An Analytical Study of China and Hong Kong Stock Markets Efficiency

This report is submitted in fulfilment of the requirements of the

MBID 1901-9536 Applied Project.

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19th April 2019

Abstract

Efficient management of corporate capital is an essential indicator of corporate financial health. In term of corporate capital management, investing in the stock market is easy to approach but challenging to succeed. The purpose of this study is to analyse the efficiency of China and Hong Kong stock markets, which can support the strategy selection for investors and the policy orientation for regulators in China and Hong Kong stock markets.

This study examines China's A-share market and Hong Kong stock market with the serial correlation tests and the runs test based on the efficient market hypothesis. The data cover the China stock market from 2008 to 2018 and the Hong Kong stock market from 1998 to 2018 with different portfolios.

This study finds that the Hong Kong stock market has been weak-form efficient since 2002; the large-cap stocks in China's A-share market were weak-form efficient from 2008 to 2014. The market inefficiency in China and Hong Kong stock markets are related to excessive speculation and inappropriate government intervention.

Acknowledgements

I want to thank my two supervisors, Dr Meng Er and Dr Ahmad Wedyan, for their help and guidance on my applied project. They are knowledgeable, academically rigorous, and enthusiastic about helping students to achieve their research goals.

I also appreciate Dr Jocelyn Williams and Dr Michele Akoorie for their advice on my ethics approval application and my research proposal.

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Chapter 1 Introduction

As a place for investment and financing, the stock market plays a vital role in the economy. Listed companies can raise money by issuing equity, and reward investors with dividends or buying back shares. Institution and individual investors can make a profit from trading or earning dividends.

Efficient management of corporate capital is an essential indicator of corporate financial health. In term of corporate capital management, investing in the stock market is an easy way to approach but challenging to succeed. How to evaluate the stock market price fluctuations and make investment decisions is critical for investors. The purpose of this study is to provide investors with some valuable perspectives in China's stock market.

1.1 Background of this study

Since the late 1970s, the reform and opening-up policy have initiated the transformation of China's economy from a planned economy to a market economy. The stock market in China was sprouted after the reform and opening-up policy. In 1984, the first public stock offering company, Shanghai Feilo Acoustics Co., Ltd. was formally established. In 1986, the first stock exchange counter was established in Shanghai. Then, the Shanghai and Shenzhen stock exchanges opened in 1990 and 1991 respectively. The A-shares and the B-shares were designed to distinguish between domestic and foreign investors. The listed domestic shares traded in Renminbi are called A-shares and the domestically listed foreign investment shares traded in foreign currencies are called B-shares (China Securities Regulatory Commission, 2008). Although the B-shares market has been fully open to domestic investors since 2001, the A-shares market has not been fully open to foreign investors yet. Because the B-share market is much smaller than the A-share market, this study chooses Hong Kong stock market to compare with the A-share market.

After 40 years of economic reform and nearly 30 years of capital market practice, China has become the second largest economy in the world. Simultaneously, the Chinese A-share market value has grown to over CNY 43 trillion (or US$ 6 trillion). The shares covered over 3500 companies and more than 146 million A-share trading accounts have been registered by the end of

2018 (China Securities Depository and Clearing Corporation Limited, 2019; Shenzhen Stock Exchange, 2019a; Shanghai Stock Exchange, 2019a). Since the impacts of A-share markets on China's domestic economy and the world economy cannot be ignored, it is necessary for both the regulators and the investors to have a good understanding of the A-share market.

The official name of A-share is Renminbi common share, which is an experiment in the process of China's transition from a planned economy to a market economy. The early stage of the A-share market had no investment value at all and was an utter place for speculation (Girardin & Liu, 2003). The reasons are as follows:

1. Since the stock issuance approval system was not equitable, enterprises had to put many resources to get the regulator's approval of the initial public offerings (IPOs), sometimes even falsifying financial statements and bribing officials. So, most of the listed companies were not prominent firms, but poor management, state-owned companies that need to be rescued by financing. The residue of planned economy management mode hindered the development of listed companies in the competitive market environment.

2. Most of the listed firms were state-holding or collective holding enterprises; the proportion of the state-owned shares or legal person shares was often over 50 per cent and could not circulate. In order to maximise their interests, dominant shareholders often harmed the interests of minority shareholders, such as not paying dividends and transferring the profits of the listed company through affiliated transactions (Minggui & Xinping, 2004).

3. Because the current market value was relatively small, the current share price was easily manipulated by some manipulators such as public funds, brokerage houses or underground funds. Sometimes, major shareholders of listed companies cooperated with speculative institutions to manipulate stock prices, to achieve the purpose of issuing additional shares at a high price.

4. There was evidence showing that government policy indeed was one of the crucial reasons for the unusual price movements in that period. For example, the IPO suspension policy has been adopted after the market fell sharply many times since 1994 and followed

by a bull market.

5. There was no short selling mechanism before the margin trading, and stock index futures officially began in 2010. In a stock market, if the investors can only do long, the stock prices do not rely on the value, only reflect the supply and demand of chips.

These problems were systematically diminished with the completion of the reform of non-tradable shares in 2007 and the continual advancement of the regulatory system. However, compared with the mature capital market, China's A-share markets still have a large number of government interventions left over from the planned economy.

Due to the A-share markets changed so much after 2008, the previous studies (Zhang & Zhou, 2001; Lu & Ito, 2010) on the A-share markets' efficiency have been out of date. We need to reevaluate the efficiency of the Chinese A-share market.

Besides, the A-share market experienced the bull market of leverage in 2015 and the crash of deleveraging from the second half of 2015 to early 2016 as well as the government bailout intervening the market. Then in 2018, the trade war between China and the US hits China's economy severely, which sent the market to a further four-years low. In order to better analyse the factors affecting market efficiency, this study selects the Hong Kong stock market as a benchmark to compare with A-share, because Hong Kong stock market is generally considered to have more improved regulations and more rational investors.

Hong Kong's stock market has a long history, dating back to 1891 when the Association of Brokers established. After many mergers, it formed the stock exchange of Hong Kong in the 1980s. The Securities and Futures Commission, as the sole statutory securities market regulator, has been improving its rules and regulations to meet the market needs since it was set up in 1989. The stock exchange of Hong Kong is now one of the world's top 10 exchanges, attracting many international investment institutions.

There are several reasons for choosing Hong Kong stock market as the benchmark of comparative study.

1. The Hong Kong stock market is an open market, allowing any individual or institution

to invest.

2. The Hong Kong stock market is about the size of China's A-share market. Moreover, the culture of China and Hong Kong are similar.

3. The Hang Seng Index (HSI), which represents the performance of the Hong Kong stock market, contains a large proportion of large Chinese mainland companies. These big companies are also larger market capitalisation stocks in the A-share markets.

4. The intervention of government funds in China's A-share markets in 2015 and that of Hong Kong stock market in 1998 can be compared.

Due to the HSI of Hong Kong market includes only the blue-chip stocks (i.e. large listed companies, usually industry leaders). In order to be more convincing in comparison with the HSI, the CNI 50 index was chosen to be the comparison object because it represents the blue-chip stocks in A-share markets.

There are more than 3,000 stocks in the A-share markets. Large-cap stocks are highly liquid, with lots of research institutions and investors paying close attention to them, while small-cap stocks are more easily manipulated with relatively few followers. If the EMH is indeed valid, then the efficiency of small stocks in responding to information should be lower than that of large stocks. Most of the previous researches of China's stock market conducted the statistical research on the Shanghai Composite Index (SHCI) or Shenzhen Composite Index (SZCI), which are included all the listed firms in Shanghai or Shenzhen Exchanges. Few scholars have studied whether or not the efficiency of large-cap stocks is the same as that of small-cap stocks. Therefore, conducting a comparative study between the blue-chip index (e.g. CNI 50 index) and the small-cap index (e.g. CNI 2000 index) also has significance.

From what has been discussed above, the problems that I focus on in this study are: First, verify whether the theory of weak-form EMH is applicable in China. Second, compare the Hong Kong stock market and A-share market to analyse the impact of government funds' intervention on market efficiency. Third, investigate whether the efficiencies of large-cap and small-cap stocks in the A-share market are the same.

1.2 Definition of terms

China's stock markets: Shanghai and Shenzhen stock exchanges, excluding Hong Kong and Taiwan stock markets.

Blue-chip stock: the stock of a company that has a nationally recognised reputation, large scale, and good earnings. Usually, the market value of blue chips is very large; many individual and institutional investors trade; the liquidity is good. (Investopedia, 2017).

Small-cap stock: in this study, small-cap stock refers to the stock with the smaller market capitalisation in China's A-share market. Small-cap companies sometimes grow into blue chips after a period of rapid growth.

Random walk: the stock price movements are random.

Efficient market hypothesis (EMH): the EMH argued that the stock market is informational efficient as a whole, and there were three forms of EMH—weak-form, semi-strong form, and strong form. Weak-form efficient market means that no one can earn an excess profit in the long run by analysing historical price data; semi-strong form efficient market implies that neither fundamental analysis nor technical analysis including current news can get an excess return; in strong form efficient market, no long-term excess return can be generated by relying on any information including insider information (Fama, 1970).

1.3 Theoretical framework

The study of how the modern stock market works is indivisible from the EMH. The EMH, developed from the Random Walk Hypothesis (RWH) by Fama (1970), is the foundation of the mainstream modern portfolio and asset pricing theories in the investment universe. The EMH interprets a complex stock market to an ideal simplified model. It is assuming that all the market participants are rational investors seeking higher returns. Every stock in the stock market is under the strict supervision of these rational investors. When any information affecting the future earning expectation of the stock appears, investors' trading activities will make the stock price reach a reasonable level immediately. That is, in an efficient stock market, the price reflects all available

information. In other words, no one can get excess profits from an efficient market. Therefore, informational efficiency is a critical factor for investors to determine their strategies for investment. However, the validity of the EMH is still controversial, and there are many empirical studies for and against it.

The notion of random changes in stock prices can trace back to the 19th century, argued by a French broker Regnault (1863). Louis Bachelier, a French mathematician, applied stochastic processes in analysing stock prices and proved similar ideas in his PhD dissertation (Bachelier, 1900). They pioneered the random walk theory although they did not use the term "random walk". Several decades later, the stochastic phenomenon of stock prices aroused the attention of academic circles again. Maurice Kendall proposed the standpoint of random movements of stock prices in his paper (Kendall, 1953). Paul Cootner, a professor of MIT Sloan School of Management, explained the same idea in his book (Cootner, 1964). The term "random walk" was first used by Fama (1965a) and became well known from a book written by Malkiel (1973). Fama (1970) reviewed both the theory and empirical evidence of RWH and extended the RWH to the profound EMH, which became a milestone of the modern financial theories and a foundational theory of modern capital asset pricing models. However, some scholars have different opinions, such as behavioural finance economists Lo and MacKinlay (2002) argued that the market could be predicted in some degrees in their book.

1.4 Research Questions

The weak-form efficiency of the stock market means that in general, investors cannot obtain excess profits by technical analysis strategies. However, the fundamental analysis still works and investing in the Exchange Traded Fund can yield average market returns.

Should the large-cap stocks or the small-cap stocks be chosen? What about government intervention in the market? Is the market efficient? These are the key factors that determine the strategy when investing in the Chinese stock market.

The two research questions are as follow.

1. Whether or not the blue-chip stocks (i.e. CNI 50 index) and small-cap stocks (i.e. CNI

2000 index) have the same market efficiency?

2. Whether or not government intervention affects the efficiency of markets during the A-share market crash in 2015 and that in Hong Kong stock market in 1998?

1.5 The significance of this study

The history of the stock market in mainland China is relatively short, with rapid economic development, policy uncertainty and irrational investors, resulting in a severe speculative atmosphere in the A-share markets. There have been numerous scholars that conducted empirical studies on Chinese stock markets to verify the efficiency of the market since the beginning of the market. The verification results were inconsistent due to the market scale was small and limited data sample size in the early stage (Zhang & Zhou, 2001). In recent years, the scale of China's stock market has grown to one of the world's top three stock markets. With the development of the Internet, scholars can obtain sufficient stock market data to study. However, there is still no unified cognition about the efficiency of A-share markets in the academic circle. Therefore, it has the necessity and practical significance using the accumulated data of the recent ten years to analyse the market efficiency comprehensively. Like Fama (1991) said, empirical research on market efficiency has been very successful in the past and likely remains so in the future.

