INFORMATION UNCERTAINTY OF EARNINGS AND INVESTOR BEHAVIOR

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A Thesis Submitted in Partial Fulfillment of the Requirements

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Department of Banking and Finance

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นายมนัสวิน ฐิติสมบูรณ์

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
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วิทยานิพนธ์ฉบับนี้มีจุดประสงค์ที่จะศึกษาพฤติกรรมของนักลงทุนอันเนื่องมาจากความ ไม่แน่นอนของข้อมูลกำไรบริษัทในประเทศไทย ช่วงระหว่างปี พุทธศักราช 2539 ถึงปีพุทธศักราช 2553 โดยความไม่แน่นอนของข้อมูลกำไรบริษัทสามารถหาได้ผ่านทางการหาความคงที่ของกำไร บริษัท และกลยุทธ์การลงทุนแบบโมเมนตัมจะถูกใช้ในการอธิบายการตอบสนองที่ช้ากว่าปกติของ นักลงทุน

วิทยานิพนธ์ฉบับนี้ได้ข้อสรุปที่สำคัญ 2 ประการ ข้อสรุปข้อที่หนึ่งคือ โดยเฉลี่ยแล้ว นัก ลงทุนจะมีพฤติกรรมที่ตอบสนองต่อข้อมูลที่ช้ากว่าในกลุ่มบริษัทที่มีระดับความไม่แน่นอนของ ข้อมูลสูงเมื่อเทียบกันกับบริษัทที่มีระดับความไม่แน่นอนของข้อมูลต่ำ ข้อสรุปข้อที่หนึ่งมีความ สอดคล้องกับงานวิจัยในอดีตที่มีใจความสำคัญว่า นักลงทุนส่วนใหญ่จะมีอคติที่มากกว่า ต่อกลุ่ม หลักทรัพย์ที่มีความไม่แน่นอนของข้อมูลสูงกว่า นอกจากนี้ พฤติกรรมตามธรรมชาติของมนุษย์ได้ ถูกหยิบยกมาอธิบายถึงข้อสรุปที่หนึ่งว่า นักลงทุนโดยทั่วไปมักจะตัดสินใจบนพื้นฐานของความ แน่นอนและพยายามหลีกเลี่ยงที่จะเลือกการตัดสินใจบนพื้นฐานของความไม่แน่นอน กล่าวคือ นัก ลงทุนมีความมั่นใจที่จะเลือกตัดสินใจในสถานการณ์ที่เขารู้ถึงความน่าจะเป็นและความเป็นไปได้ ของผลลัพธ์ ในทางกลับกันนักลงทุนจะหลีกเลี่ยงการตัดสินใจในสถานการณ์ที่เขาไม่รู้ถึงความ น่าจะเป็นและความเป็นไปได้ของผลลัพธ์

ข้อสรุปข้อที่สองคือ พฤติกรรมการตอบสนองของข้อมูลที่ช้ากว่าปกติของนักลงทุนจะมี มากกว่าในช่วงที่ระบบเศรษฐกิจอยู่ในสภาวะถดถอย เมื่อเทียบกับช่วงระยะเวลาที่ระบบเศรษฐกิจ มีการขยายตัว เนื่องจากในช่วงเวลาที่ระบบเศรษฐกิจอยู่ในสภาวะถดถอย นักลงทุนส่วนใหญ่ถูก กระทบด้วยผลของการเกลียดชังความสูญเสีย กล่าวคือ นักลงทุนมักมองการสูญเสียว่าส่งผล กระทบต่อตนเองมากกว่าการได้มา ส่งผลให้นักลงทุนมีพฤติกรรมที่ตอบสนองช้ากว่าปกติ

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The purpose of this paper is to examine how information uncertainty on earnings affects investor behavior in Thailand during 1996-2010. Specifically, this paper use earnings persistence as a proxy for information uncertainty, while momentum profits are used as a proxy for behavior of under-reaction by investor.

There are two main conclusions in this paper. First, investors are, on average, more under-react to firms that contain high degree of information uncertainty than firms that contain low degree of information uncertainty. The first conclusion is consistent with prior evidence that higher uncertainty on a group of stocks can create higher degree of psychological biases (Hirshleifer (2001)). In addition, human nature is put forward to explain the first conclusion. Investors are likely to make a decision where they know the odds and the possible outcomes, while they avoid making a decision where the odds and possible outcomes are unknown.

Second conclusion is that the degree of under-reaction is higher during economic recession than economic expansion. The explanation is given in term of loss aversion. During economic recession, investors anticipate loss on investment. In general, investors are more sensitive to a loss than a gain of similar magnitude when making a decision under uncertainty environment. This can be implied that investors prefer avoiding losses to acquiring gains, creating the behavior of under-reaction during economic recession.

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## ACKNOWLEDGEMENTS

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# CHAPTER I

# INTRODUCTION

## 1.1 Background and Problem Review

The purpose of this paper is to examine how information uncertainty on earnings affects investor behavior. Specifically, this paper use earnings quality as a proxy for information uncertainty, while momentum profits are used as a proxy for investor behavior. To understanding the term that earnings quality can be used as a proxy for information uncertainty, according to Dechow et al. (2010) [1] who provide the various measures as an indication of earnings quality, one of the indications is earnings persistence. The idea of earnings persistence is that firms with more persistent earnings have more sustainable earnings or cash flow stream. Moreover, firms that have more persistent earnings can be implied that current earnings is contained more useful summary measure of future firms' prospect and give smaller valuation errors than firms that have low earnings persistence. Penman and Zhang (2002) [2] give the definition of good earnings quality as if a reported earnings is a good indicator of future earnings which refers to sustainable earnings. On the other hands, when accounting treatment creates unsustainable earnings, it classifies as poor earnings quality. Moreover, Beneish and Vargus (2002) [3] define earnings quality as the likelihood that firm can sustain current earnings in the future. As a result, it can be concluded that when holding the value of earnings constant, the higher the earnings persistence, the higher the earnings quality, consequence in low information uncertainty. While the term that momentum profits are used as a proxy for investor behavior can be observed if investors under-react to new information, this paper

should be able to observe the abnormal returns arise after the announcement date which we call return continuation or momentum profits.

The effect of investor psychology or investor behavior on asset pricing becomes interesting because it seems that there is a misvaluation on securities that cannot be explained by traditional asset pricing theory.[1] One of the key important assumptions in traditional asset pricing theory is that investors are perfect rationality. The term "perfect rationality" means investors must be able to identify all possible outcomes and also probabilities of each outcome in order to make a decision that maximize their utilities, but in reality, rationality of investors is limited by the ability in term of acquiring and assessing the information.[2] Simon (1955) [4] is the first who proposes a behavioral model of rational choice. He states that investors are unable to reach the optimal solution due to calculating power and the complexity of decision problem. As a result, investors make a decision on their satisfaction or heuristic rather than the optimal solution. He calls this idea "Bounded rationality", which describes investors are imperfect rationality.

Hirshleifer (2001) [5] extends the idea of bounded rationality to explain that market misvaluation is arrived from investor psychology. Focusing on the robust anomaly of market misvaluation that Fama (1998) [6] had highlighted the persistence against the efficient market hypothesis, which is momentum anomaly. Price momentum refers to the status hold for the specified stocks that past winners tend to be winners in the future and also past losers tend to be losers over three to twelve months period. This anomaly is first documented by Jegadeesh and Titman

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[1] Hirshleifer (2001)

[2] Simon (1995)

(1993) [7]. After that there are many prior studies provide further evidence that confirm the significance of momentum profits in the intermediate horizon, while the other studies try to provide an explanation of the momentum profits. There are three main explanations of the momentum profits. The first explanation is that the abnormal returns from momentum strategies are related to an additional risk, but the result seems to be opposite, meanings that losers are riskier than winners.[3] As a result, in the absence of risk related explanation, some papers conclude that momentum profits are merely a statistical flawed as a second explanation.[4] Third, behavioral finance has been introduced to explain momentum profits as a last and well-accepted explanation. The models of behavioral finance are mainly point out that momentum profit is derived from the under- / over-reaction of the investors to new information. Generally speaking, momentum profits are arisen from mistaken beliefs of investors, so that on average investors gradually response to new information and create a return continuation as it is documented by Barberis, Shleifer, and Vishny (1998) [8], and Daniel, Hirshleifer, and Subrahmanyam (1998) [9].

This paper is the first that proposes other perspective on investor behavior by extending the idea whether there is any other factor additional to the expectation of investors on earnings information that might cause investor to under- / over-reaction to new information. Interestingly, there are some empirical evidence shows that the behavior of under- / over-reaction is derived from psychological aspects.[5] The first aspect is described that investors have limited cognitive capacity so that investors

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[3] Jegadeesh and Titman (1993)

[4] Fama (1998)

[5] Bloomfield, Libby, and Nelson (2000) and Griffin and Tversky (1992)

have insufficient knowledge in assessing the information that is relevant to qualitative value, such as earnings quality. As a result, when investors have to make a decision based on the information that is relevant to qualitative value, investors perceive uncertainty on that information and hesitate to take actions. This creates the behavior of under-react as it is documented by Bloomfield, Libby, and Nelson (2000) [10]. The second aspect is explained in term of human nature that tend to pay different attention on quantitative value and qualitative value which might cause investors on average over-confident to quantitative value and under-confident to qualitative value as it is documented by Griffin and Tversky (1992) [11].

This paper develops the idea that reflects the situation that might happens more in the reality by introducing the behavior that investors have a learning process from their past experience. The mechanism is that on the first moment investors have insufficient knowledge in assessing the quality information, thus investors will have high level of information uncertainty on earnings, but basically, investors have learning process from their past experience, meanings that investors are able to observe past information about earnings quality by using, such as, earnings persistence as a proxy for earnings quality. As time gone by, investors are more certain on high earnings quality firms, while they still perceive uncertainty on low earnings quality firms. As it is suggested by Hirshleifer (2001) [5] that higher uncertainty on a group of stocks can create higher degree of psychological biases, meanings that the effect of securities misvaluation that arises from investor beliefs or psychological biases should be stronger among firms that have high level of information uncertainty. In other words, investors are more under-react to earnings information that arises from low earnings quality firms. The behavior of under-

reaction can be observed by the return continuation or momentum profits over the intermediate horizon, meanings that this paper expects to observe that there should be higher momentum profits from firms that have low earnings quality than firm with high earnings quality.

Moreover, this paper also investigates the effect of information uncertainty on investor behavior among the difference in economic cycles. The reason why economic cycles are interesting to investigate is that many studies argue that state of the economy has an impact on investor sentiments and then these sentiments is transmitted into action or behavior. Economic cycles fluctuate in economy among period of expansion and contraction. John (1999) [12] states that economic recession is the time that all firms face on high uncertainty situation and the ability to generate a profit will decline. In other words, the level of information uncertainty is increasing during recession and it is decreasing during economic expansion. As a result, this paper should be able to observe the behavior of under-reaction during the recession period more than expansion period. This hypothesis can be explained through the aspect of loss aversion.[6] During economic expansion, most investors on average are making profits, while they anticipate loss on their investment during economic recession. The behavior of under-reaction during economic recession can be explained that, in general, investors are more sensitive to a loss than a gain of similar magnitude when making a decision under uncertainty environment. Kahneman and Tversky (1984) [13]  give an example that most undergraduate participants refuse to stake 10 dollars on the toss of coin if they stand to win less than 30 dollars. This can

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[6] Kahneman and Tversky (1984)

be implied that investors prefer avoiding losses to acquiring gains, creating the behavior of under-reaction.

## 1.2 Objective of the Study

There are three main objectives to be addressed in this paper. First one is to identify the earnings quality among the firms by using earnings persistence as a proxy for earnings quality. Earnings persistence can be done by running the autoregressive model of firms' earnings per share. The data is based on four subsample periods which are 1991-1995, 1996-2000, 2001-2005, and 2006-2010, because this paper concerns on the time varying that earnings quality will be changed over time.

Second objective is to examine how information uncertainty on earnings affects investor behavior. This paper use earnings quality which can be measured by earnings persistence as a proxy for information uncertainty, while momentum profits are used as a proxy for investor behavior. This can be implied that the higher earnings persistence, the lower information uncertainty and the higher momentum profits, the more under-reaction by investors. As a result, second objective is to investigate that the returns on momentum strategies from firms that have high information uncertainty (low earnings quality firms) are higher than the return from firms that have low information uncertainty (high earnings quality firms). In other words, investors are more under-react to firms that have high information uncertainty (low earnings quality) than firms that have low information uncertainty (high earnings quality). The idea has been developed under the idea of bounded rationality that investors are not perfect rational. As a result, in pricing risky assets according to information uncertainty, there should be a misvaluation on the securities. The examination is started by divided all stocks into three different groups based on

earnings quality which are high earnings quality group, medium earnings quality group, and low earnings quality group. Then, with the assumption that investors have learning process from their past experience, meanings that investors are able to observe past information about earnings quality, this makes investors perceive certainty on earnings information for high earnings quality firms over the subsequence period, while investors still perceive uncertainty on information that come from low earnings quality firms. Therefore, after earnings quality has been identified and grouped into three groups, this paper forms momentum portfolios over the subsequence period based on past returns into three portfolios and calculates momentum profit by long the winner portfolio and short the loser portfolio. The momentum profits are compared between high earnings quality group and low earnings quality group. Moreover, the comparison between high quality and low quality group is made even the momentum profits are controlled by Fama-French three factors model and double sorted method.

Third objective is to investigate the effect of information uncertainty on investor behavior among the difference in economic cycles. The reason why economic cycles are interesting to investigate is that many studies argue that state of the economy has an impact on investor sentiments and then these sentiments is transmitted into action or behavior. This paper uses information provided by Trade and Economic indices Bureau, Ministry of Commerce, Thailand, to determine the period of economic expansion and economic contraction. Then, the behavior of under-reaction is examined across the firms that have different degree of information uncertainty as well as compared across different economic cycles.

1.3 Contributions

According to prior studies about earnings qualities in Thailand, there are little evidence. This paper aims to identify earnings quality among the listed companies in Thailand. Specifically, this paper uses earnings persistence as a proxy for earnings quality according to Dechow et al. (2010) [1]. The benefit of using earnings persistence is that individual investors who are classified as unsophisticated investors are able to identify earnings quality among the firms over some periods of time. Therefore, the finding in this paper can be applied to all kinds of investors. In addition, earnings persistence has been used as a standard proxy in examining earnings quality. For example, Penman and Zhang (2002) [2] use earnings persistence as a proxy for earnings quality in order to investigate how accounting methods affect the quality of earnings. Beneish and Vargus (2002) [3] use earnings persistence as a proxy for earnings quality in order to examine whether insider trading is informative about earnings quality and the valuation implications of accruals. Moreover, this paper is the first paper that sheds further light and provides an additional explanation on the different perspective of behavioral finance by using bounded rationality in explaining that investors also concern on information uncertainty of earnings information before making a decision. Specifically, if returns from momentum strategies among low earnings quality firms are higher than the returns among high earnings quality firms, then it can be implied that level of information uncertainty is an important factor that causes investors to behave differently, creating securities misvaluation.

