decision of the asset allocation which is the choice among these assets classes such as stocks, bonds and real estates. Secondly, the decision on security selections, it is the choice of which certain securities to hold within each asset class.

As financial markets are highly competitive, investors will find ways to increase their gains. One of the methods is by diversifying their assets. Diversification means

that various assets are held in a portfolio. Diversifying investments leads to a higher expected return and lower standard deviations. In the classical way, investors believe that putting several stocks in their portfolios will lead to a decrease in risk without any consideration of the returns for these stocks. As suggested by the classical approach, investors should invest in many types of stocks that have higher expected returns at a given level of risk and will cooperate to perform better in the market. Since various approaches have been studied to solve the investment portfolio selection problem, this uncertainty was also studied by Harry Markowitz (1952) where his article entitled Portfolio Selection, brought up the modern portfolio theory that an investment's return and risk should not be calculated alone but by using an overview of the entire portfolio.

Portfolio selection is a process of choosing a portfolio by referring to maximize expected return and minimize risk, called optimal portfolio. The expected return of a portfolio is the weighted average of the stocks proportions to its weights and the variance of a portfolio is the weighted sum of the elements of the covariance matrix with the product of the investment proportions as weights (Bodie et al., 2014). The problem of portfolio selection is based on the question of which investment tools and at what weightage will be suggested in the portfolio performed. The decision in constructing a sectoral portfolio is the choice of which securities to hold within each asset class. The allocation of financial assets is a problem faced by investors in the country as they need to choose their optimal portfolios to maintain a good performance in the financial markets especially pre and post general elections. The investor's objective is choosing a portfolio that can maximize returns at certain risk conditions especially during elections and perform it in abundant in type and number instead of choosing the best investment options individually which may be subject to more risk conditions.

There are two fundamental characteristics in the financial market, the first is competition among market players and the second is uncertainty (Tataei et al., 2018). This means that a player's game will be affected by the other players' total market performance behaviour with the uncertainty conditions of the financial market. Based on these two essential fundamental characteristics, it can be implemented in the game theory part that refers to the optimal decision making by players in evaluating and calculating the payoff of other players by using mathematics. Figure 1.1 shows the implementation of a portfolio selection with game theory based model. Sectors and stocks in the portfolio model indicate players and strategies in the game theory model respectively.