The significance of this study falls into two categories:

1. This study contributes to the contemporary literature related to the EMH in China's A-share and Hong Kong stock markets. With the period from 2008 to 2018, the daily closing prices of eleven years over 2,600 observations of Chinese A-share indices can bring more evidence to the empirical EMH and RWH research.

2. This study investigated the Chinese A-share market and Hong Kong stock market in the context of size classified portfolios and government intervention period, which have not been studied before.

1.6 Report Structure

In this study, I validate the weak-form EMH in Hong Kong and China's A-share markets by

examining the randomness of daily stock index yielding. The main focuses are on different portfolios classified by size and time frames related to government intervention. The following chapters of this document provide reviews of the researches in this area, my research methodology, findings and discussions as well as conclusions and recommendations.

Chapter 2 reviews the previous related literature of the EMH theory. It includes the development history of the EMH, the empirical tests and evidence in mature markets, and some existing studies on China's stock markets efficiency.

Chapter 3 describes the research methodology. It includes the selections of statistical algorithms, tools, data, sampling periods and the hypotheses.

Chapter 4 covers the hypotheses tests and results.

Chapter 5 contains the findings and discussions.

Chapter 6 provides conclusions, describes the limitations and gives recommendations for further study and practices.

1.7 Summary

The EMH is the foundation of modern assets pricing model. Studying stock market efficiency has practical significance for both regulators and investors. Due to there is no consensus on whether or not the Chinese stock market is weak-form efficient in the academic circle, I make this analytical and exploratory study on the stock markets of China and Hong Kong. The research questions are focusing on the different efficiency level between large-cap stocks and small-cap stocks, and the impact of government intervention on the efficiency of the stock markets.

Chapter 2 Literature Review

The EMH was developed by Samuelson (1965) and Fama (1965b) independently in the 1960s. Fama (1970) made a systematic summary of the previous studies on EMH, and also put forward a complete theoretical framework for the study of EMH. In the following decades, EMH was developed and improved continuously in the debate and eventually became one of the basic theories of modern financial economics.

This chapter reviews the works on the EMH and the pieces of empirical evidence from mature stock markets as well as China's stock markets.

The literature review begins with the background, definition, theoretical framework of the EMH, then reviews the relevant empirical models. After that, some empirical validations of EMH in mature markets contrasting with the anomalies against the theory are reviewed. At last, some of the studies on China's stock markets efficiency are critically reviewed.

2.1 The theory of Efficient Market Hypothesis

The function of capital markets is to channel investors' money to sectors that need it for production. The study on the price movements of the securities has always attracted a large number of investors and scholars. Since the 1960s, with the advent of computers, Center for Research in Security Prices (CRSP) has provided research-quality facts to scholarly researchers and advanced the body of knowledge in finance, economics and related disciplines (CSRP, 2019). The EMH developed in this context.

Samuelson (1965) analysed commodities prices with linear-programming models and drew a conclusion that in the condition of market participants fully absorbing information and expectations, the price movements are not able to predict. That is, in an ideal situation, the security prices can provide accurate signals helping investors to make decisions, which is defined as an efficient market. Fama (1970) reviewed previous theoretical and empirical researches on the efficient capital markets model and proposed that in an efficient market, the security prices "fully reflect all available information".

In order for the EMH to be testable, it is necessary to define in detail what is "fully reflecting available information", the term "fully reflect" has two meanings namely accurate and in no time, and the information includes historical transaction records, public information of the firm such as periodical reports, announcements and exclusive information that is possessed by insiders (Fama, 1970). In the 1960s, most of the studies of the efficiency of markets were based on the equilibrium prices (or expected return), Fama (1970) pointed out that the models need to be based on some relevant information set. Then the efficient market expected return model would be expressed like that, based on the specific information set, the return more than the equilibrium expected return is zero. The other two efficient market models Fama (1970) reviewed were sub martingale model and random walks model, and he proved that the empirical tests of the random walk are in fact tests of the efficient market.

Together with the taxonomy of weak-form and strong form efficient market that suggested by Roberts (1967), Fama (1970) categorised the EMH into three levels, namely weak-form, semi-strong form, and strong form, corresponding to different information subsets.

1. The weak-form EMH indicates that the security price incorporates all the available historical transaction information (Fama, 1970). Fama (1991) extended the definition of historical price information in weak-form EMH to include the future return predictability through historical dividend/price ratio, earning/price ratio and so on.

2. The semi-strong form EMH means the market price of a security reflects not only the historical information but also the latest public information such as news release or financial reports, announcements of the firm and so on.

3. The strong form EMH implies that the market absorbs all available information including even the exclusive information only accessible to insiders (Fama, 1970).

Due to the inclusion relation of the information set corresponding to the weak-form, semi-strong form and strong form of the efficient market, the weak-form test should be the first step to examine the market efficiency.

Fama (1970) also summarised three ideal conditions for an efficient capital market:

a) there are no transaction fees;

b) all the market participants have access to all the available information freely;

c) all the market participants agree that the current price and future expected price have reflected all the information, that is, all participants are rational, and there are the same rules for pricing.

These ideal market conditions are practically unattainable. However, since these conditions are sufficient conditions, not necessary conditions, the market can be efficient when sufficient numbers of rational investors agree with the security price reflected by the information and the transaction cost is not too large.

2.2 The Empirical Tests and Evidence of the EMH

All empirical studies of the EMH have been focused on whether prices accurately reflect the specific subset of available information. As mentioned earlier, the information set of the semi-strong efficient market contains the information set of the weak-form efficient market, so when studying the market efficiency, the weak-form is the first to be valid, and then the semi-strong form and the strong form. The initial researches in history were tests of the weak-form of market efficiency, concerning the historical prices of the securities, most of which were based on the literature of random walk models. When a wide range of random walk tests supported the idea that markets are weak-form efficient, economists began to turn to semi-strong form efficiency tests, which examine how quickly a security's price responds to publicly released information, including dividends, stock splits, annual reports, and new share issues and so on. The strong-form efficiency tests that emerged in the late 1960s were concerned about whether some investors had monopolistic access to information about price formation of securities (Fama, 1970).

The empirical test literature of the weak-form efficiency of the security market falls into two classes; one is to examine the return series, the other is to prove the uselessness of various historical data based analytical methods (i.e. technical analysis) (Fama, 1970).

The method of testing the return series is consistent with examining random walk characters. The earliest literature on this kind of empirical research is Bachelier's (1900). However, his work had been ignored until Osborne (1959) made a further study on that model. The contribution of Bachelier and Osborne model (Fama, 1965) was applied the central-limit theorem to study the distribution of stock price movements series. Kendall (1953) examined twenty-two economic price series including British industrial stock indices, American commodities like cotton, wheat, and so on, using serial correlation tests and concluded that the price movements were random. Kendall (1953), Moore (1962), Cootner (1964), Fama (1965a), all did similar empirical studies on various price time series using the serial correlation tests. In their studies, the sample serial correlation coefficients computed for the successive price movements were extremely close to zero, that means the series was white noise (i.e. random).

The other kind of empirical research method is to test the uselessness of various technical analyses which predict security prices based on historical prices. Due to the existence of a large number of technical analysis methods for stock trading, it is impossible to test all technical analysis strategies. However, if a specific technical analysis trading strategy can obtain excess return stably in an extended period, it can at least prove that the market is inefficient. The first such study came from Alexander (1961, 1964), who tested a range of technical analysis methods. The most thorough test evidence came from the y% filtered trading strategy, which is to buy a stock when it falls to a low point and starts to rise y%; and to sell a stock when it rises to a high point and starts to fall y%. He concluded that the y% filter strategy could not beat the simple buy-and-hold strategy, which supported the sub martingale model of EMH (Fama, 1970). Fama and Blume (1966) did further research on the filter trading rules and found that when the filter y% was very small, especially y% $< 0.5\%$, this trading strategy generally outperformed the buy-and-hold strategy. However, if transaction costs were taken into account, the profits from this strategy could not cover the high costs of frequent transactions.

The test of semi-strong EMH focuses on the adjustment of securities prices to some kinds of information generating events, including a stock split, dividend, new share issue, the disclosure of financial announcements and so on. However, each test can only validate one kind of information, the accumulation of these kinds of research evidence can verify the semi-strong efficiency of the

market (Fama, 1970). The early work by Fama, Fisher, Jensen, and Roll (1969) concentrated on the impact of information about stock splits on prices. The stock split itself does not increase the company's assets, only increases the number of shares, and the amount of asset per share is reduced accordingly. The presumption was that stock split was likely to be related to more important fundamental information of the company. Therefore, this study was carried out to study the changes in prices before and after the stock split and the relationship between the stock split and changes in fundamentals. The sample included all 940 stock splits on the N.Y.S.E. from 1927 to 1959. The results showed that after the announcement of the stock split, before the implementation of the split, the stock price rose substantially, and after the stock split month, price change was not substantial. About 71.5 per cent of the stock splits experienced increasing of the dividend after the split year. Those results could be explained that the investors treated the stock split announcement as a good performance signal of the company, they expected future dividend income to be increased, so the stock price rose, which was also the efficient market evidence (Fama, 1970). Most of the validation of semi-strong efficiency falls into the event research.

In a strong form efficient market, no one can get more profit than others based on monopolistic information that he has. Niederhoffer and Osborne (1966) pointed out that New York Stock Exchange employees made a monopoly profit on the information of the unfilled orders; Scholes' (1969) evidence showed that listed companies' managers sometimes have monopolistic access to information about their companies. The main direction to test the strong form of EMH was to study whether mutual funds use insider information to obtain excess profits (Fama, 1970). The key to this kind of test is to find a reasonable evaluation standard, which can fully reflect all the information. Jensen (1968) used Sharpe (1964) Lintner (1965) equilibrium expected return model to construct a risk-return model as the judgement norm. In this model, the expected return is a linear function of risks. Returns below the expected risk-return line mean no excess returns. Jensen made a comprehensive study of the performance of 115 mutual funds in the period of 1955 – 1964, compared with the market expected return line, which was represented by the Standard and Poor Index of 500 major common stocks (S&P500). The results showed that 89 out of the 115 mutual funds underperformed the market line (S&P500), while the 10-year average return of all funds underperformed the S&P 500 by 14.6%. Although this result could not imply that no one in

the market can use monopoly information to obtain excess profits (i.e. strong form EMH), it indeed provided strong evidence for this hypothesis (Fama, 1970).

2.3 Anomalies and criticism of the efficient market hypothesis

There has been much disputation around the EMH since the 1980s. Doubts about the EMH often inevitably led to the problem of joint hypothesis because it is impossible to determine whether the market is inefficient or the asset pricing model is wrong (Fama, 1991). Kahneman and Tversky (2013) argued that the irrationality of stock market participants, including overconfidence, overreaction, representative bias, information bias, and other cognitive biases caused some investors in the market to tend to buy growth stocks at high prices, and other investors can profit from selling the overvalued growth stocks. Shiller (2003) also held the view that markets were imperfect and supported the use of behavioural finance to explain the market instead of EMH.

Ito, Noda and Wada (2016) used a non-Bayesian time-varying model to examine if the US stock market evolves, and concluded that the market efficiency fluctuates periodically, which is consistent with Lo's (2004) viewpoint of periodic fluctuation of market risk preference.

The financial crisis in 2008 led Posner (2009) to change from a supporter of the EMH to a critic. He believed that the regulators relied too much on efficient markets and "exaggerating the resilience — the self-healing powers — of laissez-faire capitalism" (Cassidy, 2010) that caused the 2008 financial crisis. Ball (2009) pointed out that despite the limitations of the efficient market theory, the spread of the financial crisis in 2008 could not negate the efficient market theory. The cause of the crisis was the stock market bubble, the miscalculation of risks by investors and the failure of averting the crisis by the regulators.

Urquhart and McGroarty (2016) examined the predictability of a range of indices, including S&P500, FTSE100, NIKKEI225 and EURO STOXX 50, by testing the daily return from 1999 to 2014. They found that the predictability of these markets varied over time and each market was different. Also, the predictability of stock returns was significantly correlated with certain market conditions.