Moreover, this paper uses Thailand equity market which is classified as one of the emerging markets because most of the prior evidence on behavioral finance is

made on developed equity markets such as US market, but the evidence on emerging market is limited. In addition, according to the differences in investor types between individual investors and institutional investors, Thailand equity market becomes an interesting place to investigate an additional work on behavioral finance out of US data because Thailand equity market value is mainly driven by individual investors (approximately 60% of total value in 2012), while in the US equity market (NYSE and NASDAQ), institutional investors are majority investor type on the market (approximately 65-70% of total market value in 2010). As a result, the differences in investor types may cause US market and Thailand market in different behavior. Su (2003) [14] states that on average individual investors have shorter investment horizon compared to institutional investors, meaning that individual investors are classified as speculators.  The effect of short term investment horizon makes individual investors pay more attention on current earnings information and might over- / under-react to the information that is relevant to revise their belief on future firms' performance which is associated with firms' fundamental prospect. This is consistent with the work from Shiller (1984) [15] and De Long et al. (1990) [16] who claim that market trend is more likely to have influence on investment decision of individual investors rather than the fundamentals information. Moreover, individual investors are uninformed investors because the limitation in accessing the information, while institutional investors are informed investors. The transactions that are executed by individual investors are based on only publicly available information, while the transactions from institutional investors are based on various sources of information. As a result, stock price movement according to individual transaction may be less information and the accounting information may contain

more surprise to the individual investors. In summary, individual investors seem to easily follow the market trend without considering on firm's financial information. Thus, individual investors may create mistakes on trading stocks regarding to the lack of understanding true nature of the equity market.

**1.4 Hypothesis Development**

**Hypothesis 1: According to the level of information uncertainty, there should be higher momentum profits from firms that have low earnings quality than firm with high earnings quality.**

Over the past few decades, there is a question that why market participants make systematic error, creating securities misvaluation. At that time, behavioral economics has been proposed as an explanation that investors make systematic error because when investors make a decision, they are always affected by psychological biases. Behavioral economics are concerned with the idea of bounded rationality. Simon (1955) [4] proposes a behavioral model of rational choice. The idea has been developed from the traditional economic theory that investors are perfect rational. The term "perfect rational" means investors must able to identify all possible outcomes and also probabilities of each outcome in order to make a decision that maximize their utilities, but in reality, rationality of investors is limited by the ability in term of acquiring and assessing the information. Specifically, investors are unable to reach the optimal solution due to calculating power and the complexity of decision problem. As a result, investors make a decision on their satisfaction or heuristic rather than the optimal solution. He calls this idea "Bounded

rationality", which describes investors are imperfect rationality. The idea of bounded rationality is consistent with behavioral finance that provides the explanation on momentum profits. The models of behavioral finance are mainly point out that momentum profit is derived from the under- / over-reaction of the investors to new information. In other words, momentum profits are arisen from mistaken beliefs of investors, so that on average investors gradually response to new information and create a return continuation as it is documented by Barberis, Shleifer, and Vishny (1998) [8], and Daniel, Hirshleifer, and Subrahmanyam (1998) [9].

This paper extends the idea whether is there any other factor additional to the expectation of investors on earnings information that might cause investor to under- / over-reaction to new information. It seems that the reliability of the information also cause investors to under- / over-react to information. Griffin and Tversky (1992) [11] explain that when new information is arrived, two things need to be considered. They suppose a situation of evaluation a recommendation letter, the first aspects is the strength of the evidence, which will answer the question that "How positive or negative is the letter?" The second aspect is the weight, which will answer the question "How credible is the writer?" In other words, readers can thing of the relation between strength and weight as the relation between size (quantity) and reliability (quality). What has been observed is that in evaluating the recommendation letter, people pay attention to the strength more than knowledgeable level of the writers. As a result, people focus on the quantity and underutilized the quality of the information. In addition, Bloomfield, Libby, and Nelson (2000) [10] propose a model called moderated confidence which describe when investors have noisy signals about reliable information; they tend to under-

react on this information which can be observed by stock prices. Specifically, if investors have moderated confidence, they will overestimate the reliability of highly unreliable information and underestimate the reliability of highly reliable information. This paper extends their finding and makes an argument that because investors have insufficient knowledge in assessing the quality information, thus investors will have high level of information uncertainty on earnings quality at first moment, but basically, investors have learning process from their past experience, meanings that investors are able to observe past information about earnings quality by using, such as, earnings persistence as a proxy for earnings quality. As time gone by, investors are more certain on high earnings quality firms, while they still perceive uncertainty on low earnings quality firms. Together with the suggestion from Hirshleifer (2001) [5] that higher uncertainty on a group of stocks can create higher degree of psychological biases. His suggestion is come from comparing risky assets which is classified as having high degree of uncertainty asset class with risk-free asset which is classified as having high degree of certainty asset class. He states that it is rarely to see misvaluation in risk free asset according to psychological biases. As a result, it seems that uncertainty on a group of stocks affects the way investors response to information. In other words, the effect of securities misvaluation that arises from investor beliefs or psychological biases should be strongest among the firms that have high level of information uncertainty. Therefore, this paper expects that over some period of time in the past, investors can identify earnings quality among the firms, meanings that investors are more certain on the information that belong to firms that have high earnings quality, while they perceive uncertainty on the information that given from firms that have low earnings quality. This situation makes

investors behave or respond differently between firms that have high quality earnings and low quality earnings. Specifically, the effect of securities misvaluation that arises from investor beliefs or psychological biases should be strongest among low earnings quality firms. In other words, investors are more under-react to earnings information that arises from low earnings quality firms. The behavior of under-reaction can be observed by the return continuation or momentum profits over the intermediate horizon, meanings that this paper expects to observe that there should be higher momentum profits from firms that have low earnings quality than firm with high earnings quality.

**Hypothesis 2: This paper hypothesizes that firms tend to more under-react during recession period than expansion period.**

This paper also investigates the effect of information uncertainty on investor behavior among the difference in economic cycles. The reason why economic cycles are interesting to investigate is that many literature argue that state of the economy has an impact on investor sentiments and then these sentiments is transmitted into action or behavior.[7] Economic cycle fluctuate in economy among period of expansion and contraction. Johnson (1999) [12] states that economic recession is the time that all firms face on high uncertainty situation and the ability to generate a profit will decline. In other words, the level of information uncertainty is increasing during recession and it is decreasing during economic expansion. As a result, this paper should be able to observe the behavior of under-reaction during the recession

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[7] Johnson (1999), Garcia (2013), and Chang (2011)

period more than expansion period. This hypothesis can be explained through the aspect of loss aversion. During economic expansion, most investors on average are making profits, while they anticipate loss on their investment during economic recession. The behavior of under-reaction during economic recession can be explained that, in general, investors are more sensitive to a loss than a gain of similar magnitude when making a decision under uncertainty environment. Kahneman and Tversky (1984) [13] give an example that most undergraduate participants refuse to stake 10 dollars on the toss of coin if they stand to win less than 30 dollars. This can be implied that investors prefer avoiding losses to acquiring gains, creating the behavior of under-reaction.

CHAPTER II

LITERATURE REVIEW

## 2.1 Under- / Over-reaction of Investors

Griffin and Tversky (1992) argue that human thought is influenced by the basic elements of the weighing evidence and the formation of belief. They focus on giving explanations on prior studies that people are often more confident in their judgment than is assured by the facts. They exploit the knowledge of the nature of human that most people pay more attention to the quantitative value than the qualitative value. They hypothesize that if people pay attention or have high sensitive to quantitative value, and pay less attention or have less sensitive to qualitative value, then the behavior of over-confident is happened when quantitative value is high and qualitative value is low, while behavior of under-confident when qualitative value is high and quantitative value is low. In addition, they also evaluate the hypothesis in term of statistical test by using sample size test and base rate test. The results from statistical evaluating still conclude in the same way as human nature that people are more sensitive to the strength of evidence than to its weight.

Bloomfield, Libby, and Nelson (2000) propose a model called moderated confidence which describe when investors have noisy signals about reliable information; they tend to underreact on this information which can be observed by stock prices. Their hypothesis has developed on the assumption that investors are Bayesian investors and have imperfect information about signal reliability. If investors have moderated confidence, they will overestimate the reliability of highly unreliable

information and underestimate the reliability of highly reliable information. In this situation, the reliable signal can be viewed as the most recent earnings announcement, while the unreliable signal can be viewed as long-term earnings patterns. In addition, noise signals are happened because investors have insufficient knowledge in assessing information reliability or investors put different weights on paying attention to information about favorable information and reliable information. It can be easier to illustrate on statistical probability. Let assume the firms' value equal to V, which is either 1 or 0 with equally likely to happen. Typically, investors receive two signals. The first signal represents the probability between 0.5 and 1 of reliable information (R). The second signal provides noisy signal of the reliability of the first signal with probability between 0.5 and 1 ($\pi$). In the situation under the high reliable information, Bayesian investors estimate the reliability of information by weighted average, $\pi$*high+(1-$\pi$)*low, meaning that on average investors estimate the reliability of information lower than the actual reliable information. On the contrary, under the low reliable information, the estimation is given by (1-$\pi$)*high+$\pi$*low, meaning that on average investors estimate the reliability of information higher than the actual reliable information. From their finding, it can be implied that the expectation of Bayesian investors on information reliability can lead to the pattern of stock price under- / over-reaction.

Simon (1995) constructs the definitions of "rational choice" which are modeled more closely upon the actual decision processes in the behavior of organisms than definitions heretofore proposed, is the purpose of this paper. Nevertheless, the method to determine these definitions of approximate rationality,

is to provide some materials for construction of a theory of the behavior of a human individual or of groups of individuals who are making decisions in an organizational circumstance. The definitions might have normative as well as descriptive value. They may suggest approaches to rational choice in areas that appear to be far beyond the capacities of existing or perspective computing equipment particularly. The economic theory of firm and the theory of administration attempt to deal with human behavior in situations, at least "intended" rational, to face the apparent paradox. At the same time, if we assume the global kinds of rationality of the classical theory the problems of internal structure of the firm or other organization largely disappear; Then, the outlines of theory begin to appear when we replace "economic man" or "administrative man" a choosing organism of limited knowledge and ability. This organism introduces differences between the simplified model and the reality; serve to explain many of the phenomena of organizational behavior.

## 2.2 Information Uncertainty

Hirshleifer (2001) provides a research on investor psychology and asset pricing because it seems that rational asset pricing theory is subsumed by broader approach which relevant to psychological biases. In other words, risk and misvaluation have an influence on securities expected return. This can be implied that beside risk factor that determine asset price in rational pricing approach, misvaluation created by investor psychology is one of the factor that determine asset price as well. One of the most important arguments he made is that higher uncertainty on a group of stocks can create higher degree of psychological biases. His suggestion is come from comparing risky assets which is classified as having high degree of uncertainty asset

class with risk-free asset which is classified as having high degree of certainty asset class. He states that it is rarely to see misvaluation in risk free asset according to psychological biases. As a result, it seems that uncertainty on a group of stocks affects the way investors response to information. In other words, the effect of securities misvaluation that arises from investor beliefs or psychological biases should be strongest among the firms that have high level of information uncertainty.

Zhang (2006) examines the relationship between information uncertainty and the return continuation phenomenon. The term information uncertainty means the ambiguity of the implications of new information for a firm's value which can be divided into two parts which are volatility of the firm's fundamental and poor information. He hypothesizes that if return continuation anomaly is derived from the behavior of under-reaction to public information by investors, then investors are under-react even more in the situation of greater information uncertainty. He focuses on two studies of post-analyst forecast revision price drift and price momentum in order to examine how information uncertainty contributes to stock returns. The result suggests that the adjustment about firms' value according to publicly new information is almost complete in low uncertainty stocks, while the adjustment about firms' value due to new information is far from complete in high uncertainty stocks. In other words, the degree of delayed adjustment of market reaction to new information increases with the level of information uncertainty. This can be implied that investors tend to under-react if they perceive that the information that relevant to firm value is ambiguity.

Daniel (1961) explains about human behavior in making decision under uncertainty. Suppose there are two jars contained red and black balls. Participants

are asked to bet on drawing a red ball from either first jar or second jar. If red ball is drawn, participants will get reward, but if black ball is drawn, participants will get nothing. The information provided to participants is that first jar contains 100 balls of red and black with no information about the proportion of red and black balls. Second jar contains the exactly 50 red balls and 50 black balls. The result shows that the majority choose to draw a ball from second jar. In other words, participants make decision where they know the odds and the possible outcomes, while they avoid making decision where the odds and possible outcomes are unknown. His explanation on the result is that participants avoid making a decision when they have insufficient information. Moreover, when there is more than one choice, participants will choose another choice with more information is available.

## 2.3 Earnings Quality

Dechow et al. (2010) provide the various measure as an indication of earnings quality. They classify the proxy of earnings quality into three categories. The first category is the properties of earnings such as earnings persistence, earnings smoothness, and asymmetric timeliness and timely loss recognition. The second category is the investor responsiveness to earnings that can be identified by earnings response coefficient or the $R^2$ from the earnings returns model. The last category is the external indicators of earnings misstatements, includes restatements, Accounting and Auditing Enforcement Releases, and internal control deficiencies reported under the Sarbanes Oxley Act. This paper focuses on earnings persistence as it is used to proxy for earnings quality. The idea of earnings persistence is that firms with more persistent earnings have more sustainable earnings or cash flow stream. They also

give the explanation that link earnings persistence with earnings quality. Firms that have more persistent earnings can be implied that current earnings is contained more useful summary measure of future firms' prospect and give smaller valuation errors than firms that have low earnings persistence. As a result, it can be concluded that when holding the value of earnings constant, the higher the earnings persistence, the higher the earnings quality.

Penman and Zhang (2002) investigate the relationship between investment activities and conservative accounting. The contribution on their paper shed further light on how accounting methods affect the quality of earnings. They give the definition of good earnings quality as if a reported earnings is a good indicator of future earnings which refers to sustainable earnings. In the other hands, when accounting treatment creates unsustainable earnings, it classifies as poor earnings quality. The idea is that when there is an increasing in investment, firms will report lowers earnings. On the contrary, if there is a decreasing in investment, firms will report higher earnings. The result suggests that changes in the amount of investments can affect the quality of earnings for firms that apply conservative accounting method.

Beneish and Vargus (2002) examine whether insider trading is informative about earnings quality and the valuation implications of accruals. They define earnings quality as the likelihood that firm can sustain current earnings in the future. Their finding indicates that one year ahead persistence of income-increasing accruals is lower when abnormal insider selling, while it is higher when insider buying. This can be implied that insider trading is an informative signal about earnings quality.

Moreover, the mispricing of income-increasing accruals can explain the accrual mispricing phenomenon.