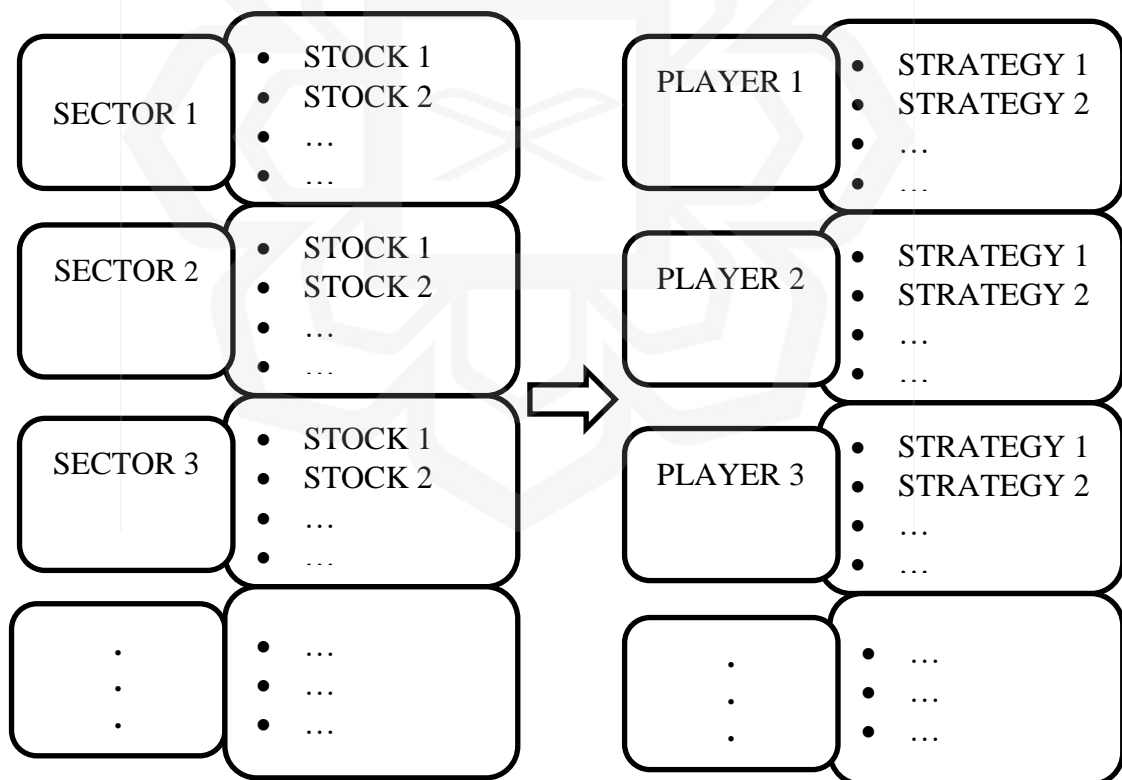


Figure 1.1 The Implementation of Portfolio Selection with Game Theory Based Model.

1.3 POLITICAL ELECTIONS AND FINANCIAL MARKETS

The political election seasonal trend holds significant influence to the security prices anomaly in the stock market (Chandra, 2009). A stock index gives the overall financial conditions on stock market. It is one of the most sensitive benchmarks of business cycle. The sentiment of the investors on political election could create ups and downs investment reaction in the stock market. The minority of the government coalition in parliament seats will make the investors react more volatile manner with short time trading days. Specifically, investor desires all move to invest in stock market if it in the convincing condition, otherwise they will withdraw from the market due to the expectation on implementation of the economic policy of a minority governments country (Bialkowski et al., 2008). Thus, their responses may cause changes in trading volume, volatility and stock prices (Tuyon et al., 2016). The investors' expectations and politics condition has been researched in many countries in various contexts. The unstable politics surrounding during elections initiate the economic uncertainties and raise the investors' risk aversion behaviours. This can be observed through Donald Trump's success in the US presidential election since presidential cycle brings consequences to all across the globe. In response to the US presidential cycle, the American stock market performance seemed to be least affected when comparing to the Asian market (Iskryan, 2016).

Malaysia has undergone fourteen episodes of general election up to 2018. Before the 14th General Election, the Barisan Nasional coalition had won all 13 previous elections. The last two general elections (GE13 and GE14) saw a particularly close competition between Barisan Nasional and Pakatan Rakyat which resulted in a higher chance for Pakatan Rakyat to win the election. After the dissolution of the Pakatan Rakyat, a new party was formed known as the Pakatan Harapan in 2015.

Pakatan Harapan ultimately won a simple majority in parliament to form a new government in 2018. Liew and Rowland (2016) found that during the Malaysia general elections in 2008 and 2013, fluctuations in the stock market return showed that political uncertainty has a significance influence. However, the general election years of 1995, 1999 and 2004 showed that it had no effect on stock market returns.

1.4 RESEARCH MOTIVATION

In general, politic has an influence on financial markets in terms of stocks performances as well as the volatility. General election is a political event that affects stock market return before and after general election phases where both phases are based on the stability on political condition (Liew & Rowland, 2016). In 2018, the 14th Malaysian general election that was held on 9th May witnessed unprecedented victories in Malaysia's election history where the Barisan Nasional party was defeated for the first time by the Pakatan Harapan. Barisan Nasional has ruled Malaysia almost 61 years since its independence in 1957. There are effects on the stock market and political risk in democracy country (Lehkonen & Heimonen, 2015). Fluctuating stock market conditions are common in the investment world. Any increase of prices of stocks in the stock market will be followed by its decline and vice versa. The pattern and trend of stock market conditions are the same unless there is a new event occurs in certain period (Nawaz & Mirza, 2012).

With the victory of Pakatan Harapan in the general election, this research investigates whether some sectors were being influenced in the Malaysia stock market or not, by using a fair allocation of Shapley value in a cooperative game theory. By looking at the stock market's mechanism, this research aims to find an optimal portfolio selection by adapting investors and the market as players with a conflict of interest in a

normal form game. The players move simultaneously and cooperative game theory framework is used to suggest each sector's percentage and stocks' weightages allocations.

1.5 RESEARCH OBJECTIVES

The study aimed to achieve the following objectives:

1. To determine the impact of elections to the chosen stocks by using Shapley value solution concept in cooperative game theory approach before and after general elections of GE13 and GE14 in Malaysia.
2. To construct the optimal portfolio selection based on the weightage allocation for GE14 and measure its performance by using Sharpe ratio.