The debate about the EMH has never stopped. We have to admit the limitations of the EMH

in explaining anomalies, but we should also recognise and take advantage of this simple model to analyse and understand the complex market behaviours.

2.4 Empirical Evidence from China's Stock Market

With the expansion of China's stock market scale, scholars have done many pieces of research on whether China's stock markets are informational efficiency. Wang et al. (2018) conducted the Sequential Panel Selection Method and the Panel KSS unit root test with a Fourier function on the military stocks in China's stock market and got the result implying inefficiency. Similar evidence was found in the tests by Lu and Ito (2010), who applied the combination of unit root test, generalized method of moments method and cointegration estimate.

Some scholars simultaneously studied the stock markets of mainland China, Taiwan and Hong Kong as well as those of other countries in the Asia-pacific region. Huang and Lee (2016) applied a panel stationarity test to analyse the China mainland, Taiwan and Hong Kong stock markets. The data covered 1995 – 2012, they found all the markets were inconsistent with a random walk, and investors could use historical data to get excess profits. Hamid et al. (2017) tested the monthly stock market returns of Pakistan, India, Sri Lanka, China, Korea, Hong Kong, Indonesia, Malaysia, Philippine, Singapore, Thailand, Taiwan, Japan and Australia between 2004 and 2009, using the Autocorrelation, Ljung-Box Q-statistic Test, Runs Test, Unit Root Test and the Variance Ratio, and the results showed inefficiency of all of these markets. Pankaj and Vanita (2015) used similar methods to investigate China's Shanghai Composite Index, Shenzhen Composite index, India's Nifty and Sensex indices in the period from 2003 to 2013. Although there were contradicting results between autocorrelation test and runs test for the Shanghai Composite Index, they concluded the absence of weak-form efficiency of China's stock markets.

Most of these studies use some kinds of statistical algorithms to test whether the time series of China's stock market composite index conforms to the random walk (i.e. weak-form efficient market). Some scholars also compare market efficiency in certain periods. For example, Liu-Ferrara (2013) used wavelets to examine the efficiency of Shanghai and Shenzhen indices from 2002 to 2011, especially the changes of market efficiency before and after the reform of non-tradable state-owned shares. Liu-Ferrara (2013) concluded that the "post-reform has a higher

degree of normality than the pre-reform", though China's A-share markets were still inefficient. Morales and Andreosso-O'Callaghan (2018) selected the context of the 1997 – 1999 Asian financial crisis and 2007 - 2009 Global financial crisis, analysed East Asian economies including Japan, Hong Kong, Malaysia, Singapore, South Korea and China, and found that all the six stock markets were inconsistent with the random walk theory.

All of these works of literature discussed above are tests of the weak-form EMH or the random walk hypothesis. Moreover, most of them concluded that the Chinese stock markets were inefficient. However, there are also a few studies showing that the Chinese stock markets are in weak-form efficiency. For instance, Liu, Hu and Li (2018) investigated all the daily closing prices of Shanghai Composite Index from the beginning of the market in December 1990 to May 2018 and got the results that China's stock market has gradually developed from an initially inefficient market to a roughly weak-form efficient market. Sed'a and del Río (2016) examined the weak-form EMH of the Shanghai Composite Index and Hang Seng Index using variance ratio test and Engle's ARCH test. The testing period covered from 2003 to 2015, and was divided into three sub-periods, namely the pre-crisis period (2003-2007), crisis period (2007-2009) and post-crisis period (2009-2015). The results showed different implications for Shanghai and Hongkong in all sub-periods. Hang Seng Index became inefficient in the global financial crisis period while the Shanghai Composite Index showed efficient which cannot be explained.

Ma, Song and Yang (2010) have made an in-depth study of the influence of the Chinese government on China's stock market, revealing an essential reason for the inefficiency of China's stock market. That is, the Chinese government is both the regulator and the owner of the stock market, resulting in the stock market being frequently controlled by the government, rather than being driven by market demand. One obvious consequence is that there is no good listing and delisting system, which makes it difficult for leading enterprises to be listed and poorly performing enterprises to be delisted. Other researchers (Wang, Tsai & Li, 2017; Heilmann, 2002) have also demonstrated the significant influence of government policies on China's stock market.

2.5 Summary

This chapter reviewed the well-known EMH and its development history, various empirical

tests, as well as the anomalies and criticisms. Although the EMH cannot entirely explain all real market phenomena (e.g. asset bubbles and financial crises), it remains the basic theory of modern asset pricing. Many test results proved that the weak-form and semi-strong form EMH is valid most of the time in mature markets.

As I have shown, there are numerous empirical studies on China's stock markets. Most scholars believe the absence of weak-form efficiency in China whereas a few recent studies have shown evidence to the contrary. Scholars have used a variety of examining methods to analyse market efficiency; however, few of them considered that the blue-chip stocks might be different from the small-cap stocks in terms of efficiency. Besides, government interventions have significant effects on the stock markets in China, which might be a significant factor related to market efficiency. These are the reasons why I conduct research to examine the efficiency of different size portfolios in the Chinese stock market.

Chapter 3 Methodology

In this chapter, I mainly describe the research design, methodology, data collection, statistical and analytical tools as well as the hypothesis test.

3.1 Research Design

From the literature review of the previous chapter, we know that the EMH is a theoretical framework derived by deduction on the basis of empirical research. Positivism is characterised by observing phenomena, deducing testable hypotheses, and then verifying the hypothesis theory through experiments (Saunders, Lewis & Thornhill, 2016). This study continues the previous researches on the informational efficiency of the stock market and adopts the positivist research philosophy. The methodological choice is a mono quantitative method because this study analyses the statistical stock price data collected from the market. The research strategy is to test hypotheses experimentally. From the viewpoint of objectives, this research is explanatory research, which attempts to analyse the relations between the stock market efficiency and government intervention as well as the capital size of stocks in China.

3.2 Data Collection

The empirical research of the EMH can be studying an individual stock, a portfolio of several stocks, or studying a price index representing the overall market. This research focuses on the informational efficiency of China and Hong Kong stock markets.

The stock exchange of Hong Kong ranks in the top ten in the world. It is a relatively transparent and open stock market, attracting a large number of global investment institutions and individuals. The HSI index includes the 50 most influential stocks listed on the Hong Kong stock exchange. The 50 constituent firms represent about 60 per cent of the market capitalisation and turnover of Hong Kong Stock Exchange (Hang Seng Indexes, 2019). Therefore, we can validate the weak-form EMH by examining the randomness of the returns of the HSI index.

By contrast, China's A-share market is still a closed market with a deficient proportion of overseas investment funds despite the Qualified Foreign Institutional Investors system and the

experiments of Shanghai-Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect in recent years. There is an index similar to the HSI called the CNI 50 index in China's A-share market, which can be compared with the HSI to study the efficiency of A-share.

Moreover, the Hong Kong stock market experienced government intervention in 1998 during the Southeast Asian financial crisis, and the A-share market experienced a similar situation during the stock market crash in 2015. The impacts of government interventions can be analysed by studying market efficiency during those critical periods.

Therefore, the China A-share CNI index and Hang Seng Index (HSI) of the Hong Kong stock market are used to compare and analyse the market efficiency of China and Hong Kong stock markets. The periods cover CNI data from 2008 to 2018, and HSI data from 1998 to 2018.

The small-cap stocks in A-share are more volatile and speculative than blue-chip stocks. The CNI 2000 index which represents the small and micro-sized stocks in the A-share market can be a proper study object to compare with the CNI 50 index. The purpose of this comparison is to determine the market efficiency among differently sized portfolios in the A-share market.

The CNI indices are developed by Shenzhen Security Information Co., Ltd., a subsidiary of Shenzhen Stock Exchange. In this research, I use two scale indices namely CNI 50 and CNI 2000, which are free-float capitalisation-weighted. CNI 50 index is similar to HSI of the Hong Kong Stock Exchange and comprises the 50 largest and most liquid A-share stocks listed and trading on the Shanghai Stock Exchange and Shenzhen Stock Exchange. Likewise, the CNI 300 index involves the 300 largest firms; the CNI 1000 index consists of the 1,000 largest firms. Unlike these indices we just talked about, CNI 2000 index is defined as a benchmark of the small and micro-cap segment of the A-share universe and includes the following 2,000 securities after the 1,000 constituents of the CNI 1000 index ranked by total market capitalisation, free-float market capitalisation and turnover (CNIDEX, 2019).

All of these data are able to freely downloaded from the quotation software provided by Capital Securities Co., Ltd.

In order to study the impact of government intervention on the stock market, I divide the

A-share data into two stages: the normal stage before 2015 and the particular stage after 2015. Meanwhile, for better comparing with A-shares, the HSI index is divided into three stages: the Asian financial crisis and dot-com bubble period from 1998 to 2001, from 2002 to 2015 including the phase of the 2008 financial crisis and the usual period after 2015. The period scheme for testing these indices is as **Table 1** shows.

Table 1 Period scheme for indices

INDICES	TIME SPAN 1	TIME SPAN 2	TIME SPAN 3
Hang Seng Index	01/01/1998-31/12/2001	01/01/2002-31/12/2014	01/01/2015-31/12/2018
CNI 50 Index	01/01/2008-31/12/2014	01/01/2015-31/12/2018	
CNI 2000 Index	01/01/2010-31/12/2014	01/01/2015-31/12/2018	

3.3 The Techniques of Data Processing

3.3.1 The Autocorrelation and Ljung-Box Q Test

Since the 1950s the United States set off a wave of study on random walks and efficient market, various types of mathematical and statistical tools have been innovatively applied to the empirical studies, such as Fourier analysis, Wavelet analysis, Sequential Panel Selection Method, and so on. However, the most commonly used and recognised methods are the serial correlation coefficient (i.e. autocorrelation) test and the runs test.

The serial correlation was suggested by Kendall and Hill (1953) and Fama (1965b) to test the randomness of the changes of securities (i.e. the return of the stock). The return rate of a stock can be expressed as $R_{t+1} = P_{t+1} \div P_t$, where P_t is the price of time t, R_{t+1} is the return rate of the stock in the period from time t to time t+1. The benefit of using a natural logarithm to transform data is that it can make data more stable and eliminate heteroscedasticity and so on. Therefore, I use the natural logarithm rate of return, the equation becomes to $\ln R_{t+1} = \ln P_{t+1} - \ln P_t$. The formula for the serial correlation coefficient is as follows:

$$\rho(k) = \frac{covariance(r_t, r_{t-k})}{variance(r_t)}$$

where $\rho(k)$ is the serial correlation coefficient of r_t, r_t is the logarithmic return series of the stock,

k is the lag of period. The covariance and variance function algorithms are given by the following formulas:

$$\text{covariance(x, y)} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})\,(y_i - \bar{y})}{n-1}$$

$$\text{variance(x)} = \frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N}$$

where the $\bar{x}$ and $\bar{y}$ are the means of x and y respectively.

The serial correlation is a measurement of the relationship between the return at time t (i.e. r_t) and its value k periods earlier (r_{t-k}). The serial correlation coefficient is close to 0 means the r_t is independent. For time series without autocorrelation, with the increase of sampling, the correlation coefficient will converge to zero ($\rho(k) = 0$). Since the time series we detected are not infinite, in order to determine that the sequence has no autocorrelation, the correlation coefficient is set to be less than 2 standard deviations.

The Ljung-Box Q test is a portmanteau test for autocorrelation, which can test the overall randomness of a time series based on a number of lags (Ljung & Box, 1978). The null hypothesis of the Ljung-Box test is that there is no correlation; that is, the correlation coefficients are zero; any observed correlation that is not zero is due to a random sampling error. The test statistic is given by the following formula.

$$Q = n(n+2)\sum_{k=1}^{h}\frac{\rho_k^2}{n-k}\ .$$

where n is the sample size, ρ_k is the sample autocorrelation at lag k, and h is the number of lags. The statistic Q asymptotically follows a chi-square distribution with h degree of freedom. For significance level α, the critical region for rejection of the hypothesis of randomness is $Q > \chi^2_{1-\alpha,h}$.