## 2.4 Momentum Strategies

Jegadeesh and Titman (1993) are the first group who provide the empirical evidence about the price momentum in the US market. They come up with the idea that whether stock prices over-react or under-react to information, the current prices is not the correct prices and investors can make an abnormal return by choosing the stocks based on their past return. The portfolios are formed monthly based on the past performance ranking over the past most recent J months. The stocks are allocated into the deciles according to their past return and the performance is measured over the following K months. This also refers to J-month/K-month strategy which investors look back J months on past performance to form portfolios and holding portfolios over K months. Investors then make the price momentum strategies by long the stocks with the highest past return and short the stocks with the lowest past return. Using the sample of New York Stock Exchange and American Stock Exchange during the period of 1965 to 1989, they find a significant positive return over three to twelve months holding period and the strategy that look back to twelve months period and holding the portfolio for three months can generate the highest return about 1.31 percent per month. This indicates that price momentum is existed in the US market. Furthermore, they investigate momentum profits based on firm size and ex ante beta estimates, in order to test whether momentum strategy is confined to particular firm characteristics. The result shows momentum profits for small size, medium size, and large size are 0.99 percent, 1.26 percent, and 0.75

percent, respectively. Momentum profits for low beta, medium beta, and high beta are 0.62 percent, 0.79 percent, and 1.08 percent, respectively. They conclude that even momentum profits tend to be related to firm size and beta, momentum profits based on firm characteristics appear to be the same as on full sample which is 0.95 percent. Thus, momentum profits do not seem to confine to particular firm characteristics. Moreover, they also examine whether momentum strategy is persistent overtime. They extend the holding period from 12 months to 36 months following the formation period. The result shows that momentum strategy can create a positive return during the first year, but negative after first year. This can be implied that momentum strategy is not persistent overtime.

Rouwenhorst (1998) find an evidence of medium-term price momentum over the twelve European countries between 1980 and 1995. The portfolios are constructed as same as Jegadeesh and Titman (1993) framework and allocated into deciles with an equally weighted for each portfolio. The result concludes that the strategies that long the past winner stocks and short the past loser stocks can earn an abnormal return approximately one percent per month for a time horizon of one year holding period. He test the momentum strategies using the data from 12 European countries. Rouwenhorst finds that the return from momentum strategies can create the statistically significant positive return at 0.05 level of confidence. He says that the momentum strategy can create a positive return around 0.70 percent to 1.35 percent when varying holding period. This can be implied that price momentum is not limited to a particular market and the fact that he can find momentum profit in all twelve European countries in his sample set. He tries to explain the source of momentum profit and hypothesizes that if the momentum

profits are related to the additional risk measured by beta, winners portfolio should has higher beta compared to the losers portfolio, but this result appears to be on the opposite that winners have lower beta. As a result, he concludes that market risk seems to have no explanatory power on momentum profits. In his in depth analysis, Rouwenhorst finds that the stocks which are classified as winner and loser are likely to be small size. He finds a negative relationship between firm size and momentum profits. Moreover, he examines the persistence of momentum anomaly over two years after formation period. Rouwenhorst suggests that momentum returns are positive up to 11 months, after that momentum returns turn out to be negative but not statistically significant. This can be implied that momentum anomaly shows sign of reversal after one year which is consistent with Jegadeesh and Titman (1993).

Fama (1998) proposes the possible reason that might explain the momentum returns. He argues that momentum strategies are merely a statistical flawed. Meaning that momentum anomaly will disappear when adjusting the methodology and examining out of sample, but this explanation seems to be unacceptable since the momentum anomaly is proven to exist all over the world. As a result, he highlights the existence of momentum anomaly against the efficient market.

Daniel, Hirshleifer, and Subrahmanyam (1998) propose an overconfidence model to explain the momentum anomaly. They make the distinction between private information and public information, as well as develop the model to predict the behavior of under- and over-reaction by investors. The model is relied on two important psychological biases which are overconfidence and self-attribution bias. Self-attribution bias is the psychological bias that people attribute successful outcome to their own ability and blame unsuccessful outcomes on bad luck, while

overconfidence make individual investors overestimate the precision of their private information signals and under-react to public information. This can be implied that the confidence of investors increases when public information is in line with their own private information. On the contrary, investor confidence does not decrease commensurately when public information contradicts their own privately information. As a result, they suggest that momentum anomaly is derived from continuing over-reaction in short run, while during the long run, it seems that stock returns is followed by correction period, creating return reversal anomaly.

Barberis, Shleifer, and Vishny (1998) explain source of momentum anomaly by using the model of investor sentiment. The model is drawn based on psychological biases which are conservatism and representativeness. Conservatism bias is a bias that related to investors information processing. Specifically, it suggests that investors are over-weight to the prior information and under-weight to the new information. The representativeness heuristic refers to the judgment about the probability of an event under uncertainty that is based on stereotypes. In the present of these two psychological biases, investors are overweight to the recent company prospect and when the new information arrived, investors still under-weight to new information and gradually absorb these new information into the stock price. They also take the expectation on future earnings as it has a pattern, which is reality it is a random process. Over the short to medium tern horizon, investors usually expect future earnings to be mean reverting, meaning that investors expects a positive earnings shock to be reversed in the next period, but what if investors expectation is opposite to the reality that the future shock is also positive. The stock returns will be positive because investors are taken the surprise.

Hong and Stein (1999) propose the model called "Gradual Information Diffusion Model" that aims to explain the momentum profits based on interaction between two groups of investors. The first group is called news-watchers which make the forecast based on the signals of firms fundamental. The second group is called momentum traders which make the position only one the past price movements. The transactions are first made by news-watchers since they can observe the private information of firms fundamental, but the action is gradually made across news-watchers. This can be implied that news-watchers are under-react to new information. After that momentum traders who observe the positive past price changes due to news-watchers action start take an action and lead the stock price adjusted to the intrinsic value. There are some momentum traders that take the action slower because they can observe the positive past price changes, not due to news-watchers action but the momentum traders' action. This can be implied that momentum traders create the over-reaction in the stock prices and make the prices deviate from the intrinsic value.

## 2.5 Economic Cycles and Investor Sentiment

Garcia (2013) extends the information from prior studies that investor sentiment can make a difference on decision-making. He investigates the effect of investor sentiment on asset prices during the economic downturn. His framework is built up on Shiller (2000) and Tetlock (2007) conclusion. Shiller (2000) concludes that news media plays a key role in setting the stage for market moves. This can be implied that investors tend to believe and follow the news even though much of it is pure hype. Tetlock (2007) concludes that the number of negative words in Wall

Street Journal can predict the stock returns at daily frequency. As a result, he use financial news from New York Times during 1905 to 2005 as a proxy for market sentiment and examine the relationship between market sentiments and stock returns. The result suggests that news content helps predict stock returns at the daily frequency, especially during recession period. The result shows that during recession period, Dow Jones Industrial Average moves 12 basis points when one standard deviation change in pessimism factor, while Dow Jones Industrial Average moves 3.5 basis points during expansion period.  He gives the explanation that economic expansion period is the time that most investors are happy and optimistic, while in recession period, investors are fearful and anxious. Thus, according to the emotions, investor behavior is varied across time of economic expansion and recession. Specifically, investor sentiment is more sensitive to news information during recessionary period than expansionary period which can be observed by stock price movement that more deviates when good and bad news is announced during the economic recession.

Chang (2011) examines whether psychological biases have an impact on economic cycles and how these emotional factors involve in moving market price. Economic cycle fluctuate in economy among period of expansion and contraction. During the economic expansion, most of the assets seem to be over-valued, while during the contraction, the assets are under-valued. One factor that makes assets deviate from its fundamental value is attributed to the nature of human, investor psychological biases, and emotions.  He explains that when the stock prices continue moving up, investors are willing to invest more with the biases of heuristics and herding which lead to the period of economic expansion. On the contrary, after the

peak of economic cycle is reached, investors are full of fear, together with the feeling of under-confident which leads to slow down in financial activities, creating an economic contracting period.

Garcia (2013) aims to shed further light on how individuals process and perceive information in order to make financial decision. He states that when decision-making made by investors who dominated by the psychological biases or the limited ability in accessing the complex information, the importance of information is reduced or even eliminated. By reviewing literature on the field of financial economics, he concludes that over-confidence and limited cognitive capacity are the two psychological aspects that have the most influence on investor behavior regarding in terms of using and acquiring the information. Over-confidence leads investors to put excess weight on their believe and sometimes reject the signals from the market. On the matter of cognitive capacity which is happened when investors have limited ability to access the complex information, as it turns out, investors choose the short-cut or rule of thumb instead of using processes that require high cognitive level. In his conclusion, Garcia does not reject traditional theoretical frameworks for financial decision making, he suggests taking into account the aspects of human behavior regarding to over-confidence and limited cognitive capacity.

Johnson (1999) examines how stock return and earnings vary with the economic cycle. He uses earnings response coefficients as a variable to capture the impact of economic cycle on stock return and earnings. He uses the expansion and recession economic cycle between 1970 and 1987 of one quarter ahead forecast from Data Resource, Inc. The result indicates that earnings response coefficients are

larger in expansion period. This is because during the expansion period inventory turnover will increase and the inventory holding cost will decrease implied the lower interest rate. Therefore, it is easier to capitalized on investment opportunities and create higher earnings persistence than the contraction period. On the contrary, the economic contraction period is the time that all firms face on high uncertainty situation and the ability to generate a profit will decline. As a result, earnings on economic contraction period are more volatile and less persistence than expansion period.

CHAPTER III

SAMPLE DATA AND METHODOLOGY

## 3.1 Sample Data

The data is based on the firms listed on the stock exchange of Thailand provided on the Datastream (Thomson Reuters) and Bloomberg during the period of 1991 to 2010. One important thing on collecting the data is to avoid the survivorship bias. Since this paper collects the data from the current Datastream (Thomson Reuters) information, meaning that firms that were delisted before the collecting date will not be appeared on the current Datastream (Thomson Reuters) stocks list. Then, this paper adds back the delisted firms into the stocks list based on a specified period that the delisted stocks were traded. This procedure can avoid the survivorship bias that might come from the limitation of collecting the data. The data requires the firms' information of price, market equity, book to market ratio, earnings per share. Momentum portfolio will be adjusted every month; therefore, the firms that are delisted or newly listed will not be constrain in forming price momentum portfolios. The portfolios will be based on only the stocks that have available information on the specified periods.

### 3.1.1 Required Data

Earnings per share: The definition of earnings per share is the amount of company's profit that is allocated to the outstanding shares of common stock.

Earnings per share is computed as net income available to common shareholders divided by the basic weight average shares outstanding.

Price return index: This paper uses price return index as a benchmark for the market returns.

Risk free rate: This paper uses one month government bill available on the Datastream (Thomson Reuters) as a risk free rate. According to the limitation of information on Datastream (Thomson Reuters), one month government bill is available from 2004 onwards; therefore, Thailand interbank rate is used as a risk free rate in the period before 2004.

Market capitalization: The data of market capitalization is collected from Datastream (Thomson Reuters). Market capitalization is a monetary value of all outstanding shares stated in the pricing currency. Capitalization is a measure of corporate size and it is derived from market price multiply common shares outstanding. Hong et al. (2000) finds that when stocks are implemented on small size, momentum profits are higher than large stocks. In addition, Fama-French (1993) gives the reason why firm sizes are related to economic fundamentals. Firm sizes can be implied the ability to generate the profit among the different firm sizes. Holding everything else constant, small firms tend to have lower earning on assets than large firms.

Book to market ratio: The information provided by Datastream (Thomson Reuters) (Thomson Reuters) is in the form of market to book ratio which is the measurement of the relative value of a company compared to its market value. Market to book ratio can be calculated from market value of equity divided by book

value of the equity. Book to market ratio is a reciprocal of market to book ratio. According to Daniel and Titman (1999), they find that book to market ratio can affect the momentum profits. Specifically, firms with lower book to market ratio are more profitable. Moreover, Fama-French (1993) argues that book to market ratio is one of the three factors that have an impact on assets return. Firms that have high book to market ratio tend to generate low earning on assets, while, firms that have low book to market ratio are able to generate high earning on asset.

## 3.1.2 Dependent and Independent Variables on Fama-French three Factors Model

This paper applies the Fama-French three factors model which is constructed by using the portfolios formed on size and book to market. There are three important variables as below information.

First, adjusted momentum returns are used as a dependent variable that derived from subtracting raw momentum returns with risk free rate.

Second, $R_m$ - $R_f$ is the excess return on the market. The market return is calculated by the value weighted of all stocks on the stock exchange of Thailand on monthly time t period.

Third, SMB is referred to "small minus big" portfolio that is long on small firms and short on large firms. To construct the SMB portfolio, the stocks will be sorted according to the market equity where market equity is obtained by multiply market price with the outstanding shares. After sorting the stocks, the stocks can be divided into two portfolios which are big firms and small firms.

Forth, HML is referred to "high minus low" portfolio that is long on high book to market stocks and short on low book to market stocks. To construct the HML portfolio, the stocks must be sorted according to the book to market ratio, where book to market ratio is obtained by divided book equity with market equity. After sorting the stocks, the stocks will be divided into three portfolios which are bottom 30% (low), middle 40% and top 30% (high).

More specifically, there are six portfolios that are classified by the intersection of firm sizes and book to market ratio. The six portfolios are consisting of small-low B/M portfolio, small-medium B/M portfolio, small-high B/M portfolio, big-low B/M portfolio, big-medium B/M portfolio, and big-high B/M portfolio. SMB and HML can be constructed by the following equation. Note that low B/M also refers to growth stock, medium B/M refers to neutral stock and high B/M refers to value stock.

$$\text{SMB} = \left(\frac{1}{3}\right)(\text{small-value + small-neutral + small-growth}) - \left(\frac{1}{3}\right)(\text{big-value + big-neutral + big-growth}) \quad (2)$$

$$\text{HML} = \left(\frac{1}{2}\right)(\text{small-value + big-value}) - \left(\frac{1}{2}\right)(\text{small-growth + big-growth}) \quad (3)$$

### 3.1.3 Data Descriptive on Momentum Strategy

To examine how information uncertainty on earnings affects investor behavior in Thailand during 1996-2010, this paper need to know whether momentum anomaly is existing in Thailand without conditioning on information uncertainty. Table 1 documents the stock returns of portfolios formed on the basis of six months look back period and six months holding period as it is documented by Jegadeesh and Titman (1993) [7]. P1 represents portfolio that contains 30 percent of the stocks with the lowest past return and P3 represents portfolio that contains 30 percent of the

stocks with the highest past return. P3-P1 represents momentum strategy which takes the long position on winner portfolio and takes short sell position on loser portfolio. Subsequent to the formation date, table 1 shows that winner outperforms loser, so that on average the momentum strategy creates profit around 2.8 percent during the period between 1995 and 2010,while in the subsample period momentum strategy creates profits around 3.6 percent, 2.6 percent, and 2.3 percent during the period between 1995-2000, 2001-2005, and 2006-2010, respectively.