1.6 SCOPE AND LIMITATION OF THE STUDY

This research is limited to 14 chosen stocks among 30 stocks in different sectors that maintain listed in FTSE Bursa Malaysia Kuala Lumpur Composite Index (FBMKLCI) during GE13 and GE14. Those sectors are financial services, consumer products and services, and telecommunications and media. The daily closing prices of stocks are used to calculate the annual average return. This research does not intend to investigate whether the stock market is better or worse after the change of the government. This research proposes an optimal portfolio selection before and after Malaysia GE14 by using a game theory framework and uses Sharpe ratio to compare each portfolio's performance during Malaysia's GE14.

1.7 SIGNIFICANCE OF THE STUDY

The findings of this research contribute to the game theory study in Malaysia. This research also contributes in the investment theory field in which it provides guidance to investors in making any decisions by diversifying their portfolios in order to aim high returns and low risk investment especially during the general election of political unrest.

1.8 THESIS ORGANISATION

Overall, this thesis consists of six chapters. The remaining chapters of this thesis is structured as follows. Chapter 2 firstly reviews the previous literature on the game theory framework and political condition towards stock market performance. Chapter 3 presents the research methodology. The investigation on the sectoral percentage comparison of GE13, period between GE13 and GE14, and GE14 presents in Chapter 4. In Chapter 5, this research shows the result of the Shapley optimal portfolio based on the weightage allocation for GE14 and measure its performance by using Sharpe ratio. Lastly, Chapter 6 provides the conclusion of this research outcomes and research contribution and future research followed by references and appendices.

CHAPTER TWO

LITERATURE REVIEW

2.1 GAME THEORY

Game theory comes up with a formal analytical framework with a number of mathematical instruments to study the complex intersections among rational players (Osborne, 2004). The Theory of Games and Economic Behaviour, a book by John von Neumann and Oskar Morgenstern was first published in 1944. In 1950 and 1951, John Nash's papers about the meaning of equilibrium and proof on modern non-cooperative game theory were introduced, while cooperative game theory by Nash in 1950 and Shapley in 1953 on bargaining game. In the 1950s, game theory models started to be used in political and economic science. In the 1970s, game theory was first used in evolutionary biology. Later, the game theory come to dominate microeconomics theory and also in many other fields of economic and behavioral and social sciences.

The view of the game theory models on the general taxonomy concepts are based on several dimensions. A simultaneous game is a game model that all players will choose decisions simultaneously. By this type of movement, all players will not know the strategies that will be chosen by other players. The representation of this type of game is payoff matrix table. Non-cooperative game is a situation where the players make a decision on their strategy to maximize their payoff. In contrast, cooperative game is a situation where there exist binding agreement among the players through agreements or negotiations. Since the game basically are played under uncertainties and risky conditions, there are many common aspects between financial market and game. The investor and the stock market (FBMKLCI) can be two players opposed each other

in the stock market called zero-sum game. The game basically consists of one player that opposes to the nature player whereas the stock market itself represents the nature player with all its features. The condition of the stock market was not solely depend on the overall market since there are some factors such as political, economic condition and social behaviour changes in the stock market.

There are previous studies that involve game theory approaches in stock markets (Colini-Baldeschi et al., 2017; Kocak, 2014; Mussard & Terraza, 2007, 2008; Ozkan, 2015; Shalit, 2017; Slišković & Škrinjarić, 2019; Tataei et al., 2018). However, the studies of Kocak (2014), Ozkan (2015), Shalit (2017), Slišković and Škrinjarić (2019) and Tataei et al. (2018) are detailed in section 2.3. Mussard and Terraza (2007) investigated the new risk indicators that allow one to classify securities of a portfolio depending on their degrees of risk. They used Shapley value to define two risk-trading indexes which are risk-trading index based on Shapley value (RTI) and Gini risk index (RTIG). By using data from five French securities (Accor, Michelin, Carrefour, Wanadoo and TF1) from Cotation Assistée en Continu (CAC 40) French Index and a Gini coefficient as a foundation risk measure, they did an empirical analysis and found that RTI avoided the difficulties related to the Gaussian assumptions and the theory of Markowitz. Meanwhile, RTIG depends on the expected difference between two returns drawn at random with repetition. Mussard and Terraza (2008) and Colini-Baldeschi et al. (2017) explained the possible theoretical part for this methodology application and corresponding Shapley decomposition of the variance solutions.

Huo and Al-Shamaa (2017) studied the impact of noise trading behaviour on Chinese stock market. They applied evolutionary game model to analyse the Chinese stock market growth towards noise trading equilibrium or called as evolutionary stable strategy in game model. The data used is a monthly basis from over 862 public firms