3.3.2 The Runs Test

Another simple and practical test for the randomness of stock returns is the runs test. It is a nonparametric test method that can test whether the event in a series is random. The variable type of the runs test must be binary, and the purpose of the test is to analyse whether the order of the

observed values is random. In the stock return sequence, if the rising and unchanged prices are defined as '+' and the falling prices are defined as '-', the sequence might look like "++ -- +++++ - ++". A run is defined as a continuous period of + or -. Thus, the above sequence has five runs. In a random series, the number of runs should be neither too many nor too few. Therefore, detecting the number of runs of the stock changes with the total expected number can also be an approach to verify the randomness of the stock prices.

For the large sample size, let n_1 and n_2 represent the number of positive returns (+) and the number of negative returns (-), the number of runs is approximately normally distributed, the statistic is defined as the following formulas:

$$\mathrm{Z} = \frac{r - E(r)}{\sigma_r}$$

$$\mathrm{E}(r) = \frac{2n_1 n_2}{n_1 + n_2} + 1$$

$$\sigma_r = \sqrt{\frac{2n_1 n_2 (2n_1 n_2 - n_1 - n_2)}{(n_1 + n_2)^2 (n_1 + n_2 - 1)}}$$

where r is the number of runs, i.e. $r=n_1+n_2$. The null hypothesis of the runs test is that the time series is from a random process, for the significance level of 0.05, the critical region for rejection of the hypothesis of randomness is $|Z|>1.96$.

In this study, I apply the runs test on the logarithm stock daily return, and the cut-off point is 0.

3.4 Software Tools

This research project uses two software tools. The trading software provided by Capital Securities Co., Ltd. is used to download historical trading data, including CNI indices and Hang Seng Index. The data is in text format, including date, open price, highest price, lowest price, close price, volume and other fields.

The other software is IBM SPSS Statistics version 22, which is used to process and analyse

data.

3.5 Hypotheses

The presuppositions of the EMH include 1. Investors are all rational and have the same value judgment criteria; 2. Investors have equal and free access to information; 3. Transaction cost is 0. These ideal conditions cannot be achieved in reality, but the degree to which these conditions are achieved corresponds to the degree of market efficiency, that is, the weak-form, semi-strong form and strong form efficient market suggested by Fama (1970).

Under normal circumstances, most investors in the stock market are relatively rational and conduct stock trading by analysing relevant information and measuring risks and returns. Thus, the market shows weak-form or semi-strong form efficient traits. However, under certain special conditions such as the panic caused by a financial crisis, herd behaviour that leads investors to trade irrationally or liquidity drying up caused by the similarity of program trading strategies, market efficiency may collapse.

The purpose of this project is to study the efficiency of the China A-share and Hong Kong markets. Two pairs of comparison are used, one is the CNI 50 index and HSI index, the other is the CNI 50 index and the CNI 2000 index. I use the serial correlation test and the runs test to verify the randomness of the daily closing price yield of the indices. If both the p-values of the serial correlation test and the runs test are more prominent than the significance level of 5 per cent, we cannot reject the H_0, that is, the stock index is weak-form efficient. There are seven hypotheses as presented below.

Hypothesis 1:

$H1_0$: The HSI daily yield series shows weak-form efficiency from 01/01/1998 to 31/12/2001.

$H1_A$: The HSI daily yield series does not show weak-form efficiency from 01/01/1998 to 31/12/2001.

Hypothesis 2:

$H2_0$: The HSI index daily yield series shows weak-form efficiency from 01/01/2002 to 31/12/2018.

$H2_A$: The HSI index daily yield series does not show weak-form efficiency from 01/01/2002 to 31/12/2014.

Hypothesis 3:

$H3_0$: The CNI 50 index daily yield series shows weak-form efficiency from 01/01/2008 to 31/12/2014.

$H3_A$: The CNI 50 index daily yield series does not show weak-form efficiency from 01/01/2008 to 31/12/2014.

Hypothesis 4:

$H4_0$: The CNI 50 index daily yield series shows weak-form efficiency from 01/01/2015 to 31/12/2018.

$H4_A$: The CNI 50 index daily yield series does not show weak-form efficiency from 01/01/2015 to 31/12/2018.

Hypothesis 5:

$H5_0$: The CNI 2000 index daily yield series shows weak-form efficiency from 01/01/2010 to 31/12/2014.

$H5_A$: The CNI 2000 index daily yield series does not show weak-form efficiency from 01/01/2010 to 31/12/2014.

Hypothesis 6:

$H6_0$: The CNI 2000 index daily yield series shows weak-form efficiency from 01/01/2015 to 31/12/2018.

$H6_A$: The CNI 2000 index daily yield series does not show weak-form efficiency from 01/01/2015 to 31/12/2018.

Hypothesis 7:

$H7_0$: The HSI index daily yield series shows weak-form efficiency from 01/01/2015 to 31/12/2018.

$H7_A$: The HSI index daily yield series does not show weak-form efficiency from 01/01/2015 to 31/12/2018.

3.6 Summary

This chapter described the research methodologies, data selection considerations, the empirical study methods that I used and the seven hypotheses that I tested. The autocorrelation detection and the runs test were the research techniques I utilised to examine the randomness of the daily return. The research objects included Chinese A-share blue-chip index (CNI50) and small-cap index (CNI2000), as well as Hong Kong HSI index. The test periods included when the market was healthy and when the government intervened the market.

Chapter 4 Hypotheses Tests and Results

This chapter is divided into three parts. In the first part, I run the time plots and provide the descriptive statistics of the indices, including the HSI index, the CNI 50 index and the CNI 2000 index. Through the graphs and the statistics, we can intuitively understand the trends in price changes and fluctuations. In the second part, I use the autocorrelation test and the runs test functions to conduct the validation of the hypotheses. In the third part, I summarise the test results.

4.1 The Graphs and statistics of the Indices

In this section, I present the visual graphs of the indices to help grasping trends and volatility of the variables. The indices are the HSI index of Hong Kong stock exchange from 01/01/1998 to 31/12/2018, the CNI 50 index of China's A-share from 01/01/2008 to 12/31/2018, which represents fifty blue-chip stocks listed on A-share markets, and the CNI 2000 index of China's A-share from 01/01/2010 to 12/31/2018, which represents 2,000 small-cap and micro-cap listed firms.

Table 2 shows the sample data segment of the CNI 50 index. The raw data obtained from the database include the "date" and "closing price" fields. The "logarithmic daily return" field is calculated from the formula described in the third chapter: $\ln R_{t+1} = \ln P_{t+1} - \ln P_t$, where t is the date, P_t is the closing price of t, R_{t+1} is the return rate of the period from t to t+1.

Table 2 CNI 50 Index Data Segments

DATE	CLOSING PRICE	LOGARITHMIC DAILY RETURN
19.02.2008	5915.21	0.0184
20.02.2008	5726.64	-0.0324
21.02.2008	5623.67	-0.0181
22.02.2008	5372.31	-0.0457
25.02.2008	5172.13	-0.0380
26.02.2008	5210.59	0.0074
27.02.2008	5368.45	0.0298
28.02.2008	5322.60	-0.0086
29.02.2008	5383.23	0.0113
03.03.2008	5493.13	0.0202
04.03.2008	5307.47	-0.0344
05.03.2008	5240.75	-0.0127

As can be seen from **Figure 1**, in the long run, the stock price index has an apparent upward trend, which mainly reflects economic growth and inflation.

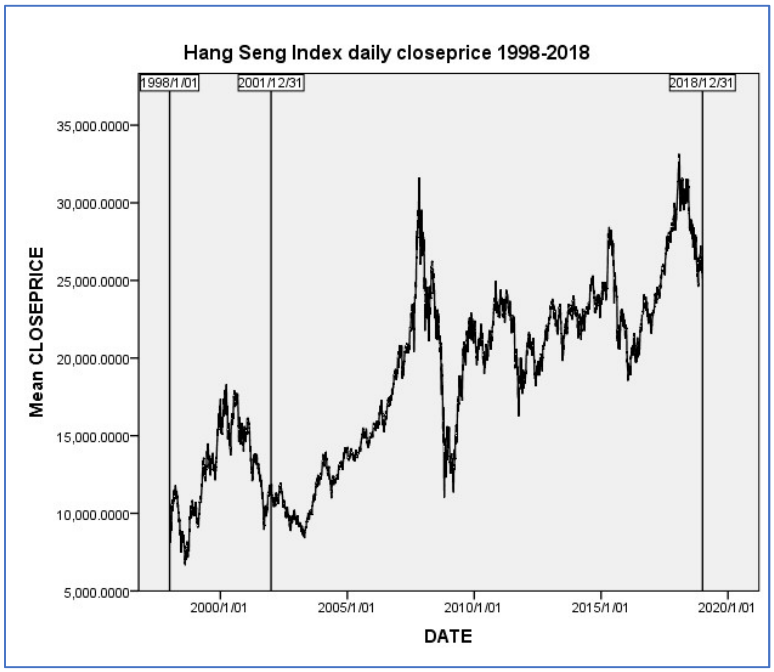

Figure 1 Hang Seng Index 1998 – 2018

Figure 2 shows a daily yield graph that looks more like a random process. The variable of **Figure 2** is the one we want to test for the random walk theory or the weak-form EMH.

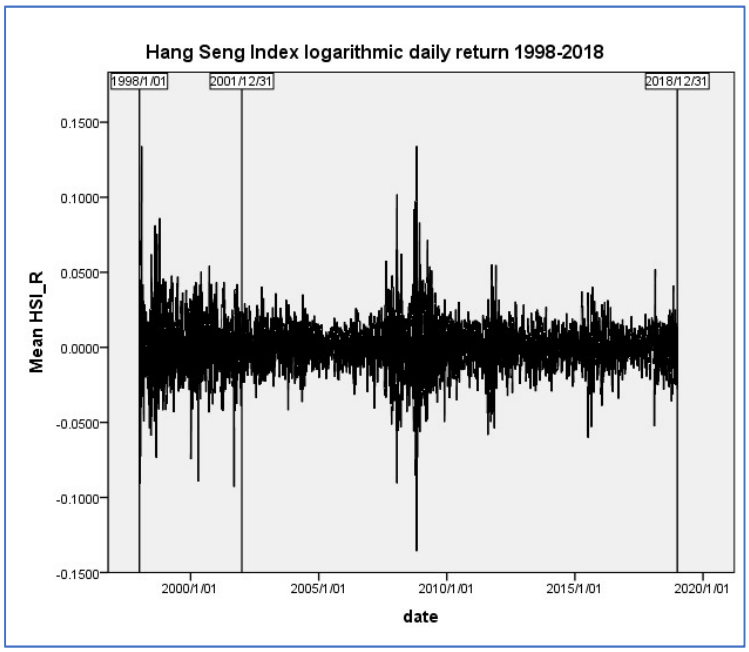

Figure 2 Heng Seng Index Logarithmic Daily return 1998-2018

Table 3 shows the descriptive statistics of the logarithmic daily return (HSI_R), including the maximum, the minimum, the mean, the standard deviation and the variance.

Table 3 Hang Seng Index logarithmic daily return 01/01/1998 - 31/12/2018

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
HSI_R	5165	-.1358	.1341	.000170	.0157484	.000
Valid N (listwise)	5165					

Figure 3 and **Figure 4** are the daily closing price and the logarithmic daily earnings charts of China's A-share CNI 50 index covering 2008 to 2018.