Table 1 Data Descriptive on Momentum Strategy

This table shows average month-end returns for winner and loser stocks. For each month t, all stocks in each are ranked based on their past returns over 6 months period and then allocated into three groups which are winner group, middle group, and loser group. Winner group contains stocks that have the highest past return. Middle group contains stocks that their past returns rank in the middle. Loser group contains stocks that have the lowest past return. Then, this paper calculates returns on each groups with 6 months holding period. Last column presents the momentum profits which is derived from the strategy that take long on winner group and short sell on loser group. Positive number can be implied that momentum anomaly is existed. . $t$-statistics are reported in parenthesis. * indicates that the returns are significantly greater than zero at the 0.05 level, and ** indicates that the returns are significantly greater than zero at the 0.01 level.

|  | P1 (loser) | P2 (middle) | P3 (winner) | P3-P1 (winner – loser) |
|---|---|---|---|---|
| 1995-2010 | -0.003 | 0.006** | 0.026** | 0.028** |
|  | (-1.04) | (4.05) | (9.71) | (14.65) |
| 1995-2000 | -0.016** | -0.003 | 0.020** | 0.036** |
|  | (-2.95) | (-0.86) | (3.46) | (8.36) |
| 2001-2005 | 0.010** | 0.014** | 0.036** | 0.026** |
|  | (3.14) | (7.34) | (8.93) | (11.22) |
| 2006-2010 | -0.002 | 0.009** | 0.021** | 0.023** |
|  | (-0.69) | (5.85) | (6.45) | (7.86) |

### 3.1.4 Economic Cycle Benchmark

One of the objectives in this paper is to investigate the effect of information uncertainty on investor behavior among the difference in economic cycles. The time

frame between 1990 and 2010 is divided into economic expansion and economic contraction as shown in table 2. The benchmark is Thailand business cycle index provided by Trade and Economic indices Bureau, Ministry of Commerce, Thailand.

According to the Bureau of Trade and Economic Indices, Ministry of Commerce Thailand, economic cycle is a wave of money and economic activities that forms a regular pattern, defined in terms of periods of expansion or recession. During expansions, the economy, measured by indicators like jobs, production, and sales, is growing in real terms, after excluding the effects of inflation. Recessions are periods when the economy is contracting.

Business cycle index is the cycle component of economics variables resulting from averaging the separate data series that cover a broad range of the economy. Specifically, business cycle index is composed of three categories, which are coincident business index, leading business index, and lagging business index. Coincident index and leading index are the key elements in determining peaks and troughs in the business cycle.

Coincident business index is run concurrent with the business cycle. The coincident index is decomposed into Domestic sale of passenger and commercial cars, Production of beer, Production of cement, Production of commercial vehicle, Production of motorcycles, Business taxes, Value added taxes and Specific business taxes, Import duties, Real import value (in Baht term), and Retail sale index.

Leading business index shows the turning points before those in aggregate economic activity. Leading index shows the sign that either the risk of a recession has increased or that a recession may be reaching to the end. Leading business index can

be divided into short term and long term. Short term leading business index tends to lead the economic cycle by turning down before the down cycle begins and turning up before expansionary cycle begin for 3 to 5 months. The short term leading indicators are consisting of Construction areas permitted in Bangkok metropolis, Number of foreign tourists, Stock exchange of Thailand index, Value of authorized capital of newly registered businesses, Real export value (in Baht term), and Narrow money. Medium term leading business index tends to lead the economic cycle by turning down before the down cycle begins and turning up before expansionary cycle begin for 9 to 11 months. The medium term leading indicators are consisting of Average interbank overnight lending rates, sign differential inverted, Construction areas permitted in Bangkok metropolis, Industrial Material Price Index growth rate, Japan Leading Index, sign percentage inverted, USA Leading Index, Value of authorized capital of newly registered businesses, and Broad money growth rate.

Turning point indicates that either economy have been turn up from recession to expansion or turn down from expansion to recession. The turning point on recession period is a significant decline in activity spread across the economy, lasting more than a few months, visible in industrial production, employment, real income, and wholesale-retail sales. A recession begins just after the economy reaches a peak of activity and ends as the economy reaches its trough.

Table 2 Thailand economic cycles during 1990 – 2008

Two majorities of economic cycles are economic expansion and economic contraction. The data of various expansion and contraction periods are determined by Trade and Economic indices Bureau, Ministry of Commerce, Thailand.

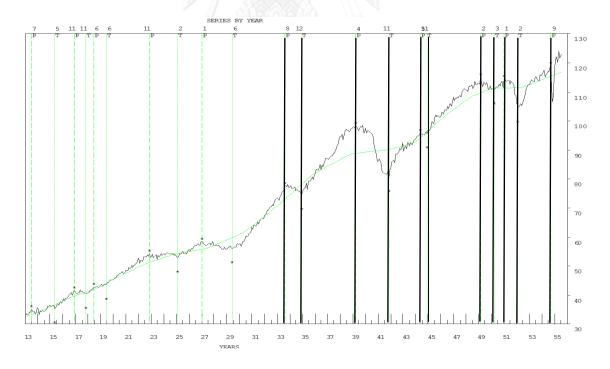| Economic Expansion (month/year) | Economic Contraction (month/year) | months |
|---|---|---|
| - | 8/1990 – 12/1991 | 16 |
| 12/1991 – 4/1996 | - | 52 |
| - | 4/1996 –11/1998 | 31 |
| 11/1998 - 5/2001 | - | 30 |
| - | 5/2001 – 3/2007 | 70 |
| 3/2007 – 1/2008 | - | 10 |
| - | 1/2008 – 2/2009 | 13 |
| 2/2009 – 9/2011 | - | 31 |



Figure 1 illustrates the Thailand economic cycles determined by Trade and Economic indices Bureau, Ministry of Commerce, Thailand. The vertical solid lines represent the major turning point in economic cycles during 1990 – 2008.

**3.2 Methodology**

**3.2.1 Identifying Earnings Quality**

The first objective is to identify the earnings quality by using method provided by Dechow et al. (2010) [1]. They provide the various measures as an indication of earnings quality. They classify the proxy of earnings quality into three categories. The first category is the properties of earnings such as earnings persistence, earnings smoothness, and asymmetric timeliness and timely loss recognition. The second category is the investor responsiveness to earnings that can be identified by earnings response coefficient or the $R^2$ from the earnings returns model. The last category is the external indicators of earnings misstatements, includes restatements, Accounting and Auditing Enforcement Releases, and internal control deficiencies reported under the Sarbanes Oxley Act. This paper focuses on identifying earnings persistence as a proxy for earnings quality.

*3.2.1.1 Earnings Persistence*

The general concept that this paper uses to find earnings persistence is to run the first order autocorrelation of total earnings.

$$earnings_t = \alpha + \beta(earnings)_{t-1} + \varepsilon_t \qquad (4)$$

In practice, many studies use different variables instead of total earnings.[8] The reason is to reduce the effect of leverage when using total earnings by using different variables that have less sensitive to leverage. For example, Boubakri (2012) uses earnings that are scaled by assets as a representative of earnings, while some

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[8] Dechow et al. (2010)

researchers scale earnings by number of shares. This paper use total earnings scaled by number of shares due to the limitation of data on total assets information. Therefore, the general equation (equation (4)) is converted into the equation (5).

$$EPS_t = \alpha + \beta(EPS_{t-1}) + \varepsilon_t \qquad (5)$$

This paper focuses on interpreting the $\beta$ coefficient as it refers to earnings persistence coefficient. The $\beta$ coefficient is close to one if earnings are highly persistence.

According to prior studies, earnings persistence can be identified by using autoregressive model, meanings that there is only one number indicate earnings quality for each individual firm over a studied period. In general, it seems that firms with high earnings quality tend to have high quality in a subsequence period, but this paper concerns on the time varying that the earnings quality will be changed over time. Thus, this paper divides the sampling period of 20 years into 4 different periods (1991-1995, 1996-2000, 2001-2005, and 2006-2010) and follows the equation (5) to obtain the earnings persistence, but this time each firm will have the degree of earnings persistence that vary across 4 different periods between 1991-2010.

### 3.2.2 Information Uncertainty and Momentum Returns

Second objective is to investigate that the return on momentum strategies from firms that have high information uncertainty (low earnings quality firms) are higher than the return from firms that have low information uncertainty (high earnings quality firms). First, this paper divides all stocks into three different groups based on information uncertainty by using earnings quality as a proxy, low

information uncertainty (high earnings quality group), medium information uncertainty (medium earnings quality) and high information uncertainty (low earnings quality group). After that, over a subsequence period, this paper forms momentum portfolios based on past returns into three portfolios and calculates momentum profits by long winner portfolio and short loser portfolio. The momentum profits are compared between high earnings quality group and low earnings quality group. In addition, this paper adjusts the returns from momentum strategies by controlled for the Fama-French three factors model.

### 3.2.2.1 Forming Momentum Portfolios Based on Earnings Quality

First, this paper sorts all stocks according to the level of earnings quality that are obtained from the first objective into three groups, which are high earnings quality, medium earnings quality and low earnings quality.

Second, this paper follows Jegadeesh and Titman (1993) [7] to form J/K momentum strategies. At the beginning of each month from January 1996 to December 2010, all stocks are ranked base on their past return, and then allocate the stocks into three groups. Price momentum portfolios arises from equally weighted long the stocks with the highest past return group and short the stocks that have the lowest past return group. The portfolio is held for some specific periods of time. Jegadeesh and Titman (1993) [7] also suggest the method to avoid test statistics based on overlapping returns when either J or K is greater than one by the following procedure. Assume that J is a look-back period and K is a holding period. At any time t  (beginning of each month), there are "K" portfolios, for example if holding period is one month, at any time there is only one portfolio, but if holding

period equal to three months, at any time there are three portfolios. At time t, this paper looks at the past returns from t-J-K to t-K and then sorts the stocks into winners and losers. Winners and losers portfolio return are the average of these "K" active portfolios.

For example, 3/3 momentum strategy refers to 3 months look-back period and 3 months holding period momentum strategy. At the beginning of the first month (m=1), Jegadeesh and Titman (1993) suggest that in order to avoid test statistics based on overlapping returns, this paper should construct portfolio equal to the number of holding period, which is 3 active portfolios in this example. Assume that the current period is t, first portfolio is consisting of look-back period between t-6 and t-3, while holding period is between t-1 and t+2. Second portfolio is consisting of look-back period between t-5 and t-2, while holding period is between t and t+3. Third portfolio is consisting of look-back period between t-4 and t-1, while holding period is between t+1 and t+4. During look-back period, this paper sorts and groups all stocks according to past returns into 3 portfolios. Stocks that have the highest past returns will be classified as winner portfolio, while stocks that have the lowest past returns will be classified as loser portfolio. Momentum strategy is derived from long on winner portfolio and short on loser portfolio. Momentum profits are derived from averaging 3 portfolios as it is held for 3 months. After the first month of constructing the momentum portfolio, all stocks will be sorted and grouped again in the second month (m=2) follow the above procedure. The method in forming momentum portfolio will roll over again and again for the third month (m=3) so on an so forth. The method of forming 3/3 momentum strategy is illustrated on figure 2.
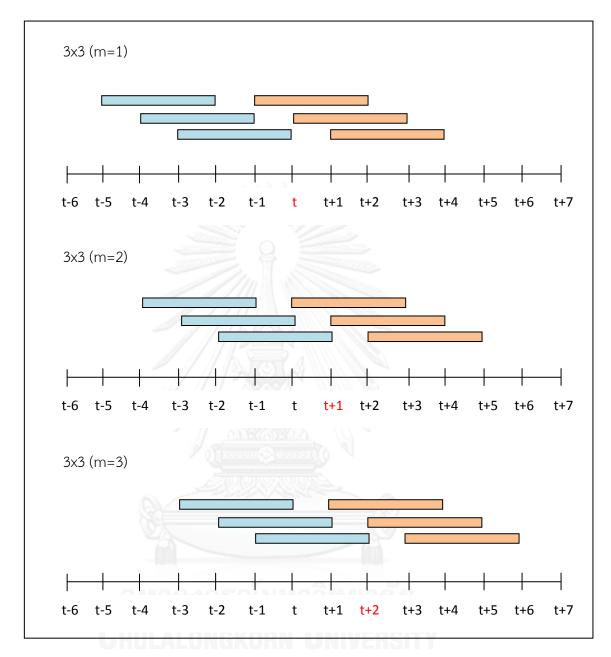
Figure 2 illustrates the procedure of forming 3/3 momentum strategy when rolling the window from the first month to the third month. The red color text indicates the current date or the formation date for each month.

Other examples of forming momentum strategy are 3/6 momentum strategy and 6/6 momentum strategy as it is illustrated on figure 3 and 4. 3/6 momentum strategy is consisting of 6 active portfolios because there are 6 months holding period. During the first month (m=1), look-back period is located between t-9 and t-6 for the first portfolio, while the second, third, fourth, fifth, and sixth are located

between t-8 and t-5, t-7 and t-4, t-6 and t-3, t-5 and t-2, and t-4 and t-1, respectively. Holding period for the first, second, third, fourth, fifth, and sixth are located between t-5 and t+1, t-4 and t+2, t-3 and t+3, t-2 and t+4, t-1 and t+5, and t and t+6, respectively. Momentum profits are derived from averaging 6 active portfolios returns as it is held for 6 months. The portfolio will rebalance every months follow the same procedure.

6/6 momentum strategy is consisting of 6 active portfolios because there are 6 months holding period. During the first month (m=1), look-back period is located between t-12 and t-6 for the first portfolio, while the second, third, fourth, fifth, and sixth are located between t-11 and t-5, t-10 and t-4, t-9 and t-3, t-8 and t-2, and t-7 and t-1, respectively. Holding period for the first, second, third, fourth, fifth, and sixth are located between t-5 and t+1, t-4 and t+2, t-3 and t+3, t-2 and t+4, t-1 and t+5, and t and t+6, respectively. Momentum profits are derived from averaging 6 active portfolios returns as it is held for 6 months. The portfolio will rebalance every months follow the same procedure.

Third, this paper obtains nine portfolios from the intersection of three earnings quality portfolios and three price momentum portfolios.