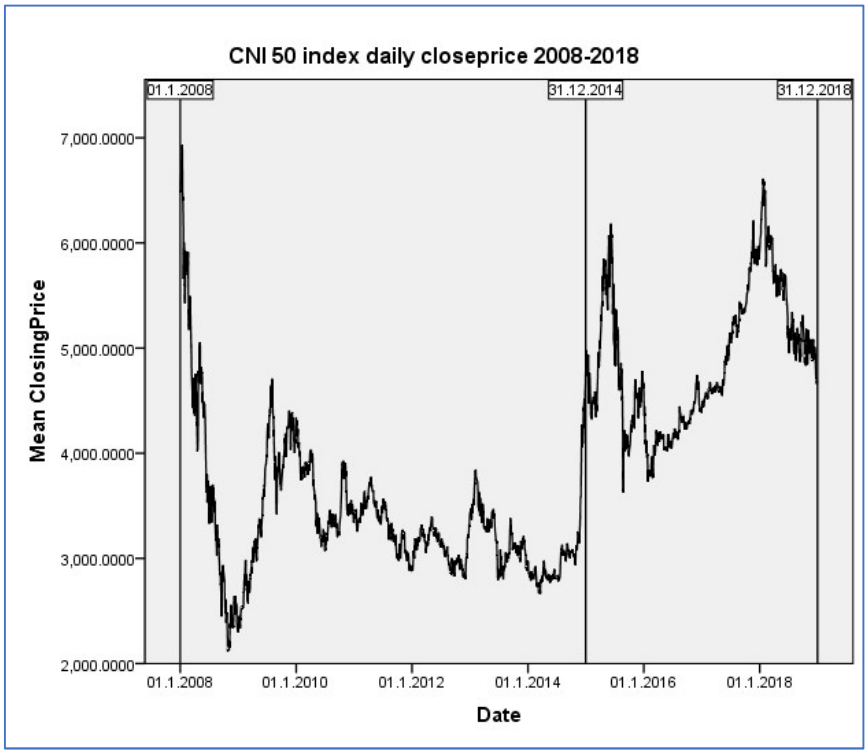

Figure 3 CNI 50 Index Daily Closing Price 2008 – 2018

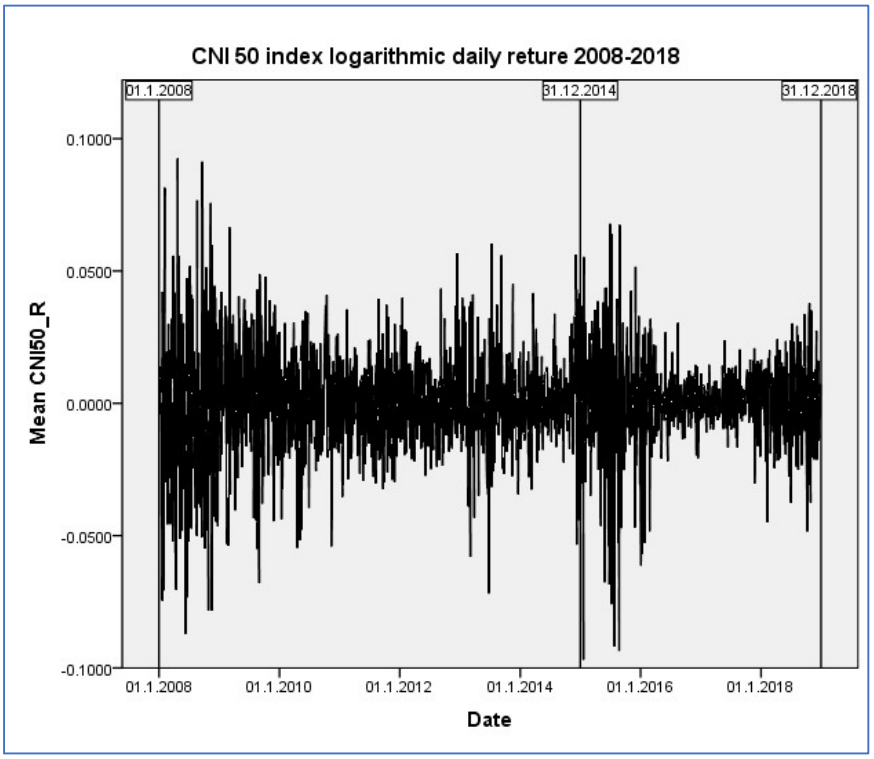

Figure 4 CNI 50 Index Logarithmic Daily Return 2008-2018

Table 4 presents the descriptive statistics of the logarithmic daily yield series CNI50_R.

Table 4 CNI 50 Index logarithmic daily return 01/01/2008 - 12/31/2018

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
CNI50_R	2677	-.0968	.0925	-.000123	.0176707	.000
Valid N (listwise)	2677					

Figure 5 and **Figure 6** are the daily closing price and the logarithmic daily earnings charts of China's A-share CNI 2000 index covering from 2010 to 2018.

Figure 5 CNI 2000 Index 2010-2018

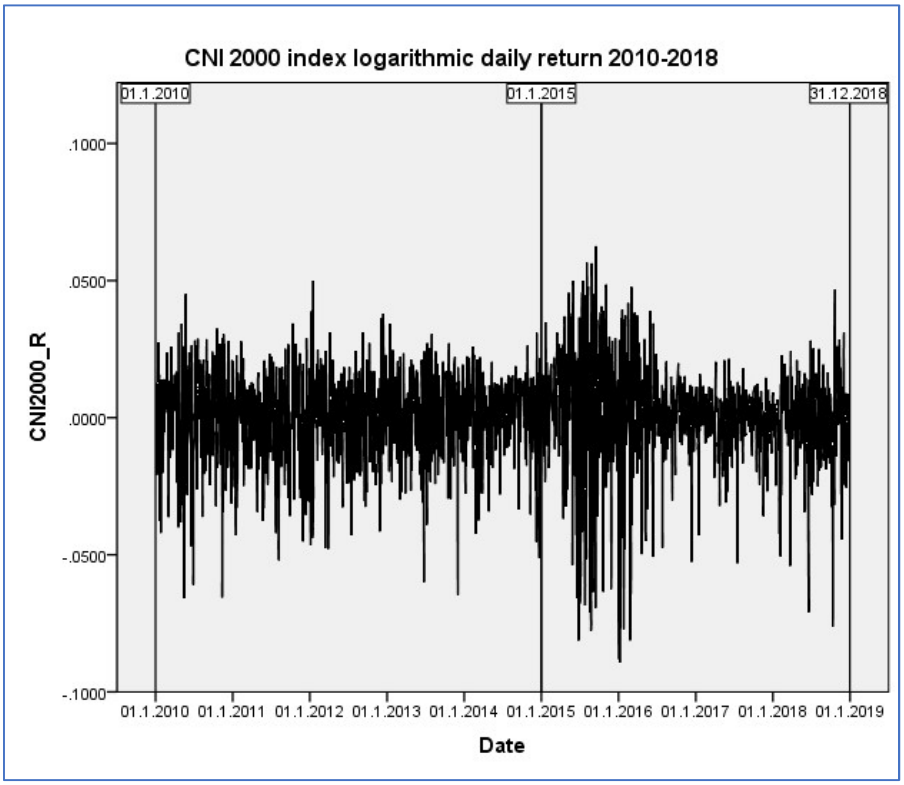

Figure 6 CNI 2000 Index Logarithmic Daily Return 2010-2018

Table 5 presents the descriptive statistics of the logarithmic daily yield series CNI2000_R.

Table 5 CNI 2000 index logarithmic daily return 01/01/2010 - 31/12/2018

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
CNI2000_R	2186	-.0894	.0626	.000181	.0175945	.000
Valid N (listwise)	2186					

4.2 Hypotheses Tests

Hypothesis 1

The autocorrelation test and the runs test results of the HSI series in the period of 01/01/1998 – 31/12/2001 are presented in **Table 6** and **Table 7**. As can be seen from **Table 6**, for the lag numbers of 1 to 8, the autocorrelation values and the standard deviations are calculated. The Ljung-Box statistics columns include the Q statistics value (Value), the degree of freedom (df) which equals to the lag number and the P-value (Sig) which is obtained from the Q value by checking the

chi-square distribution table. Because all the P-values except lag 1 are less than 0.05, we can reject the null hypothesis at 5 per cent significance level. That is, we reject the hypothesis that there is no autocorrelation. **Table 7** shows the runs test result. The "Asymp. Sig. (2-tailed)" is the P-value that is calculated from the Z statistics. Because the Z = -0.764, we cannot reject the null hypothesis of the series is from a random process at 5 per cent significant level. Considering the results of the autocorrelation test and the runs test, we reject $H1_0$; that is, during this period, the HSI index does not conform weak-form efficient.

Table 6 HSI logarithmic daily return Autocorrelations 1998 - 2001

Series: HSI_R

			Ljung-Box Statistic		
Lag	Autocorrelation	Std. Error[a]	Value	df	Sig.[b]
1	.060	.032	3.588	1	.058
2	-.065	.032	7.822	2	.020
3	.056	.032	10.872	3	.012
4	.001	.032	10.873	4	.028
5	-.082	.032	17.511	5	.004
6	.030	.032	18.383	6	.005
7	.024	.032	18.947	7	.008
8	-.002	.032	18.950	8	.015

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

Table 7 HSI 1998 - 2001 Runs Test

Series	HSI_R
Test Value[a]	.000000
Total Cases	984
Number of Runs	481
Z	-.764
Asymp. Sig. (2-tailed)	.445

a. User-specified.

Hypothesis 2

The autocorrelation test and the runs test results of the HSI series in the period of 01/01/2002 – 31/12/2018 are presented in **Table 8** and **Table 9**. The results in **Table 8** show that for all the lag numbers, the HSI series has no autocorrelation because the Ljung-Box test P-values are all larger than 0.05, which means we cannot reject the null hypothesis of Ljung-Box test at 5 per cent significance level. The runs test result showed in **Table 9** means we cannot reject randomness of this time series because the P-value is larger than 0.05. Therefore, we cannot reject the $H2_0$, that is, the HSI index in the period of 2002 – 2018 conforms to the weak-form efficient market characteristics.

Table 8 HSI logarithmic daily return Autocorrelations 2002-2014

Series: HSI_R

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.015	.018	.720	1	.396
2	.008	.018	.922	2	.631
3	-.040	.018	6.146	3	.105
4	-.034	.018	9.808	4	.044
5	-.006	.018	9.924	5	.077
6	-.002	.018	9.942	6	.127
7	.024	.018	11.857	7	.105
8	.029	.018	14.583	8	.068

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

Table 9 HSI 2002 - 2014 Runs Test

	HSI_R
Test Value[a]	.000000
Total Cases	3209
Number of Runs	1630
Z	.937
Asymp. Sig. (2-tailed)	.349

a. User-specified.

Hypothesis 3

The autocorrelation test and the runs test results of the CNI 50 index series in the period of 01/01/2008 – 31/12/2014 are presented in **Table 10** and **Table 11**. The autocorrelation test results show that we cannot reject the null hypothesis of Ljung-Box test because all the P-values are larger than 0.05; that is there is no autocorrelation. The P-value of the runs test result is larger than 0.05, so the null hypothesis of the runs test cannot be rejected at 5 per cent significance. Therefore, we cannot reject $H3_{0,}$ namely the CNI 50 index is in line with the weak-form efficient market

characteristics from 2008 to 2014.

Table 10 CNI 50 index logarithmic daily return Autocorrelations 2008 - 2014

Series: CNI50_R

Lag	Autocorrelation	Std. Error[a]	Ljung-Box Statistic		
			Value	df	Sig.[b]
1	.002	.024	.005	1	.943
2	.005	.024	.044	2	.978
3	.006	.024	.105	3	.991
4	.046	.024	3.658	4	.454
5	-.010	.024	3.833	5	.574
6	-.042	.024	6.811	6	.339
7	.028	.024	8.159	7	.319
8	.003	.024	8.172	8	.417

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

Table 11 CNI 50 Runs Test 2008 - 2014

Series	CNI50_R
Test Value[a]	.000000
Total Cases	1702
Number of Runs	866
Z	.680
Asymp. Sig. (2-tailed)	.497

a. User-specified.

Hypothesis 4

The serial correlation test and runs test results of the CNI 50 index series in the period of 01/01/2015 – 31/12/2018 are presented in **Table 12** and **Table 13**. From **Table 12**. It is easy to see that except the P-value of Ljung-Box statistic at 1 degree of freedom, the other P-values are all less than 0.05. That means we can reject the null hypothesis of the Ljung-Box test at the significance level of 5 per cent, that is, there are autocorrelations in the series. Although the P-

value of the runs test result is larger than 0.05, which means we cannot reject the data are from a random process, we still have to reject the $H4_0$, that is, the CNI 50 index does not conform to weak-form efficiency from 2015 to 2018.

Table 12 CNI 50 index logarithmic daily return Autocorrelations 2015 - 2018

Series: CNI50_R

Lag	Autocorrelation	Std. Error[a]	Ljung-Box Statistic		
			Value	df	Sig.[b]
1	.021	.032	.414	1	.520
2	-.107	.032	11.661	2	.003
3	-.002	.032	11.666	3	.009
4	.051	.032	14.268	4	.006
5	-.041	.032	15.928	5	.007
6	-.122	.032	30.450	6	.000
7	.015	.032	30.678	7	.000
8	.062	.032	34.433	8	.000

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

Table 13 CNI 50 Index Runs Test 2015 - 2018

Series	CNI50_R
Test Value[a]	.000000
Total Cases	975
Number of Runs	475
Z	-.854
Asymp. Sig. (2-tailed)	.393

a. User-specified.

Hypothesis 5

The autocorrelation test and the runs test results of the CNI 2000 index series in the period of 01/01/2010 – 31/12/2014 are presented in **Table 14** and **Table 15**. Because the P-values are all less than 0.05, we can reject both the null hypotheses of the Ljung-Box test and the runs test at 5 per

cent significance. So, we reject the $H5_0$, that is, the CNI 2000 index is not conformed to the weak-form efficiency between 2010 and 2014.

Table 14 CNI 2000 index logarithmic daily return Autocorrelations 2010 - 2014

Series: CNI2000_R

Lag	Autocorrelation	Std. Error[a]	Ljung-Box Statistic		
			Value	df	Sig.[b]
1	.088	.029	9.423	1	.002
2	-.044	.029	11.748	2	.003
3	.018	.029	12.140	3	.007
4	-.017	.029	12.480	4	.014
5	-.043	.029	14.759	5	.011
6	-.042	.029	16.899	6	.010
7	.045	.029	19.375	7	.007
8	-.035	.029	20.885	8	.007

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

Table 15 CNI 2000 Runs Test 2010 - 2014

Series	CNI2000_R
Test Value[a]	.000000
Total Cases	1211
Number of Runs	551
Z	-2.744
Asymp. Sig. (2-tailed)	.006

a. User-specified.

Hypothesis 6

The autocorrelation test and the runs test results of the CNI 2000 index series in the period of 01/01/2015 – 31/12/2018 are presented in **Table 16** and **Table 17**. The P-values of the Ljung-Box test are all less than 0.05. Thus, we can reject the null hypothesis of Ljung-Box at 5 per cent significance level. That is, the time series do not conform to the random distribution. The P-value of the runs test is larger than 0.05, so we cannot reject randomness by the runs test. Synthesising

the results of the autocorrelation test and the runs test, we reject the $H6_0$. Thus, the CNI 2000 index is not conformed to the weak-form EMH from 2015 to 2018.

Table 16 CNI 2000 index logarithmic daily return Autocorrelations 2015-2018

Series: CNI2000_R

Lag	Autocorrelation	Std. Error[a]	Ljung-Box Statistic		
			Value	df	Sig.[b]
1	.130	.032	16.561	1	.000
2	.032	.032	17.592	2	.000
3	.068	.032	22.095	3	.000
4	.080	.032	28.370	4	.000
5	.028	.032	29.145	5	.000
6	.017	.032	29.432	6	.000
7	.055	.032	32.400	7	.000
8	.066	.032	36.650	8	.000

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

Table 17 CNI 2000 Runs Test 2015-2018

Series	CNI2000_R
Test Value[a]	.000000
Total Cases	975
Number of Runs	473
Z	-.596
Asymp. Sig. (2-tailed)	.551

a. User-specified.

Hypothesis 7

The autocorrelation test and the runs test results of the HSI index series in the period of 01/01/2015 – 31/12/2018 are presented in **Table 18** and **Table 19**. The P-values of the Ljung-Box test and the Runs test are all larger than 0.05. Thus, we cannot reject the null hypothesis of the time series are random. That is, the HSI index is in line with the weak-form EMH from 2015 to 2018.

Table 18 HSI logarithmic daily return Autocorrelations 2015-2018

Series: HSI_R

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	.014	.032	.182	1	.669
2	.001	.032	.184	2	.912
3	.029	.032	.992	3	.803
4	-.006	.032	1.033	4	.905
5	-.049	.032	3.415	5	.636
6	-.009	.032	3.496	6	.745
7	.024	.032	4.074	7	.771
8	-.016	.032	4.310	8	.828

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

Table 19 HSI index Runs Test 2015-2018

	HSI_R
Test Value[a]	.000000
Total Cases	973
Number of Runs	473
Z	-.847
Asymp. Sig. (2-tailed)	.397

a. User-specified.

4.3 Summary

In this chapter, I test the randomness of daily returns of Hong Kong Hang Seng index, China A-share CNI 50 index and CNI 2000 index at different periods with two test methods, namely the serial correlation test and the runs test. The observed results are summarised as follows:

1. From 1998 to 2001, the Hong Kong stock market fluctuated wildly under the influence of the Asian financial crisis and the dot-com bubble on the other side of the ocean. In

1998, the government even intervened in the stock market to counter international speculator's shorting stocks. The performance of the Hang Seng Index was not in line with the weak-form efficient market characteristics in this period.

2. From 2015 to 2018, China's A-share market experienced leverage bull and deleverage bear markets. When the Chinese government intervened in the stock market, neither CNI 50 index nor CNI 2000 index was in line with the weak-form efficient market characteristics. In the same period, the Hong Kong stock market was weak-form efficient.

3. In the period from 2002 to 2014, when there were no government interventions, though there was the subprime mortgage crisis in the US, the HSI index showed weak-form efficient market traits. Similarly, the CNI 50 index in the period from 2008 to 2014 behaved in weak-form efficiency before the government intervention in 2015.

4. From 2008 to 2014, the CNI 50 index conformed to the weak-form EMH, while the CNI 2000 index did not conform to the weak-form EMH from 2010 to 2014. It indicates that the small-cap firms are different from the blue-chip firms in terms of the weak-form market efficiency.

Chapter 5 Findings and Discussions

In this chapter, I discuss the vital influence of several premise assumptions of the EMH on market efficiency and the evidence in the development process of China's stock market. The discussions are mainly focusing on the following aspects: first, whether or not the government interventions in the market have positive effects on market efficiency; second, why the large-cap stocks index shows more efficient than that of the small-cap stocks.

5.1 The Ideal Market Conditions of the Efficient Market Hypothesis

The efficient market theory has four assumptions:

1. The market information is fully disclosed, and each market participant gets the same amount of information of equal quality at the same time.
2. There is no cost to access all the information on the security market.
3. There are a large number of rational investors who actively participate in the market and rationally analyse, price and trade securities in order to pursue the maximum profit. This assumption includes three points:
    1) It is assumed that investors are rational, so investors can rationally evaluate the value of assets.
    2) Even if some investors are not rational, because their trades are random, the trades cancel each other out and do not affect the price of the asset.
    3) Even if investors' irrational behaviours are not random but correlated, they will encounter rational hedgers in the market who will eliminate the effect of the former on prices.
4. There is no delay and cost in security trading.

Electronic securities online trading system has been popularised in the last two decades, which not only reduces the cost of securities transaction but also improves the speed of information flow. Traditional securities information service mainly focuses on market service. In terms of

necessary quotation information, the amount of information is not very large. Securities investors often need to buy newspapers or watch TV to receive more information to support the analysis of the market. The modern online information service, provided by the securities information service website, not only can see the quotation, at the same time also can get information dynamic, and can be classified query. Investors can even set focus on the types of information, and the system will automatically help investors to make dynamic information retrieval, which accelerates the securities information flow. Therefore, security information services can significantly improve the factors of security information asymmetry, imperfection, and the speed of information circulation. At the same time, the securities online trading system significantly reduces transaction costs.

However, there is still a delay in the transmission of information, and there are usually many rumours that are difficult to identify. Also, getting accurate information faster than other investors, or getting faster access to the trading system than other traders, can be costly. Therefore, the information flow and the trading environment have improved, but not as perfect as the ideal conditions.

Apart from the resistance of information flow and transaction costs, the main factor affecting market efficiency is the assumption of rational investors. In the financial market, rational investors refer to those who seek to maximise profits base on rational expectations. The basis of rational expectations is a series of contemporary financial theories including Modern Portfolio Theory, Capital Asset Pricing Model and Arbitrage Pricing Theory (Markowitz, 1959; Sharpe, 1964; Roll & Ross, 1980). Rational investors make an objective evaluation on the future returns and risks of securities, then design the portfolio according to their own investment needs, and continuously adjust the portfolio according to the latest information released. However, since everyone has different opinions on the future returns and risks of securities, even rational investors have different views on the value of securities.

At the same time, irrational investment behaviours in the real market are prevalent. Behavioural finance studies have found that a large number of investors have psychological characteristics when making decisions, such as overconfidence, avoiding losses, herd mentality and shirking responsibilities, which often lead them to deviate from the optimal decisions

described by modern financial theories (Singh, 2012). As a consequence, the security market is experiencing a cycle of collapse, recovery, prosperity, irrational boom and the next collapse. In the stage of recovery and prosperity, rational investment behaviours dominate, and the market is efficient, while in the stage of irrational boom and collapse, irrational investment behaviours dominate, which causes inefficiency of the market. Even mature equity markets such as the US and UK cannot avoid periodic crashes and the periodic market inefficiency.

The underlying reasons are as follows:

1. There are no entirely rational standards because the difference of investors' cognition leads to the different understanding of the risk and return of securities.
2. Greed and fear are the nature of human, which are often amplified and lead to irrational trading behaviours when the market becomes crazy and panic.
3. The positive feedback loop effect makes investors having excessively optimistic or pessimistic expectations (Shiller, 2015).

Therefore, markets tend to become inefficiency when they collapse, and a large number of anomalies that defy the EMH also occur in the periods of financial crises.

From what has been discussed above, the EMH is a fundamental assumption under the ideal state to analyse the nature of security markets. However, this idealised model is too simple. In reality, there are imperfect information transmission and irrational investors in the security market. When the market is in recovery and prosperity stages, the market shows efficiency. When irrational exuberance or panic mode kicks in, the market is entirely inefficient.

5.2 The Interventions of Government in Hong Kong and China's Stock Markets

5.2.1 Hong Kong stock market in the Asian financial crisis

The EMH can be regarded as an extension of Smith's (2015) "invisible hand" in the investment universe. That is, when the price mechanism is fully functioning, supply and demand in a free market will naturally balance. In other words, the free market is the fundamental principle

by which markets work. The test results show that the Hang Seng index in Hong Kong was inefficient in 1998 when government funds intervened in the market. Although the subprime crisis in 2008 caused the turmoil in global stock markets, the Hang Seng index remains efficient in the other two tested periods from 2002 to 2018. At first glance, it looks as if government intervention has made Hong Kong stock market inefficient. Why does government intervention make markets less efficient? Let us analyse the specific situation at that time.

The Asian financial crisis broke out in Thailand in 1997 and then spread to other countries and regions in Southeast Asia, including Malaysia, Indonesia, Philippines and Hong Kong. Before 1997, as the US economy recovered, the Federal Reserve began to raise interest rates to curb inflation, which caused hot money to flow back into the US. Southeast Asian countries, which used to benefit from hot money inflows and enjoy economic and asset price prosperity, became to face the pressure of capital outflow and exchange rate depreciation, making them the prey of international hedge funds. Speculative institutions made use of the capital advantage to bet against the Thai Baht, forcing the Thai government to abandon the fixed exchange rate system, which led to the collapse of the Thai Baht. Subsequently, the Philippine Peso, Indonesian Rupiah and Malaysian Ringgit became the targets of international speculators one by one and all devaluated sharply.

The exchange rate of the Hong Kong dollar against the U.S. dollar has been maintained at 7.8 since 1983. Speculative institutions began to bet against the Hong Kong dollar in October 1997. The Hong Kong Monetary Authority (HKMA) utilised its $80 billion foreign reserves to defend the Hong Kong dollar's exchange rate, but speculators take advantage of the unique currency board system of Hong Kong (i.e. large net sales of local currency can push up overnight interest rates automatically) forcing interest rates increased significantly. The rising interest rate put downward pressure on the stock market and the speculators profited by shorting the stock spot and futures markets. Hang Seng index fell from 16,820 points in August 1997 to 6,660 points on August 13, 1998. The Hong Kong government and the HKMA declared war on speculators and began buying blue-chip stocks on August 14th 1998. Eventually, the Hong Kong government spent about HK $120 billion to halt the slide successfully and beat back the international hedge funds. Hong Kong's economy and the stock market recovered quickly over the next two years, surpassing pre-crisis

levels, which was partly because of the rising appetite for risk brought on by the dot-com bubble.