This paper follows Jegadeesh and Titman (1993) [7] framework by varying the window time frame for look back periods and holding periods. Specifically, this paper focuses on four main time frames, which are 3 months, 6 months, 9 months and 12 months. The intersection of these four periods can create the 16 momentum strategies. Jegadeesh and Titman (1993) [7] find that momentum strategies are able to generate significantly positive return over 3 to 12 months holding periods.
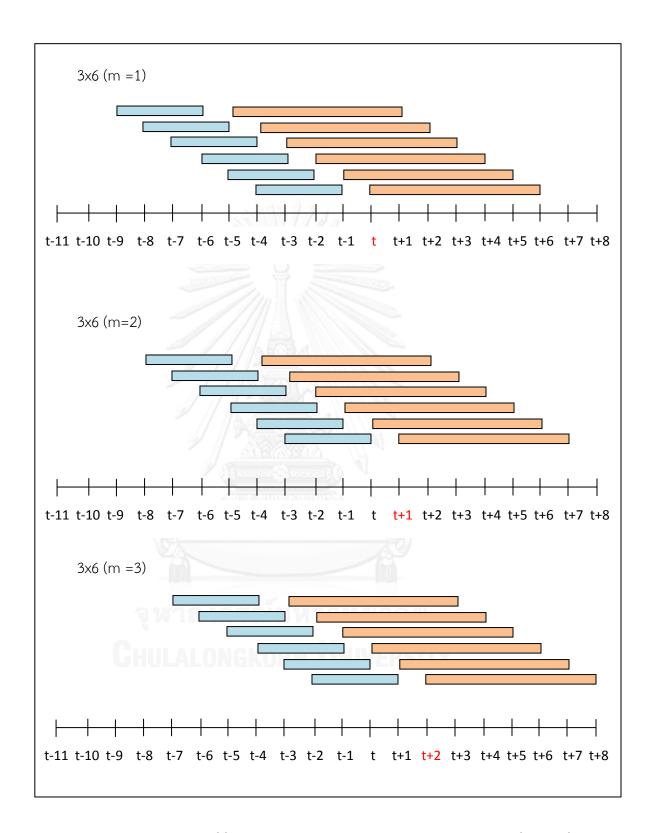
Figure 3 illustrates the procedure of forming 3/6 momentum strategy when rolling the window from the first month to the third month. The red color text indicates the current date or the formation date for each month.
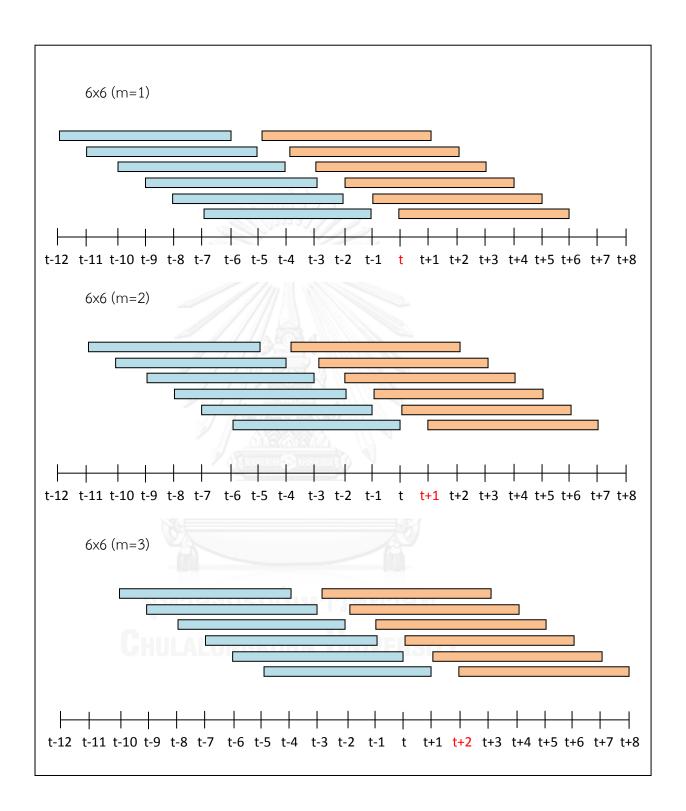
Figure 4 illustrates the procedure of forming 6/6 momentum strategy when rolling the window from the first month to the third month. The red color text indicates the current date or the formation date for each month.

*3.2.2.2 Momentum Returns when Controlled for Firm Size and Book to Market Ratio*

In addition, this paper investigates the momentum profits by controlled the firm size and book to market ratio because many studies provide the evidence that these two variables can affect the momentum profits.[9] Fama and French (2012) [17] show that the momentum returns spread that derived from long winner portfolio and short sell loser portfolio decrease from smaller stocks to bigger stocks. This paper provides two methods in controlling the firm size and book to market ratio.

The first method is based on sorting the stocks according to the market capitalization and book to market ratio in order to compare the effect of momentum profits on earnings quality in the same class of firm size and book to market ratio. Specifically, this paper sorts the stocks according to the market capitalization and ranks the stock into two portfolios, which are big firm and small firm portfolios (B and S). This paper also breaks the stocks into two portfolios according to book to market ratio which are high book to market portfolio and low book to market portfolio (H and L). The final portfolios are the four intersections between two market capitalization portfolios and two book to market portfolios (S/L, S/H, B/L, and B/H) as it is illustrated on the figure 5. From these four final portfolios, this paper continues sorting the stocks in each portfolio according to earnings quality, after that calculates the momentum profits.

The second method is running the regression of momentum returns based on earnings quality on the market excess return, SMB, and HML.

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[9] Fama and French (2012)

$$Adjusted\ Momentum\ Profits = \ \alpha_i + \beta_1\big(R_m - R_f\big) + \beta_2(SMB) + \beta_3(HML) \qquad (6)$$

This paper focuses on interpreting the alpha variables whether it is significant and greater than zero, which can be imply that momentum profits arise from sorting the stocks based on earnings quality can make a significant abnormal return when controlled for firm size and book to market ratio.
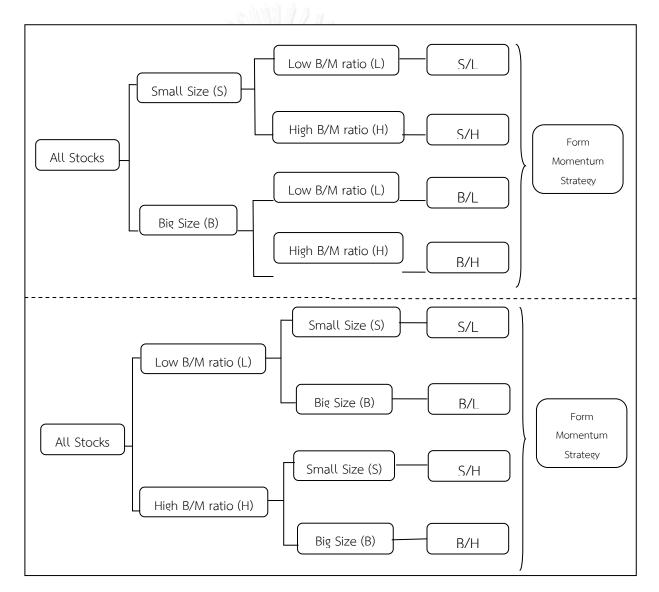
Figure 5 illustrates the procedure when controlled momentum returns with double sorted method. All stocks are sorted and grouped according to market capitalization and book to market ratio. The intersection between two market capitalization portfolios and two book to market portfolios creates four groups which are S/L, S/H, B/L, and B/H. Then, momentum strategy is formed from each group.

### 3.2.3 Information Uncertainty and Momentum Returns according to Economic Cycles

Third objective is to investigate the effect of information uncertainty on investor behavior among the difference in economic cycles. Focusing on two main different economic cycles which are economic expansion and economic recession provided by Trade and Economic indices Bureau, Ministry of Commerce, Thailand, this paper sorts all stocks according to the level of earnings quality that are obtained from the first objective into three groups, which are high earnings quality, medium earnings quality and low earnings quality. Then, stocks in each earnings quality groups are sorted according to past return into three portfolios which are the portfolio that contain firms with the highest past return (winner), portfolio that contain firms with middle past return (middle), and portfolio that contain firms with the lowest past return (loser). This paper sorts and groups the firms into portfolios are based on the period of economic expansion and recession. As a result, this paper obtains nine portfolios from the intersection of three earnings quality portfolios and three price momentum portfolios. In addition, this paper follows Jegadeesh and Titman (1993) [7] framework by varying the window time frame for look back periods and holding periods. Specifically, this paper focuses on four main time frames, which are 3 months, 6 months, 9 months and 12 months. The intersection of these four periods can create the 16 momentum strategies. Moreover, this paper controls the factors that have an effect on momentum profit which are firm size and book to market ratio by running a regression on Fama-French three factors model.

CHAPTER IV

EMPIRICAL RESULTS

### 4.1 Identifying Earnings Quality

The first objective is to identify earnings qualities that this paper uses as a proxy of information uncertainty by using earnings persistence. Since the earnings qualities are identified, this paper sorts and groups all firms according to the level of earnings persistence into three groups.  Group that contains the highest persistence coefficient is classified as high earnings quality group, group that persistence coefficient is in the middle is classified as medium earnings quality group, and group that contains the lowest persistence coefficient is classified as low earnings quality group. Low earnings quality groups have the average earnings persistence coefficient around 0.5, medium earnings quality groups have the average earnings persistence coefficient around 0.8, and high earnings quality groups have the average earnings persistence coefficient around 1. This paper focuses on interpreting the beta coefficient from running the auto-regression of earnings per share because the beta coefficient is the measure of persistence. The beta coefficient is close to one if earnings are highly persistence. As a result, earnings information from firms that are classified as high quality group contains lower uncertainty information compared to low quality group.

Table 3 reports the descriptive statistics of earnings persistence for high earnings quality group, medium earnings quality group, and low earnings quality group between 1991 and 2000. The average persistence on low quality groups that

varies every five years from 1991 to 2010 are 0.5222, 0.4551, 0.5814, and 0.4323 respectively. The average persistence on medium quality groups that varies every five years from 1991 to 2010 are 0.8006, 0.7559, 0.8148, and 0.7894 respectively. Lastly, the average persistence on high quality groups that varies every five years from 1991 to 2010 are 1.0113, 0.9102, 0.9633, and 1.0081 respectively.

Since, this paper can identify the level of information uncertainty through earnings qualities, which are high level of information uncertainty (low quality group), medium level of information uncertainty (medium quality group), and low level of information uncertainty (high quality group). Then, this paper will be able to investigate the behavior of investor giving the condition on information uncertainty of earnings.

Table 3 Earnings persistence

Earnings persistence is calculated by the following model: $EPS_t = \alpha + \beta\,(EPS_{t-1}) + \epsilon_t$. This paper focuses on interpreting beta coefficient as it is used to indicate earnings persistence. Then, this paper sorts all stocks according to the beta coefficient from low to high and groups into three groups. Low quality group contains stocks that have the lowest beta coefficient. Medium quality group contains stocks that have the beta coefficient in the middle. High quality group contains the highest beta coefficient. Panel A, panel B, panel C, and panel D represent the examination period during 1991-1995, 1996-2000, 2001-2005, and 2006-2010, respectively.

| Panel A: Earnings persistence during 1991-1995 | | | | |
|---|---|---|---|---|
| Quality group | Minimum | Maximum | Mean | Std. Deviation |
| Low Quality | -0.4462 | 0.7042 | 0.5222 | 0.2139 |
| Medium Quality | 0.7046 | 0.8690 | 0.8006 | 0.0491 |
| High Quality | 0.8726 | 1.3094 | 1.0113 | 0.1057 |
| Total | -0.4462 | 1.3094 | 0.7780 | 0.2448 |
| Panel B: Earnings persistence during 1996-2000 | | | | |
| Quality group | Minimum | Maximum | Mean | Std. Deviation |
| Low Quality | -0.0687 | 0.6554 | 0.4551 | 0.1786 |
| Medium Quality | 0.6560 | 0.8425 | 0.7559 | 0.0531 |
| High Quality | 0.8481 | 1.0072 | 0.9102 | 0.0464 |
| Total | -0.0687 | 1.0072 | 0.7090 | 0.2192 |
| Panel C: Earnings persistence during 2001-2005 | | | | |
| Quality group | Minimum | Maximum | Mean | Std. Deviation |
| Low Quality | 0.0168 | 0.7276 | 0.5814 | 0.1470 |
| Medium Quality | 0.7368 | 0.8856 | 0.8148 | 0.0468 |
| High Quality | 0.8873 | 1.2162 | 0.9633 | 0.0684 |
| Total | 0.0168 | 1.2162 | 0.7865 | 0.1850 |
| Panel D: Earnings persistence during 2006-2010 | | | | |
| Quality group | Minimum | Maximum | Mean | Std. Deviation |
| Low Quality | -0.1761 | 0.7037 | 0.4323 | 0.2365 |
| Medium Quality | 0.7040 | 0.8731 | 0.7894 | 0.0455 |
| High Quality | 0.8733 | 3.9027 | 1.0081 | 0.3247 |
| Total | -0.1761 | 3.9027 | 0.7434 | 0.3319 |

**4.2 Information Uncertainty and Momentum Returns**

Table 4 represents the average monthly momentum returns based on stocks that listed on the stock exchange of Thailand during 1996-2010. The first row presents full sample period of 15 years, while second to forth row present sub-sample period of 5 years. Raw return is shown in panel A, while in panel B shows momentum return when controlled for Fama-French three factors model. This table intentionally shows the existence of momentum returns in Thailand. Moreover, the result on table 4 is consistent with the first hypothesis that according to the level of information uncertainty, low earnings quality firms have higher momentum profits than high earnings quality firms. This can be explained that among high information uncertainty and low information uncertainty, investors are on average more under-react to firms that have high information uncertainty which can be observed by higher momentum profits. However, this paper cannot generalize that the pattern in full sample period will persist across different period, as you can see that the significant of the difference momentum profits between low earnings quality firms and high earnings quality firms in full sample period is mainly driven by the period between 2006 and 2010.

Table 4 panel A shows firms that are classified as low quality group provide momentum return of 2.3 percent on full sample period, while firms that are classified as high quality group provide momentum return of 1.6 percent on full sample period. The difference on momentum return between low quality group and high quality group is 0.7 percent. For sub-sample periods, which are 1996-2000, 2001-2005, and 2006-2010, momentum returns on low quality group are 2.5 percent, 1.8 percent, and 2.8 percent respectively, and momentum returns on high quality group

are 2.0 percent, 1.7 percent, and 1.2 percent respectively. The difference on sub-sample periods between low quality group and high quality group are 0.5 percent, 0.1 percent, and 1.6 percent respectively.

Table 4 panel B shows that when controlled for Fama-French three factors model firms that are classified as low quality group provide momentum return of 0.8 percent on full sample period, while firms that are classified as high quality group provide momentum return of zero percent on full sample period. The difference on momentum return between low quality group and high quality group is 0.8 percent. For sub-sample periods, which are 1996-2000, 2001-2005, and 2006-2010, momentum returns on low quality group are 0.5 percent, 0.2 percent, and 0.2 percent respectively, and momentum returns on high quality group are -0.3 percent, -0.2 percent, and -1.4 percent respectively. The difference on sub-sample periods between low quality group and high quality group are 0.7 percent, 0.3 percent, and 1.6 percent respectively.

When momentum profits are controlled by Fama-French three factors model, the profits are lower compared to raw momentum returns. In addition, momentum profits are mainly derived from low earnings quality group, while high earnings quality group give negative returns over sub-sample period. As this paper mentioned before, the pattern that investors under-react to high information uncertainty firms persist over full sample period, but this paper cannot generalize this pattern in general period because the behavior of under-reaction is mainly driven by 2006 to 2010. Therefore, this paper further explore whether during 2006 to 2010 have some relationship with the economic cycle or not as a third objective in this paper.