From the example of Hong Kong, we can see that the stock market was overvalued before the crisis, shorting of hedge funds made market rapid fell to a reasonable level. However, due to the external environment (financial crisis), investors worried about the market crash, when the market had been underestimated seriously, they still took short strategy. Thus, the market plunged endlessly, until the government intervention to stabilise the market. Therefore, in the environment of the market collapse in panic, the HKMA's long entry into the stock market was not the cause of market inefficiency but played a role in avoiding market collapse and bringing the market back to efficiency.

5.2.2 Leverage bull market and deleverage bear market in China's A-shares

Next, let us look at mainland China. The turbulence of China's A-share markets from 2015 to 2018 is a subject of significant research value, including surge, plunge, various government policy interventions and financial interventions. The Shanghai Composite Index (SHCI) and the Shenzhen Component Index (SZCI) are the price indices representing all the stocks trading on the Shanghai and Shenzhen stock exchanges in China. In 2014, the SHCI rose 53 per cent, and the SZCI rose 34 per cent, outperforming global equity markets. In the first half of 2015, the stock market accelerated. From December 31, 2014, to June 12, 2015, the SHCI soared by 60%, while the SZCI soared by 122%. Data from the Shanghai and Shenzhen stock exchanges (Shanghai Stock Exchange, 2019b; Shenzhen Stock Exchange, 2019b) show that the leveraged trading was the primary driver of this sharp rise. The first wave was from November 2014 to January 2015, when the financing balance rose 46.7% from 750 billion yuan to 1.1 trillion yuan, and the SHCI rose 35.8% in the same period. In order to cool the market, the China Securities Regulatory Commission (CSRC) announced the punishment decision of the financial businesses of several security brokerage firms, the accelerated entry of leveraged funds into the market came to a short end, and the market began to adjust about one month. In the second wave, from March to June of 2015, the financing balance increased from 1.2 trillion yuan to 2.26 trillion yuan, up 88.3 per cent, while the SHCI and the Growth Enterprises Market Board index rose 60 per cent and 102.3 per cent, respectively. In that period, apart from the 2.26 trillion yuan of financing provided by security

brokerage companies, there were 800 billion yuan of off-exchange trust fund allocation from the shadow banking system and an estimated 1 trillion yuan of private fund allocation, entered into A-share markets.

A virtual account management software called HOMS, developed by Hang Seng Electronics, a leading online trading system software provider for securities firms in China was the technical basis for this leveraged bull market. The software can manage thousands of virtual accounts that trade through a single account registered in security brokerage companies, and it is similar to a subordinate broker software platform, which allows any company or individual to provide financing business for its customers. As margin trading was a new thing, in order to control risks, CSRC stipulated that individual investors must have more than 500,000 CNY of capital and more than two years of stock trading experience before they can participate in margin trading. Besides, only the component stocks of CSI 300 index (large-cap stocks) can use financing funds to buy, and the financing ratio was low; usually the highest leverage ratio is 1:2. In contrast to the strict supervision of securities companies, the leverage ratio of private allocation companies was usually 1:5 to 1:10. Any stock can be purchased using allocation funds. At the beginning of 2015, the hot market coupled with the temptation of excessive profits had attracted a large number of retail investors to gamble with high leverage on illegal allocation platforms.

In April 2015, CSRC required securities firms not to participate in off-exchange fund allocation and umbrella trust, and not to provide data interfaces and other services for off-exchange stock fund allocation and umbrella trust. But there was no cooling effect. In May, the CSRC issued an emergency internal notice to securities firms, requiring them to conduct self-inspection and self-correction to participating in off-exchange capital allocation related businesses, including connecting to the Hang Seng HOMS system to provide off-exchange capital allocation services. On June 12, the CSRC issued the notice on strengthening the external access management of the information system of securities companies, which emphasised these kinds of activities were illegal. Then the A-share markets took place the most violent slump ever. In 3 months, there were 14 trading days in which more than 800 stocks hit the downward limit (i.e., -10%). More than 500 listed companies suspended their shares to avoid further fall on July 8, bringing the number of companies suspended to about 1,300, or 45 per cent of the total A-share stocks (France24.com,

2015). The SHCI fell to 2,850 points on August 26 from 5,178 points in June, and the balance of financing fell to 1.1 trillion yuan. At this point, the off-exchange fund allocation had been completely cleared out of the stock market.

In the process of market panic and plunge, the government started a large-scale rescue operation to stabilise the market. The People's Bank of China announced targeted cuts in the required reserve ratio for financial institutions starting on June 28th. The Shanghai Stock Exchange announced on its microblog that it plans to lower fees for A-share trading from August 1st. On July 4th, the State Council asked the CSRC to suspend IPOs. On July 8th, the CSRC issued a notice restricting shareholders holding more than 5 per cent of shares in listed companies from reducing their holdings. China Securities Finance Corporation Limited (CSF) started buying shares from July 9th with 120 billion CNY when the SHCI was about 3,400 points. After a brief rise, the market continued to fall. In the following years, the market fell in volatility, and the SHCI hit a new low of 2,440 points in January 2019, and the financing balance fell to a minimum of 720 billion CNY. **Figure 7** shows the bull-bear conversion of the A-share market from 2014 to 2018 with the increase of leverage and deleveraging.

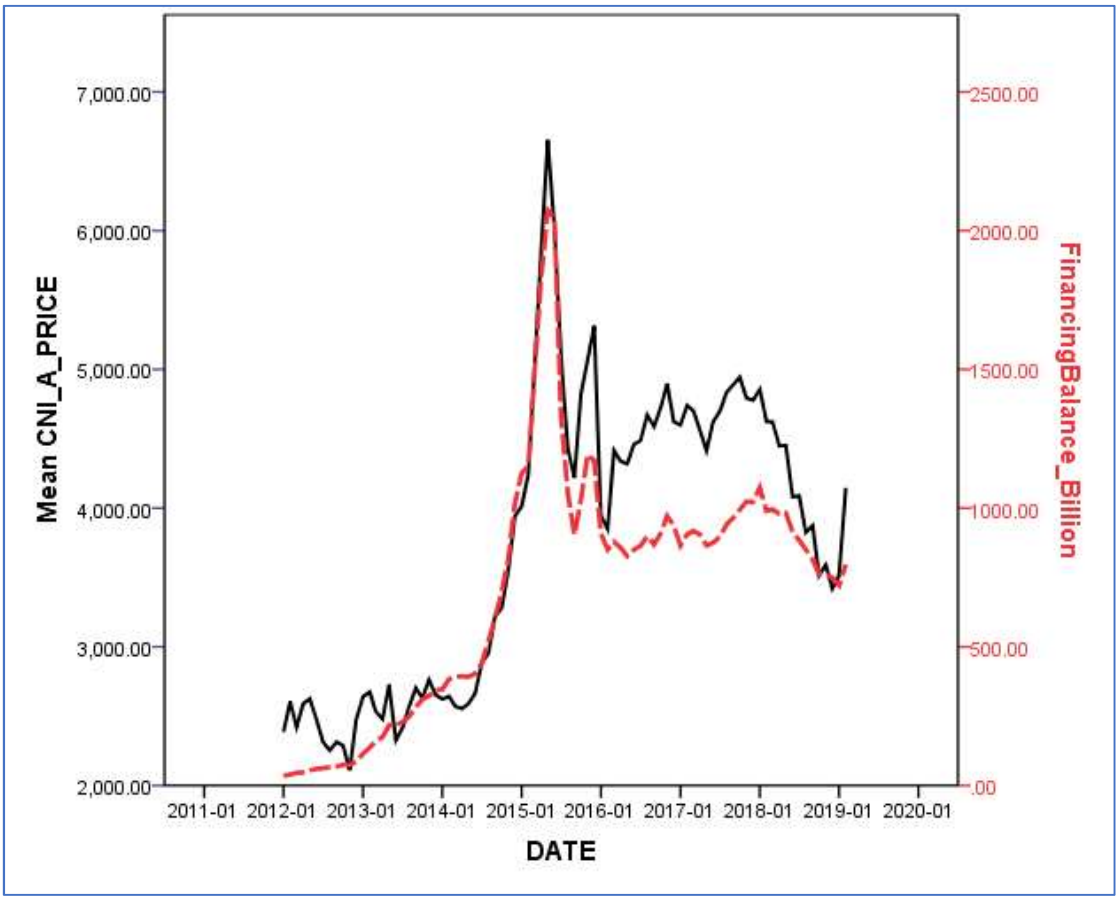

Figure 7 Monthly Financing Balance VS. CNI A Index 2012 - 2019

Compared with the global market, the composition of investors in China's stock market is different, with an overwhelming majority of retail investors. There are several characteristics of the retail investors in the Chinese stock markets:

1. They prefer small-cap and micro-cap stocks because of the significant fluctuations.
2. They have insufficient knowledge and experience in the stock market.
3. They like to study technical graphics for short-term trading.

From the above analysis, it can be seen that a large number of inexperienced retail investors participate in the margin trading and the irrational speculative behaviours are the real reasons for the market inefficiency. In the process of the rise of market irrationality, regulators' lack of supervision over the off-exchange fund allocation and their excessive supervision actions on the eve of market collapse are also the driving force for the surge and plunge of market irrationality. Government bailouts and directly buying stocks to intervene in the market are the last resort.

5.3 The Blue-chip Stocks and the Small-cap Stocks in China

According to the test results, the large-cap index CNI50 is weak-form efficient between 2008 and 2014, while the small-cap index CNI2000 does not conform to the weak-form efficient characteristics from 2010 to 2014. The reasons are as follows:

1. After the two years (2005-2007) of stock reform, a large number of state-owned shares and legal person shares that could not circulate in the past could circulate and made the current market value expand sharply. The components of the CNI 50 index are all large enterprises, and even the smallest company of the components has a market capitalisation of more than 100 billion CNY, while the components of the CNI 2000 index are mostly between 1 billion and 6 billion CNY. Small stocks are more likely to attract speculative capital and make profits by manipulating stock prices. At the same time, there are a large number of individual investors who are willing to gamble in the small-cap shares because of the volatility. As shown in **Figure 8**, the fluctuation of the CNI 2000 index is more than that of CNI 50 index.

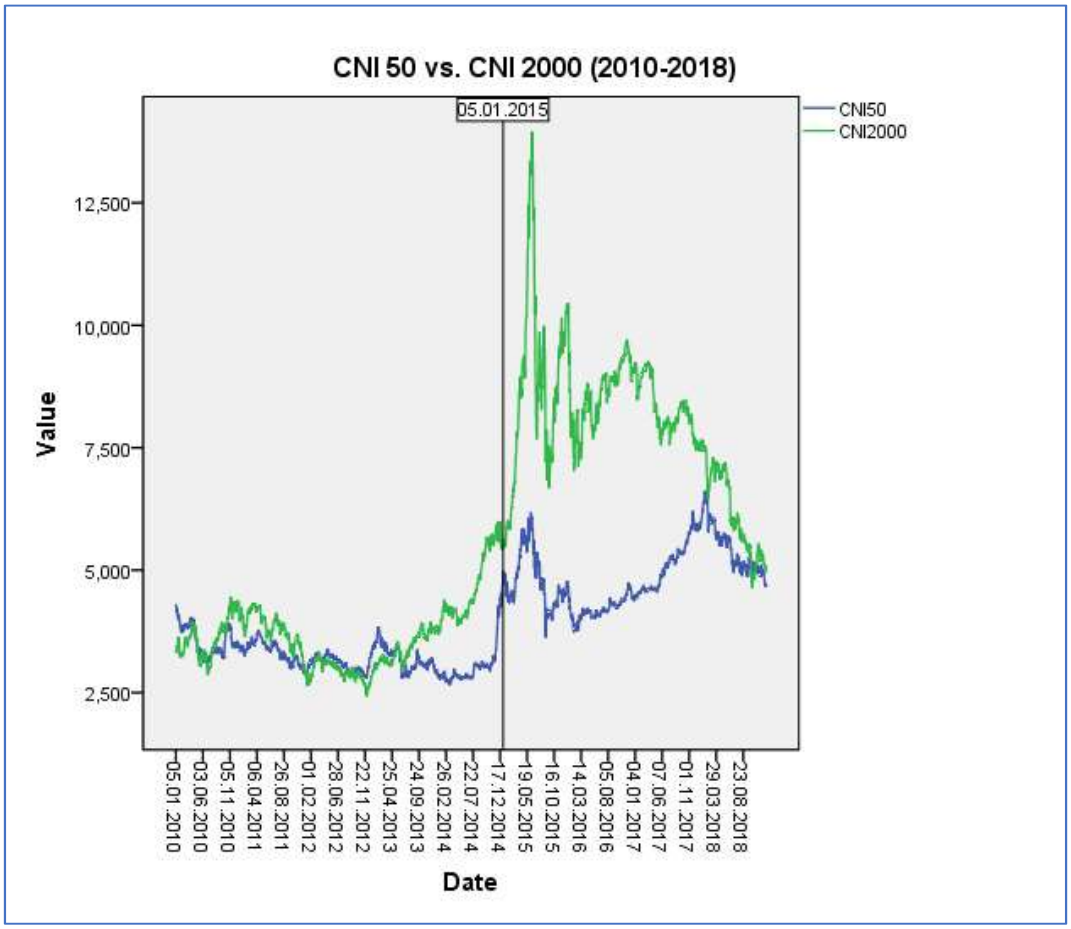

Figure 8 CNI 50 Index VS. CNI 2000 Index (2010-2018)