Table4 Momentum returns

According to the level of earnings quality which are high quality, medium quality, and low quality, for each month t, all stocks in each groups are ranked based on their past returns over a specified period (3-12 months look back periods) and then allocated into three groups which are winners group, middles group, and losers group. Winners group contains stocks that have the highest past return. Middles group contains stocks that their past returns rank in the middle. Losers group contains stocks that have the lowest past return. Momentum returns derived from the strategy that take long on winners group and short sell on losers group over a specified period (3-12 months holding periods). Last column presents the difference of momentum returns between low quality group and high quality group. Positive number can be implied that investors are more under-react to low quality group than high quality group. Panel A shows average raw momentum returns over full period between 1996 and 2010, and sub-sample period of 1996-2000, 2001-2005, and 2006-2010.  Panel B shows average momentum returns when controlled by Fama-French three factors model over full period between 1996 and 2010, and sub-sample period of 1996-2000, 2001-2005, and 2006-2010. *t*-statistics are reported in parenthesis. * indicates that the returns are significantly greater than zero at the 0.05 level, and ** indicates that the returns are significantly greater than zero at the 0.01 level.

| Panel A: raw momentum returns | | | | |
| --- | --- | --- | --- | --- |
| Years | Low Quality | Medium Quality | High Quality | Low Quality – High Quality |
| 1996-2010 | 0.023** | 0.020** | 0.016** | 0.007* |
| (N=180) | (7.64) | (7.23) | (6.57) | (1.81) |
| 1996-2000 | 0.025** | 0.025** | 0.020** | 0.005 |
| (N=60) | (5.46) | (5.87) | (4.97) | (0.70) |
| 2001-2005 | 0.018** | 0.015** | 0.017** | 0.001 |
| (N=60) | (10.17) | (8.28) | (11.02) | (0.43) |
| 2006-2010 | 0.028** | 0.018** | 0.012** | 0.016** |
| (N=60) | (9.27) | (7.63) | (5.44) | (4.51) |

| Panel B: Momentum returns when controlled by Fama-French three factors model | | | | |
| --- | --- | --- | --- | --- |
| Years | Low Quality | Medium Quality | High Quality | Low Quality – High Quality |
| 1996-2010 | 0.008** | 0.003 | 0.000 | 0.008** |
| (N=180) | (3.44) | (1.14) | (-0.09) | (2.68) |
| 1996-2000 | 0.005 | 0.004 | -0.003 | 0.007 |
| (N=60) | (1.12) | (0.96) | (-0.79) | (1.36) |
| 2001-2005 | 0.002 | -0.003 | -0.002 | 0.003 |
| (N=60) | (0.09) | (-1.74) | (-1.13) | (1.39) |
| 2006-2010 | 0.002 | -0.008** | -0.014** | 0.016** |
| (N=60) | (0.06) | (-3.57) | (-7.02) | (4.77) |

The result supports the empirical argument on behavioral finance that people are more subjective to psychological biases in making financial decision under uncertainty situation. The result is consistent with the summarizing word from Hirshleifer (2001) [5] as follow: "greater uncertainty about a set of stocks … leaves more room for psychological biases". Generally, investors are more affected by psychological biases to firms that have high information uncertainty. Moreover, the result also concludes in the same direction of prior relevant literature on behavioral finance. According to Zhang (2006) [18], he concludes that the degree of delayed adjustment of market reaction to new information increases with the level of information uncertainty. This can be implied that investors tend to under-react more if they perceive that the information that relevant to firm value is ambiguity.

This paper proposes the different perspective in explaining why investors under-react to uncertainty information. On this perspective, human nature is considered. The simplest experiment from Daniel (1961) [19] explains about human behavior in making decision under uncertainty. Suppose there are two jars contained red and black balls. Participants are asked to bet on drawing a red ball from either first jar or second jar. If red ball is drawn, participants will get reward, but if black ball is drawn, participants will get nothing. The information provided to participants is that first jar contains 100 balls of red and black with no information about the proportion of red and black balls. Second jar contains the exactly 50 red balls and 50 black balls. The result shows that the majority choose to draw a ball from second jar. In other words, participants make decision where they know the odds and the possible outcomes, while they avoid making decision where the odds and possible outcomes are unknown. His explanation on the result is that participants avoid making a

decision when they have insufficient information. Moreover, when there is more than one choice, participants will choose another choice with more information is available.

This paper follows Jegadeesh and Titman (1993) [7] framework by varying the window time frame for look back periods and holding periods. Specifically, this paper focuses on four main time frames, which are 3 months, 6 months, 9 months and 12 months. The intersection of these four periods can create the 16 momentum strategies. Table 5 presents momentum returns on difference time frames by varied the formation periods and holding periods. Time frames are written in form of "formation period x holding period". For example, 6x6 time frame refers to 6 months formation period and 6 months holding period. Table 5 panel A presents the full sample data between 1995 and 2010, while panel B, panel C, and panel D present sub sample data during 1995-2000, 2001-2005, and 2006-2010, respectively.

The result confirms the evidence from Jegadeesh and Titman (1993) [7] who find that momentum strategies are able to generate significant positive return over 3 to 12 months holding periods. Furthermore, the result still confirms the first hypothesis that according to the level of information uncertainty, investors are more under-react to firms that have high information uncertainty which can be observed by higher momentum profits. In addition, one interesting finding on the result is that when this paper extends the holding period, momentum return will be lower. This can be explained that the behavior of under-reaction is more likely to happen over the short run, then the degree of under-reaction will decrease as time increase, so that investors gradually adjust assets value to their intrinsic value as it is documented by Barberis, Shleifer, and Vishny (1998) [8], and Daniel, Hirshleifer, and

Subrahmanyam (1998) [9]. For example, in case of raw return on full sample period (table 5 panel A), momentum returns on 6x3 time frame is 4.5 percent for low quality, 3.9 percent for medium and 3.6 percent for high quality, while momentum returns on 6x12 time frame is 0.9 percent for low quality, 0.8 percent for medium quality, and 0.5 percent on high quality.

## Table5 Raw momentum returns when varied look back periods and holding periods

This table represents momentum returns when varied look back periods and holding periods over full sample period between 1996 and 2010 in panel A, while panel B, panel C, and panel D represent raw momentum return over sub-sample period between 1996-2000, 2001-2005, and 2006-2010, respectively. According to the level of earnings quality which are high quality, medium quality, and low quality, for each month t, all stocks in each groups are ranked based on their past returns over a specified period (3-12 months) and then allocated into three groups which are winners group, middles group, and losers group. Winners group contains stocks that have the highest past return. Middles group contains stocks that their past returns rank in the middle. Losers group contains stocks that have the lowest past return. Momentum returns derived from the strategy that take long on winners group and short sell on losers group over a specified period (3-12 months holding periods). *t*-statistics are reported in parenthesis. * indicates that the returns are significantly greater than zero at the 0.05 level, and ** indicates that the returns are significantly greater than zero at the 0.01 level.

| Panel A: Raw momentum return (1996-2010) | | |
|---|---|---|
| Time-frame | Low quality | Medium quality | High quality |
| 3x3 | $0.030^{**}$ | $0.024^{**}$ | $0.024^{**}$ |
| | (8.30) | (8.70) | (8.13) |
| 3x6 | $0.018^{**}$ | $0.015^{**}$ | $0.015^{**}$ |
| | (6.42) | (6.44) | (5.93) |
| 3x9 | $0.012^{**}$ | $0.009^{**}$ | $0.009^{**}$ |
| | (5.56) | (4.72) | (4.46) |
| 3x12 | $0.006^{**}$ | $0.003^{*}$ | $0.005^{**}$ |
| | (3.06) | (1.98) | (2.56) |
| 6x3 | $0.045^{**}$ | $0.039^{**}$ | $0.036^{**}$ |
| | (13.55) | (16.24) | (15.22) |
| 6x6 | $0.027^{**}$ | $0.022^{**}$ | $0.019^{**}$ |
| | (10.69) | (11.09) | (9.47) |
| 6x9 | $0.016^{**}$ | $0.013^{**}$ | $0.010^{**}$ |
| | (8.13) | (7.67) | (5.81) |
| 6x12 | $0.009^{**}$ | $0.008^{**}$ | $0.005^{**}$ |
| | (5.22) | (5.80) | (3.55) |
| 9x3 | $0.044^{**}$ | $0.037^{**}$ | $0.033^{**}$ |
| | (14.95) | (18.09) | (17.61) |
| 9x6 | $0.030^{**}$ | $0.024^{**}$ | $0.021^{**}$ |
| | (11.83) | (13.78) | (13.64) |
| 9x9 | $0.019^{**}$ | $0.015^{**}$ | $0.012^{**}$ |
| | (8.83) | (10.06) | (9.02) |
| 9x12 | $0.012^{**}$ | $0.010^{**}$ | $0.006^{**}$ |
| | (6.36) | (8.07) | (5.74) |
| 12x3 | $0.040^{**}$ | $0.035^{**}$ | $0.028^{**}$ |
| | (15.71) | (19.82) | (18.61) |
| 12x6 | $0.030^{**}$ | $0.026^{**}$ | $0.019^{**}$ |
| | (12.88) | (17.33) | (15.17) |
| 12x9 | $0.022^{**}$ | $0.019^{**}$ | $0.012^{**}$ |
| | (10.14) | (14.94) | (11.25) |
| 12x12 | $0.015^{**}$ | $0.013^{**}$ | $0.007^{**}$ |
| | (7.90) | (12.63) | (6.99) |

Panel B: Raw momentum return (1996-2000)

| Time-frame | Low quality | Medium quality | High quality |
|---|---|---|---|
| 3x3 | 0.034** | 0.026** | 0.024** |
|  | (4.29) | (3.61) | (3.02) |
| 3x6 | 0.020** | 0.018** | 0.016* |
|  | (2.95) | (3.00) | (2.28) |
| 3x9 | 0.011* | 0.010* | 0.008 |
|  | (2.07) | (2.07) | (1.46) |
| 3x12 | 0.001 | -0.001 | 0.001 |
|  | (-0.01) | (-0.12) | (0.02) |
| 6x3 | 0.058** | 0.056** | 0.051** |
|  | (11.42) | (9.67) | (9.60) |
| 6x6 | 0.031** | 0.030** | 0.024** |
|  | (6.91) | (6.01) | (4.95) |
| 6x9 | 0.014** | 0.015** | 0.008* |
|  | (3.61) | (3.70) | (2.06) |
| 6x12 | 0.003 | 0.007** | 0.001 |
|  | (0.78) | (2.35) | (0.38) |
| 9x3 | 0.054** | 0.052** | 0.049** |
|  | (12.84) | (10.65) | (13.04) |
| 9x6 | 0.033** | 0.032** | 0.029** |
|  | (8.79) | (7.62) | (9.41) |
| 9x9 | 0.017** | 0.018** | 0.014** |
|  | (4.65) | (5.19) | (5.33) |
| 9x12 | 0.006* | 0.010** | 0.006** |
|  | (1.92) | (3.94) | (2.69) |
| 12x3 | 0.048** | 0.050** | 0.043** |
|  | (12.74) | (11.92) | (15.07) |
| 12x6 | 0.033** | 0.037** | 0.028** |
|  | (9.68) | (10.21) | (11.58) |
| 12x9 | 0.020** | 0.026** | 0.016** |
|  | (6.30) | (8.89) | (8.09) |
| 12x12 | 0.010** | 0.013** | 0.007** |
|  | (3.67) | (7.67) | (4.02) |

Panel C: Raw momentum return (2001-2005)

| Time-frame | Low quality | Medium quality | High quality |
|---|---|---|---|
| 3x3 | 0.019$^{**}$ | 0.016$^{**}$ | 0.023$^{**}$ |
| | (6.44) | (7.06) | (7.94) |
| 3x6 | 0.012$^{**}$ | 0.009$^{**}$ | 0.015$^{**}$ |
| | (5.16) | (5.92) | (8.15) |
| 3x9 | 0.009$^{**}$ | 0.005$^{**}$ | 0.011$^{**}$ |
| | (5.56) | (4.14) | (6.91) |
| 3x12 | 0.007$^{**}$ | 0.003* | 0.009$^{**}$ |
| | (4.91) | (2.06) | (6.73) |
| 6x3 | 0.029$^{**}$ | 0.027$^{**}$ | 0.030$^{**}$ |
| | (12.12) | (16.19) | (10.86) |
| 6x6 | 0.019$^{**}$ | 0.016$^{**}$ | 0.019$^{**}$ |
| | (9.58) | (11.89) | (9.04) |
| 6x9 | 0.015$^{**}$ | 0.011$^{**}$ | 0.014$^{**}$ |
| | (8.22) | (8.51) | (8.22) |
| 6x12 | 0.011$^{**}$ | 0.009$^{**}$ | 0.012$^{**}$ |
| | (6.61) | (6.83) | (8.24) |
| 9x3 | 0.030$^{**}$ | 0.026$^{**}$ | 0.026$^{**}$ |
| | (14.73) | (18.57) | (10.64) |
| 9x6 | 0.022$^{**}$ | 0.019$^{**}$ | 0.019$^{**}$ |
| | (11.63) | (12.79) | (9.00) |
| 9x9 | 0.017$^{**}$ | 0.013$^{**}$ | 0.014$^{**}$ |
| | (8.76) | (9.65) | (8.18) |
| 9x12 | 0.013$^{**}$ | 0.010$^{**}$ | 0.011$^{**}$ |
| | (6.84) | (8.69) | (7.77) |
| 12x3 | 0.028$^{**}$ | 0.025$^{**}$ | 0.023$^{**}$ |
| | (15.45) | (19.34) | (10.64) |
| 12x6 | 0.022$^{**}$ | 0.020$^{**}$ | 0.018$^{**}$ |
| | (12.17) | (16.43) | (9.53) |
| 12x9 | 0.018$^{**}$ | 0.016$^{**}$ | 0.014$^{**}$ |
| | (9.54) | (14.16) | (8.61) |
| 12x12 | 0.014$^{**}$ | 0.013$^{**}$ | 0.011$^{**}$ |
| | (7.64) | (13.01) | (7.48) |

Panel D: Raw momentum return (2006-2010)

| Time-frame | Low quality | Medium quality | High quality |
|---|---|---|---|
| 3x3 | 0.038** | 0.030** | 0.025** |
| | (5.62) | (9.41) | (8.21) |
| 3x6 | 0.022** | 0.017** | 0.014** |
| | (5.12) | (6.39) | (5.16) |
| 3x9 | 0.016** | 0.011** | 0.009** |
| | (4.87) | (4.52) | (3.75) |
| 3x12 | 0.012** | 0.008** | 0.005** |
| | (4.33) | (3.73) | (2.56) |
| 6x3 | 0.048** | 0.036** | 0.027** |
| | (6.17) | (11.23) | (9.03) |
| 6x6 | 0.031** | 0.020** | 0.014** |
| | (5.41) | (6.95) | (4.83) |
| 6x9 | 0.021** | 0.012** | 0.006** |
| | (4.79) | (4.61) | (2.65) |
| 6x12 | 0.014** | 0.008** | 0.002 |
| | (3.94) | (3.32) | (0.85) |
| 9x3 | 0.048** | 0.033** | 0.024** |
| | (6.70) | (13.18) | (10.46) |
| 9x6 | 0.035** | 0.021** | 0.014** |
| | (5.53) | (8.84) | (6.34) |
| 9x9 | 0.024** | 0.013** | 0.006** |
| | (4.71) | (5.71) | (3.08) |
| 9x12 | 0.016** | 0.008** | 0.001** |
| | (3.92) | (3.82) | (0.84) |
| 12x3 | 0.046** | 0.030** | 0.019** |
| | (7.36) | (17.30) | (11.51) |
| 12x6 | 0.036** | 0.022** | 0.011** |
| | (6.18) | (11.76) | (6.98) |
| 12x9 | 0.027** | 0.014** | 0.006** |
| | (5.22) | (7.79) | (3.56) |
| 12x12 | 0.020** | 0.009** | 0.002 |
| | (4.45) | (4.99) | (1.24) |

Table 6 presents momentum returns when controlled for Fama-French three factors model with various window time frames. Specifically, this paper focuses on four main time frames, which are 3 months, 6 months, 9 months and 12 months. The intersection of these four periods can create the 16 momentum strategies. The result suggests that even when momentum profits are controlled by Fama-French three factors model, momentum strategies are able to generate positive returns over 3 to 6 months holding period. However, high earnings quality groups and medium earnings quality groups give negative momentum returns when this paper extend holding period more than 6 months. This can be explained that the behavior of under-reaction is more likely to happen over the short run, then the degree of under-reaction will decrease as time increase, so that investors gradually adjust assets value to their intrinsic value as it is documented by Barberis, Shleifer, and Vishny (1998) [8], and Daniel, Hirshleifer, and Subrahmanyam (1998) [9]. The result on table 6 supports the first hypothesis that investors are more under-react to firms that have high information uncertainty. Table 6 panel A presents the full sample data between 1995 and 2010, while panel B, panel C, and panel D present sub sample data during 1995-2000, 2001-2005, and 2006-2010, respectively.

Table6 Momentum returns when controlled by Fama-French three factors model and varied look back periods and holding periods

This table represents momentum returns controlled by Fama-French three factors model when varied look back periods and holding periods over full sample period between 1996 and 2010 in panel A, while panel B, panel C, and panel D represent momentum return over sub-sample period between 1996-2000, 2001-2005, and 2006-2010, respectively. According to the level of earnings quality which are high quality, medium quality, and low quality, for each month t, all stocks in each groups are ranked based on their past returns over a specified period (3-12 months) and then allocated into three groups which are winners group, middles group, and losers group. Winners group contains stocks that have the highest past return. Middles group contains stocks that their past returns rank in the middle. Losers group contains stocks that have the lowest past return. Momentum returns derived from the strategy that take long on winners group and short sell on losers group over a specified period (3-12 months holding periods). *t*-statistics are reported in parenthesis. * indicates that the returns are significantly greater than zero at the 0.05 level, and ** indicates that the returns are significantly greater than zero at the 0.01 level.

| Panel A: Momentum return when controlled by Fama-French three factors model (1996-2010) | | |
|---|---|---|
| Time-frame | Low quality | Medium quality | High quality |
| 3x3 | $0.016^{**}$ | $0.016^{**}$ | $0.012^{*}$ |
|  | (3.04) | (3.46) | (2.42) |
| 3x6 | 0.008 | 0.005 | 0.002 |
|  | (1.77) | (1.41) | (0.54) |
| 3x9 | 0.002 | -0.002 | -0.003 |
|  | (0.52) | (-0.61) | (-0.72) |
| 3x12 | -0.002 | $-0.007^{*}$ | -0.006 |
|  | (-0.54) | (-2.18) | (-1.74) |
| 6x3 | $0.025^{**}$ | $0.018^{**}$ | $0.015^{**}$ |
|  | (5.26) | (4.50) | (3.96) |
| 6x6 | $0.011^{**}$ | 0.003 | 0.001 |
|  | (2.63) | (0.74) | (0.17) |
| 6x9 | 0.002 | -0.006 | -0.006 |
|  | (0.57) | (-1.66) | (-1.75) |
| 6x12 | -0.004 | $-0.010^{**}$ | $-0.010^{**}$ |
|  | (-1.06) | (-3.21) | (-2.92) |
| 9x3 | $0.024^{**}$ | $0.016^{**}$ | $0.012^{**}$ |
|  | (5.52) | (4.21) | (3.44) |
| 9x6 | $0.013^{**}$ | 0.004 | 0.002 |
|  | (3.12) | (1.17) | (0.53) |
| 9x9 | 0.003 | -0.004 | -0.006 |
|  | (0.79) | (-1.27) | (-1.85) |
| 9x12 | -0.003 | $-0.008^{**}$ | $-0.009^{**}$ |
|  | (-0.90) | (-2.71) | (-3.10) |
| 12x3 | $0.021^{**}$ | $0.015^{**}$ | $0.008^{*}$ |
|  | (5.37) | (4.37) | (2.48) |
| 12x6 | $0.012^{**}$ | $0.007^{*}$ | 0.000 |
|  | (3.26) | (2.12) | (0.02) |
| 12x9 | 0.005 | 0.000 | -0.006 |
|  | (1.31) | (0.06) | (-1.83) |
| 12x12 | -0.001 | -0.004 | $-0.009^{**}$ |
|  | (-0.31) | (-1.36) | (-2.92) |

Panel B: Momentum return when controlled by Fama-French three factors model (1996-2000)

| Time-frame | Low quality | Medium quality | High quality |
|---|---|---|---|
| 3x3 | 0.017 | 0.029[*] | 0.010 |
| | (1.23) | (2.28) | (0.71) |
| 3x6 | 0.012 | 0.015 | 0.001 |
| | (1.03) | (1.42) | (0.12) |
| 3x9 | 0.002 | -0.002 | -0.006 |
| | (0.23) | (-0.17) | (-0.63) |
| 3x12 | -0.008 | -0.015 | -0.013 |
| | (-0.78) | (-1.73) | (-1.38) |
| 6x3 | 0.035[**] | 0.030[*] | 0.021 |
| | (3.14) | (2.61) | (1.95) |
| 6x6 | 0.013 | 0.003 | -0.004 |
| | (1.25) | (0.32) | (-0.41) |
| 6x9 | -0.003 | -0.013 | -0.016 |
| | (-0.30) | (-1.45) | (-1.78) |
| 6x12 | -0.015 | -0.023[**] | -0.022[*] |
| | (-1.57) | (-2.81) | (-2.54) |
| 9x3 | 0.030[**] | 0.027[*] | 0.020[*] |
| | (3.06) | (2.42) | (2.10) |
| 9x6 | 0.010 | 0.006 | 0.002 |
| | (1.07) | (0.60) | (0.21) |
| 9x9 | -0.007 | -0.009 | -0.012 |
| | (-0.82) | (-1.02) | (-1.48) |
| 9x12 | -0.017[*] | -0.017[*] | -0.018[*] |
| | (-2.09) | (-2.08) | (-2.34) |
| 12x3 | 0.020[*] | 0.028[**] | 0.016 |
| | (2.25) | (2.68) | (1.85) |
| 12x6 | 0.006 | 0.013 | 0.001 |
| | (0.74) | (1.40) | (0.16) |
| 12x9 | -0.007 | 0.002 | -0.009 |
| | (-0.82) | (0.17) | (-1.09) |
| 12x12 | -0.016[*] | -0.006 | -0.014 |
| | (-2.02) | (-0.70) | (-1.81) |

Panel C: Momentum return when controlled by Fama-French three factors model (2001-2005)

| Time-frame | Low quality | Medium quality | High quality |
|---|---|---|---|
| 3x3 | 0.004 | -0.001 | 0.003 |
|  | (1.19) | (-0.20) | (0.83) |
| 3x6 | -0.003 | -0.007** | -0.003 |
|  | (-1.01) | (-3.69) | (-1.20) |
| 3x9 | -0.007** | -0.010** | -0.007** |
|  | (-3.36) | (-5.96) | (-3.34) |
| 3x12 | -0.010** | -0.012** | -0.008** |
|  | (-5.02) | (-8.22) | (-4.59) |
| 6x3 | 0.012** | 0.007** | 0.011** |
|  | (3.99) | (3.71) | (3.45) |
| 6x6 | 0.002 | -0.001 | 0.001 |
|  | (0.76) | (-0.79) | (0.46) |
| 6x9 | -0.004 | -0.006** | -0.003 |
|  | (-1.62) | (-3.75) | (-1.61) |
| 6x12 | -0.008** | -0.008** | -0.005** |
|  | (-3.45) | (-4.90) | (-3.00) |
| 9x3 | 0.015** | 0.007** | 0.007 |
|  | (5.63) | (3.80) | (2.50) |
| 9x6 | 0.007** | -0.001 | 0.001 |
|  | (2.96) | (-0.45) | (0.22) |
| 9x9 | 0.001 | -0.006** | -0.004* |
|  | (0.47) | (-3.27) | (-2.29) |
| 9x12 | -0.003 | -0.008** | -0.007** |
|  | (-1.22) | (-4.81) | (-4.30) |
| 12x3 | 0.012** | 0.008** | 0.003 |
|  | (4.75) | (3.94) | (1.26) |
| 12x6 | 0.007** | 0.002 | -0.001 |
|  | (2.66) | (1.23) | (-0.56) |
| 12x9 | 0.003 | -0.002 | -0.005* |
|  | (1.01) | (-1.35) | (-2.65) |
| 12x12 | -0.001 | -0.005** | -0.008** |
|  | (-0.37) | (-3.21) | (-4.77) |

Panel D: Momentum return when controlled by Fama-French three factors model (2006-2010)

| Time-frame | Low quality | Medium quality | High quality |
|---|---|---|---|
| 3x3 | 0.007 | 0.002 | -0.003 |
| | (0.72) | (0.34) | (-0.54) |
| 3x6 | -0.003 | -0.007 | -0.012[*] |
| | (-0.41) | (-1.38) | (-2.52) |
| 3x9 | -0.006 | -0.009[*] | -0.014[**] |
| | (-1.20) | (-2.16) | (-3.49) |
| 3x12 | -0.010[*] | -0.013[*] | -0.019[**] |
| | (-2.21) | (-3.38) | (-5.21) |
| 6x3 | 0.022[*] | 0.007 | 0.001 |
| | (2.07) | (1.42) | (0.21) |
| 6x6 | 0.005 | -0.007 | -0.013[**] |
| | (0.65) | (-1.67) | (-2.82) |
| 6x9 | -0.004 | -0.014[**] | -0.019[**] |
| | (-0.74) | (-3.53) | (-4.85) |
| 6x12 | -0.010 | -0.017[**] | -0.023[**] |
| | (-1.99) | (-4.99) | (-6.88) |
| 9x3 | 0.017 | 0.006 | -0.002 |
| | (1.83) | (1.52) | (-0.38) |
| 9x6 | 0.006 | -0.006 | -0.012[**] |
| | (0.69) | (-1.63) | (-3.42) |
| 9x9 | -0.004 | -0.013[**] | -0.020[**] |
| | (-0.66) | (-4.35) | (-6.19) |
| 9x12 | -0.010 | -0.018[**] | -0.025[**] |
| | (-1.96) | (-6.48) | (-8.13) |
| 12x3 | 0.017[*] | 0.004 | -0.007[*] |
| | (2.23) | (1.25) | (-2.05) |
| 12x6 | 0.007 | -0.005 | -0.014[**] |
| | (0.99) | (-1.93) | (-4.83) |
| 12x9 | -0.001 | -0.012[**] | -0.020[**] |
| | (-0.18) | (-5.04) | (-7.09) |
| 12x12 | -0.008 | -0.018[**] | -0.024)[**] |
| | (-1.47) | (-7.77) | (-9.04) |

This paper also provides different method in controlling the factors of book to market and firm size by double sorted method. The reason why this paper controls the factors of book to market and firm size is because many studies provide the evidence that these two variables can affect the momentum profits. For example, Fama and French (2012) [17] show that the momentum returns spread that derived from long winner portfolio and short sell loser portfolio decrease from smaller stocks to bigger stocks. Jegadeesh and Titman (1993) [7] examine the return on 6/6 momentum strategy based on firm size. They find that average monthly return small capitalization firms, medium capitalization firms, and large capitalization firms are 0.99 percent, 1.26 percent, and 0.75 percent, respectively. Thus, it seems that the momentum returns tend to be related to firm size.  In addition, Liu et al (1999) indicate that winner stocks tend to have low book to market ratio and loser stocks tend to have high book to market ratio.

Table 7 presents the momentum returns when controlled by double sorted method. According to prior studies, firm size and book to market ratio are affected momentum returns. Double sorted method provides a way that this paper can examine the relationship between information uncertainty and investor behavior by restricted the stocks into four different characteristic groups. All firms will be sorted and grouped into four groups that have different characteristics which are small size with low book to market ratio (S/L), small size with high book to market ratio (S/H), big size with low book to market ratio (B/L), and big size with high book to market ratio (B/H). After controlled firm size and book to market ratio, the result tends to confirm the first hypothesis that according to the level of information uncertainty,

investors are more under-react to firms that have high information uncertainty which can be observed by higher momentum profits.