2. A mature stock market needs a short-selling mechanism. When the stock price is overvalued, the short-selling mechanism can suppress the stock price to a reasonable level. The shorting mechanism of the A-share markets has been tried out since 2010, but only a few hundred large-cap stocks can be shorted, without covering the small and medium-sized stocks such as the components of the CNI 2000 index. The imperfection of short-selling mechanism causes the average P/E of large-cap stocks like the CNI 50 index to fluctuate between 10-25, while the average P/E of small-cap stocks like CNI 2000 index often fluctuates between 25-70.

3. Due to historical reasons, the IPO system and delisting mechanism of A-shares are unreasonable. The approval IPO system caused that it is complicated for a company to list on the A-share market. As a result, once a company listed, each stakeholder tries their best not to let the company delisted. Even if the company cannot bring any profit, the

major shareholders would also maintain the status of the listed company by restructuring, divestment of loss-making businesses or selling shell and so on. Generally, emerging markets have relatively low delisting rates, such as Hong Kong at around 2% per year, while mature markets have high delisting rates, such as the UK and US capital markets at around 10% per year. However, since the first delisting case in 2001, only 108 stocks have been delisted as of July 30, 2018, in China's A-share markets, and 36 of them were delisted because of mergers. Why are there so few delisted stocks? In the financial type of delisting standards in the A-share market, there is a standard that for three consecutive years of losses, the company should be delisted. Many poorly managed and unprofitable companies avoid delisting by whitewashing financial statements after two years of losses. The methods include selling land, creditor's rights transfer, selling accounts receivable, debt exemptions and so on. For speculators, speculation in small-cap stocks means huge profits and minimal risk of delisting, which attracts a large number of speculators treating CNI 2000 index components as their speculative targets and do not care about their intrinsic value.

In brief, in China's A-share markets, the CNI 50 index representing blue-chip stocks usually shows the characteristics of weak-form efficiency because more rational individual and institutional investors usually concern the large-cap stocks with good liquidity and reasonable prices. On the other hand, the more easily manipulated small-cap stocks tend to be favoured by speculators, which causes that the CNI 2000 index shows greater volatility and inefficiency.

5.4 Summary of Findings

This chapter discusses the assumptions of EMH and analyses the market efficiency of the Hong Kong stock market and China's A-share market in different periods based on the results of the hypothesis test in the previous chapter. The following findings are obtained.

The first finding derived from the hypothesis test results is the inefficiency of China's A-share and Hong Kong stock markets during the periods of the direct intervention of government funds. The periods include the Hong Kong stock market in 1998 and China's A-share market in 2015. Sometimes I find that these government interventions were not the reason for the market's

inefficiency. On the contrary, they were the force to make the market return to be efficient. It was the excess speculations that caused the inefficiency, and the market could not recover on its own under that panic atmosphere.

The second finding is that the large-cap stocks in China's A-share market show weak-form efficiency, while the small-cap stocks are inefficient. The reasons include:

1. Small-cap stocks need fewer funds to drive price rise; thus, they are more easily manipulated by speculators;
2. There is no short selling mechanism for small-cap stocks in A-share markets;
3. Most of the small-cap firms are almost impossible to be delisted because of the defects of the delisting system.

Chapter 6 Conclusions and Recommendations

6.1 Conclusions

The EMH has been challenged over the past 40 years by various market anomalies, such as the small firm effect (Reinganum, 1981), the calendar effect (Rossi, 2015), the stock market crash during the recurring financial crisis (Ball, 2009) and so on. Fama (1998) countered the critics of behavioural finance arguing that there are all sorts of states in an efficient market, both overreaction to price information and underreaction to it. Markets are efficient if the probability of overreaction and underreaction is roughly equal, which was proved in many empirical studies. To reject the EMH requires a well-defined opposing hypothesis, which behavioural finance cannot yet do. The EMH reflects the ideal conditions, while the anomalies of the real market are deviations from the ideal conditions. We can study the level of market efficiency by selecting different periods and portfolios.

In this study, I investigate the performance of China and Hong Kong stock markets in different periods. The CNI 50 index, the CNI 2000 index and the HSI index are selected as the research objects to analyse and compare the informational efficiency related topics. The CNI 50 index represents the big listed companies, and the CNI 2000 index represents the small-cap and micro-cap firms of Chinese A-share market. The HSI index, which compares with the CNI 50 index, represents Hong Kong blue-chip stocks. Periods selections include the A-share crash of 2015 and the Southeast Asian financial crisis of 1998, which both involve government bailouts. There are seven hypotheses to verify whether the indices are in line with the weak-form efficiency in the specified periods, by conducting the serial correlation test and the runs test.

Through the empirical tests, I summarise the following characteristics of China's A-share and Hong Kong stock markets:

1. In the A-share market, the large-cap stocks index was in line with the weak-form efficient characteristics from 2008 to 2014, while small-cap stocks index did not. This result is consistent with the previous study (Liu, Hu & Li, 2018) that the Shanghai Composite index is roughly weak-form efficient.

2. When the market entered the panic mode, the government intervened in the market, and the market was no longer consistent with the weak-form efficiency, which has been verified in both the A-share market and the Hong Kong market.

3. The Hong Kong HSI index was consistently weak-form efficient from 2002 to 2018, which was benefited from having lots of rational investors and effective rules. The CNI 2000 index did not conform to the weak-form efficiency because of a large number of irrational speculators and the unreasonable listing and delisting rules in China's A-share market.

Although both the CNI 50 index and CNI 2000 index from 2015 to 2018 showed inefficiency, I guess this is the result of the excessive deleveraging after the overleveraged bull market in 2015. In my opinion, the blue chips in China's A-share are weak-form efficient, and the small-cap stocks are more speculative at the moment. Hong Kong stock market is more efficient than China's A-share because of the more rational participants and more effective regulations.

The implications of these findings can help regulators better understand the market and improve the regulations. Investors can choose the appropriate investment strategies and targets according to the market efficiency level in China and Hong Kong stock markets.

6.2 Limitations of This Study

One limitation of this study is that the A-share market is relatively young and the period of the sample data is not as large as the mature markets. The CNI 50 index has been published since 2005. However, due to the A-shares were not fully tradable before the stock market reform, the data from 2008 to 2018 are selected as the research object. The CNI 2000 index data was only released after 2010 when the number of A-shares exceeded 3,000. Up to now, it has only nine years of historical data.

The other limitation is that the autocorrelation test and the runs test have been used for many years to validate the weak-form efficient market. However, the EMH and the two validating methods are not exactly equivalent. The autocorrelation test can validate the white noise trait of a time series. The runs test can examine the random distribution character. Both the white noise and

random distribution are necessary conditions for the weak-form efficient market, but not sufficient conditions. Therefore, when both of the necessary conditions are met, it can only be said that we cannot reject the null hypothesis. Namely, the market is weak-form efficient. When any of the conditions reject the null hypothesis, the market is inefficient.

6.3 Recommendations for Further Studies

With the support and promotion of the government, China's A-share markets are gradually maturing. The approaches to promote market efficiency include the increase of pension fund investment proportion, the further improvement of rules and regulations, and the progressive relaxation of foreign investment access regulations. Meanwhile, with the overall level of education and the popularity of the Internet, more and more retail investors of the stock market are changing from the past speculative strategy to the strategy of value investing. Therefore, it is of great significance to study the weak-form efficiency and semi-strong efficiency of the A-share market. There are two research orientations suggested as follows:

For the data selection, in order to obtain more sample data in a short period, the hourly closing price or even the five-minute closing price can be applied to observe the price's response to the information. The price data of various sub-indices or individual stocks can be used to study market efficiency.

As for research methods, apart from trying different statistical methods to study randomness of the security price movements, validating the uselessness of varied technical analysis should also be addressed. Since China's economic model is not entirely market-driven and government policies have a profound impact on the market, the impact of policy information on market efficiency is also worth further study.

6.4 Recommendations for Practices

Through this study, I find that speculation in China's A-share market especially the small-cap stocks is quite common, and a plethora of speculation behaviours probably causes the market inefficiency. The practical recommendations are divided into two aspects, for regulators and investors.

In order to improve market efficiency, the following issues need to be addressed by the policymakers and regulators:

1. The Initial Public Offering and delisting systems should be improved to encourage enterprises to return to shareholders through dividends and change the past model that investors could only earn profits by trading.

2. The financial fraud activities of listed companies should be severely punished; meanwhile, a class-action lawsuit system should be established to protect the interests of small shareholders.

3. The short selling mechanism needs to be improved. Although there is margin trading in the A-share market at present, there are few securities to lend to short, which is one of the main reasons why stocks are overvalued in the A-share market.

4. Individual investors account for more than 90 per cent of the A-share market in China (China Securities Depository and Clearing Corporation Limited, 2019), and investor education should be incorporated into the national education system. Although some schools have started offering financial investment courses, they are not part of the national education system (Xie, 2019).

The recommendations to investors have three main points as followings:

1. Hong Kong's stock market is already weak-form efficient, and China's blue-chip index is almost weak-form efficient. According to the EMH, the technical analysis fails in weak-form efficient markets. Therefore, fundamental analysis (i.e. value investment) is an effective strategy. The apparent investment opportunities are in the under-valued blue-chip stocks, for example, the average price to earnings ratio (P/E) of Chinese banking companies listed in A-share and Hong Kong markets is much lower than that in the US stock market.

2. The improvement of regulations, the rapid increase of retail investors' cognitive level, the entry of long-term investment institutions and the relaxation of foreign investment access rules have been driving the A-share market to be more efficient. Efficient market

means there is less chance to beat the market. Thus, passive investing is smarter in both China's A-share and Hong Kong stock markets.

3. The financial crisis broke out periodically in the past few decades, such as the black Monday in 1987, the Southeast Asian financial crisis in 1997 and the American subprime mortgage crisis in 2008. What these crises have in common is their rapid spread to other countries. Currently, when most of the global stock markets are at record highs, investors need to be very cautious.

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Appendix A Project Plan

This research project includes five stages, namely, initiating research proposal and getting approval, reviewing the literature and determining the research method, collecting and analysing data, discussing the results and writing the draft report, getting feedback from supervisors and revision. The detailed tasks and planned schedule present in **Figure 9**.

Figure 9 Gann chart of the research schedule

An Analytical Study of China and Hong Kong Stock Markets Efficiency				DURATION (days)
TASK NO.	START DATE	END DATE	DESCRIPTION	
1	8/12/2018	14/01/2019	Research proposal feedback and revision	36
2	15/01/2019	31/01/2019	Literature review and research design	16
3	1/02/2019	10/02/2019	Data collection and analysis	9
4	11/02/2019	31/03/2019	Analysing results and writing draft report	50
5	1/04/2019	17/04/2019	Revising paper according to the supervisors' feedback	17
6	18/04/2019	19/04/2019	Submitting the paper	1