## Table7  Momentum returns when controlled by double sorted method

This table represents momentum returns controlled by double sorted method when varied look back periods and holding periods over full sample period between 1996 and 2010. All stocks are sorted according to the market capitalization and ranked into two portfolios, which are big firm and small firm portfolios (B and S). This paper also breaks the stocks into two portfolios according to book to market ratio which are high book to market portfolio and low book to market portfolio (H and L). The final portfolios are the four intersections the two market capitalization and two book to market groups (S/L, S/H, B/L, and B/H). Then, earnings qualities are identified and grouped into three groups which are high quality group, medium quality group, and low quality group. After that stocks in each group of final portfolios are ranked based on their past returns over a specified period (3-12 months) and then allocated into three groups which are winners group, middles group, and losers group. Winners group contains stocks that have the highest past return. Middles group contains stocks that their past returns rank in the middle. Losers group contains stocks that have the lowest past return. Momentum returns derived from the strategy that take long on winners group and short sell on losers group over a specified period (3-12 months holding periods). Panel A represents stocks that have characteristic of small size and have low book to market ratio (S/L). Panel B represents stocks that have characteristic of small size and have high book to market ratio (S/H). Panel C represent stocks that have characteristic of big size and low book to market ratio (B/L). Panel D represent stocks that have characteristic of big size and high book to market ratio (B/H). $t$-statistics are reported in parenthesis. * indicates that the returns are significantly greater than zero at the 0.05 level, and ** indicates that the returns are significantly greater than zero at the 0.01 level.

| Panel A: Momentum returns when controlled by double sorted method (S/L group) | | |
|---|---|---|
| Time-frame | Low quality | Medium quality | High quality |
|---|---|---|---|
| 3x3 | 0.030** | 0.032** | 0.024** |
| | (2.76) | (3.05) | (3.27) |
| 3x6 | 0.023* | 0.020* | 0.008 |
| | (2.19) | (2.26) | (1.13) |
| 3x9 | 0.013 | 0.016* | 0.008 |
| | (1.53) | (2.03) | (1.12) |
| 3x12 | 0.009 | 0.013* | 0.004 |
| | (1.43) | (1.99) | (0.74) |
| 6x3 | 0.035** | 0.017 | 0.025** |
| | (3.91) | (1.63) | (2.72) |
| 6x6 | 0.028** | -0.001 | 0.006 |
| | (2.96) | (-0.07) | (0.84) |
| 6x9 | 0.020** | 0.018** | 0.004 |
| | (2.42) | (2.89) | (0.78) |
| 6x12 | 0.011 | 0.002* | -0.001 |
| | (1.57) | (0.21) | (-0.31) |
| 9x3 | 0.043** | 0.044** | 0.026** |
| | (4.98) | (3.86) | (3.56) |
| 9x6 | 0.028** | 0.037** | 0.017** |
| | (3.19) | (3.60) | (2.74) |
| 9x9 | 0.020* | 0.031** | 0.010* |
| | (2.37) | (3.53) | (1.77) |
| 9x12 | 0.015* | 0.026** | 0.005 |
| | (1.97) | (3.52) | (0.97) |
| 12x3 | 0.039** | 0.044** | 0.029** |
| | (5.06) | (4.52) | (5.37) |
| 12x6 | 0.029** | 0.038** | 0.024** |
| | (3.82) | (4.32) | (4.81) |
| 12x9 | 0.022** | 0.033** | 0.019** |
| | (2.95) | (4.18) | (4.18) |
| 12x12 | 0.017** | 0.028** | 0.016** |
| | (2.50) | (4.30) | (3.50) |

Panel B: Momentum returns when controlled by double sorted method (S/H group)

| Time-frame | Low quality | Medium quality | High quality |
|---|---|---|---|
| 3x3 | -0.002 | 0.004 | -0.005 |
| | (-0.14) | (0.30) | (-0.41) |
| 3x6 | 0.004 | -0.003 | 0.003 |
| | (0.45) | (-0.29) | (0.41) |
| 3x9 | 0.005 | -0.010 | 0.013 |
| | (0.77) | (-1.31) | (1.52) |
| 3x12 | -0.005 | -0.009 | 0.003 |
| | (-0.82) | (-1.38) | (0.53) |
| 6x3 | 0.028$^{**}$ | 0.023$^{*}$ | 0.031$^{**}$ |
| | (4.17) | (2.26) | (3.94) |
| 6x6 | 0.018$^{**}$ | 0.037$^{**}$ | 0.020$^{**}$ |
| | (2.73) | (5.59) | (3.74) |
| 6x9 | 0.022$^{**}$ | 0.019$^{**}$ | 0.017$^{**}$ |
| | (3.40) | (2.95) | (3.08) |
| 6x12 | 0.014$^{*}$ | 0.017$^{**}$ | 0.013$^{*}$ |
| | (2.34) | (3.03) | (2.06) |
| 9x3 | 0.040$^{**}$ | 0.042$^{**}$ | 0.038$^{**}$ |
| | (6.27) | (5.55) | (4.51) |
| 9x6 | 0.023$^{**}$ | 0.034$^{**}$ | 0.027$^{**}$ |
| | (3.79) | (4.46) | (4.00) |
| 9x9 | 0.019$^{**}$ | 0.018$^{**}$ | 0.021$^{**}$ |
| | (3.48) | (2.65) | (3.28) |
| 9x12 | 0.007 | 0.016$^{**}$ | 0.011$^{*}$ |
| | (1.61) | (2.89) | (1.72) |
| 12x3 | 0.034$^{**}$ | 0.035$^{**}$ | 0.041$^{**}$ |
| | (5.25) | (4.77) | (7.16) |
| 12x6 | 0.016$^{**}$ | 0.018$^{**}$ | 0.035$^{**}$ |
| | (3.22) | (2.84) | (6.25) |
| 12x9 | 0.019$^{**}$ | 0.014$^{**}$ | 0.022$^{**}$ |
| | (3.80) | (2.50) | (4.36) |
| 12x12 | 0.016$^{**}$ | 0.012$^{*}$ | 0.016$^{**}$ |
| | (3.43) | (2.32) | (3.57) |

Panel C: Momentum returns when controlled by double sorted method (B/L group)

| Time-frame | Low quality | Medium quality | High quality |
|---|---|---|---|
| 3x3 | -0.002 | 0.023 | 0.008 |
|  | (-0.14) | (1.29) | (0.63) |
| 3x6 | 0.003 | 0.017 | 0.006 |
|  | (0.25) | (1.07) | (0.57) |
| 3x9 | 0.011 | 0.006 | 0.009 |
|  | (1.20) | (0.60) | (0.92) |
| 3x12 | 0.001 | -0.003 | 0.002 |
|  | (0.17) | (-0.36) | (0.22) |
| 6x3 | 0.040** | 0.044** | 0.044** |
|  | (4.68) | (4.60) | (5.47) |
| 6x6 | 0.022** | 0.026** | 0.028** |
|  | (2.49) | (3.13) | (3.49) |
| 6x9 | 0.018* | 0.012 | 0.014* |
|  | (2.29) | (1.58) | (1.84) |
| 6x12 | 0.014* | -0.005 | 0.006 |
|  | (2.10) | (-0.72) | (0.84) |
| 9x3 | 0.047** | 0.054** | 0.032** |
|  | (5.54) | (5.93) | (3.92) |
| 9x6 | 0.027** | 0.031** | 0.011 |
|  | (3.37) | (4.31) | (1.39) |
| 9x9 | 0.015* | 0.014* | -0.002 |
|  | (1.84) | (2.00) | (-0.26) |
| 9x12 | 0.009 | 0.001 | -0.006 |
|  | (1.13) | (0.19) | (-0.88) |
| 12x3 | 0.044** | 0.051** | 0.043** |
|  | (4.57) | (5.96) | (4.84) |
| 12x6 | 0.032** | 0.035** | 0.026** |
|  | (3.26) | (4.48) | (2.99) |
| 12x9 | 0.021* | 0.017* | 0.019* |
|  | (2.25) | (2.32) | (2.33) |
| 12x12 | 0.012 | 0.007 | 0.010 |
|  | (1.36) | (1.00) | (1.19) |

Panel D: Momentum returns when controlled by double sorted method (B/H group)

| Time-frame | Low quality | Medium quality | High quality |
|------------|-------------|----------------|--------------|
| 3x3   | 0.010       | -0.012       | 0.009       |
|       | (0.83)      | (-0.80)      | (0.89)      |
| 3x6   | 0.005       | -0.012       | 0.003       |
|       | (0.64)      | (-1.17)      | (0.48)      |
| 3x9   | 0.007       | -0.006       | 0.001       |
|       | (0.99)      | (-0.75)      | (0.23)      |
| 3x12  | 0.005       | -0.016       | -0.002      |
|       | (0.90)      | (-1.76)      | (-0.43)     |
| 6x3   | 0.035$^{**}$ | 0.039$^{**}$ | 0.037$^{**}$ |
|       | (3.87)      | (4.70)       | (4.82)      |
| 6x6   | 0.019$^{**}$ | 0.024$^{**}$ | 0.023$^{**}$ |
|       | (2.44)      | (3.57)       | (3.59)      |
| 6x9   | 0.014$^{*}$  | 0.020$^{**}$ | 0.018$^{**}$ |
|       | (2.20)      | (3.12)       | (3.65)      |
| 6x12  | 0.010       | 0.000        | 0.007       |
|       | (1.50)      | (0.02)       | (1.57)      |
| 9x3   | 0.027$^{**}$ | 0.035$^{**}$ | 0.026$^{**}$ |
|       | (3.76)      | (5.93)       | (4.01)      |
| 9x6   | 0.023$^{**}$ | 0.030$^{**}$ | 0.024$^{**}$ |
|       | (3.58)      | (5.59)       | (3.77)      |
| 9x9   | 0.017$^{**}$ | 0.024$^{**}$ | 0.018$^{**}$ |
|       | (2.89)      | (3.77)       | (3.26)      |
| 9x12  | 0.012$^{*}$  | 0.022$^{**}$ | 0.010$^{*}$  |
|       | (2.26)      | (3.46)       | (2.27)      |
| 12x3  | 0.052$^{**}$ | 0.043$^{**}$ | 0.049$^{**}$ |
|       | (7.27)      | (5.98)       | (6.17)      |
| 12x6  | 0.040$^{**}$ | 0.035$^{**}$ | 0.039$^{**}$ |
|       | (6.67)      | (5.65)       | (5.60)      |
| 12x9  | 0.031$^{**}$ | 0.029$^{**}$ | 0.026$^{**}$ |
|       | (5.59)      | (4.29)       | (4.73)      |
| 12x12 | 0.024$^{**}$ | 0.024$^{**}$ | 0.019$^{**}$ |
|       | (4.54)      | (3.70)       | (4.14)      |

In summary, the result suggests that investors are more under-react to firms that have high information uncertainty than firms that have low information uncertainty. Specifically, by using earnings quality as a proxy for level of information uncertainty and using momentum profit as a proxy of under-reaction behavior, the result shows that firms that contain high information uncertainty have higher momentum return than firms that contain low information uncertainty by 0.7 percent. The first finding is consistent with prior evidence that higher uncertainty on a group of stocks can create higher degree of psychological biases (Hirshleifer (2001) [5]). In addition, human nature is put forward to explain that investors are likely to make a decision where they know the odds and the possible outcomes, while they avoid making a decision where the odds and possible outcomes are unknown. Furthermore, this finding is existed even when this paper controlled for the factors that might relevant to the momentum return which are firm size and book to market ratio.

**4.3 Information Uncertainty and Momentum Returns according to Economic Cycles**

Table 8 represents the average monthly momentum returns based on stocks that listed on the stock exchange of Thailand according to the economic cycles. The first row presents the result on economic expansion period that contains the data during fifth month on 1996 to eleventh month on 1998 and sixth month on 2001 to third month on 2007, while second row present the result on economic recession period that contains the data during twelfth month on 1998 to fifth month on 2001 and forth month on 2007 to first month on 2008. Raw return is shown in panel A, while in panel B shows momentum return when controlled for Fama-French three factors model. The result on table 8 is consistent with the second hypothesis that on average this paper should observed the behavior of under-reaction during the recession period more than expansion period. More specifically, for all groups of earnings quality, momentum returns during recession period are higher than expansion period. This can be implied that the degree of under-reaction is driven by recession period.

Table 8 panel A shows that on expansion period, momentum returns on low quality, medium quality, and high quality are 2.5 percent, 1.9 percent, and 1.6 percent, respectively. When this paper compares momentum return to recession period, momentum returns on this period are higher in every quality group which is 2.7 percent for low quality, 2.3 percent for medium quality, and 2 percent for high quality group.

Table 8 panel B shows momentum return when controlled for Fama-French three factors model on economic cycles, the result is consistent with second

hypothesis that momentum profits during recession period are higher than expansion period. Momentum returns during expansion period on low quality, medium quality, and high quality are 0.8 percent, -0.1 percent, and -0.3 percent, respectively. When this paper compares momentum return to recession period, momentum return is 0.8 percent for low quality, 0.2 percent for medium quality, and 0.2 percent for high quality group.

## Table8  Momentum returns on different economic cycles

According to the level of earnings quality which are high quality, medium quality, and low quality, for each month t, all stocks in each groups are ranked based on their past returns over a specified period (3-12 months look back periods) and then allocated into three groups which are winners group, middles group, and losers group. Winners group contains stocks that have the highest past return. Middles group contains stocks that their past returns rank in the middle. Losers group contains stocks that have the lowest past return. Momentum returns derived from the strategy that take long on winners group and short sell on losers group over a specified period (3-12 months holding periods). Last column presents the \\\\difference of momentum returns between low quality group and high quality group. Positive number can be implied that investors are more under-react to low quality group than high quality group. Note that the procedure of sorting and grouping the firms into portfolios are based on the period of economic expansion and recession provided by Trade and Economic indices Bureau, Ministry of Commerce, Thailand on table 2. Panel A shows average raw momentum returns over economic expansion and recession period.  Panel B shows average momentum returns when controlled by Fama-French three factors model over economic expansion and recession period. $t$-statistics are reported in parenthesis. * indicates that the returns are significantly greater than zero at the 0.05 level, and ** indicates that the returns are significantly greater than zero at the 0.01 level.

| Panel A: Raw returns | | | | |
| --- | --- | --- | --- | --- |
| Economic cycle | Low Quality | Medium Quality | High Quality | Low Quality-High Quality |
| Expansion | 0.025** | 0.019** | 0.016** | 0.009* |
| (N=101) | (7.04) | (7.27) | (6.50) | (1.94) |
| Recession | 0.027** | 0.023** | 0.020** | 0.007 |
| (N=40) | (7.37) | (6.61) | (7.00) | (1.32) |
| Recession-Expansion | 0.002 | 0.004 | 0.004 | |
| | (0.32) | (0.78) | (1.05) | |

| Panel B: Controlled with Fama-French three factors model | | | | |
| --- | --- | --- | --- | --- |
| Economic cycle | Low Quality | Medium Quality | High Quality | Low Quality-High Quality |
| Expansion | 0.008** | -0.001 | -0.003** | 0.011** |
| (N=101) | (2.97) | (-0.47) | (-2.81) | (3.73) |
| Recession | 0.008* | 0.002 | 0.002 | 0.006 |
| (N=40) | (2.18) | (0.69) | (0.54) | (1.38) |
| Recession-Expansion | 0.000 | 0.003 | 0.005 | |
| | (0.01) | (0.83) | (1.50) | |

The result can be explained using the idea provided by Kahneman and Tversky (1984) [13]. The idea can be explained through the aspect of loss aversion.

During economic recession, most investors on average anticipate loss on their investment. The behavior of under-reaction during economic recession can be explained that, in general, investors are more sensitive to a loss than a gain of similar magnitude when making a decision under uncertainty environment. This can be implied that investors prefer avoiding losses to acquiring gains, creating the behavior of under-reaction.

In addition, the result in this session can be explained through the linkage between investors sentiment and behavior. There are some empirical evidence argue that investors sentiment has an influence on decision making. Baker and Wurgler (2006) [20] design an experiment in order to examine how investor sentiment affects stock returns by tracking investor sentiment with stock performances over subsequent period. Small stocks, young stocks, high volatility stocks, unprofitable stock, and non-dividend paying stocks are considered as subjective stocks. This can be implied that information arrived from subjective stocks contains high information uncertainty. The finding suggests that when investors are optimistic, subjective stocks are underperform over subsequent period, while during the time that investors are pessimistic, subjective stocks are outperform over subsequence period. Period of economic expansion is considered that investors on average are optimistic, while during economic recession, investors are pessimistic. The result shows that for all earnings quality groups – low quality, medium quality, and high quality – momentum profits during recession period are higher than expansion period. In other words, conditioning on the same level of information uncertainty, investors with pessimistic sentiment tend to under-react more than investors with optimistic sentiment.

Table 9 presents momentum returns on difference time frame by varied the formation periods and holding periods during the economic expansion period and economic recession period. Time frames are written in form of "formation period x holding period". For example, 6x6 time frame refers to 6 months formation period and 6 months holding period. The result still confirms the first hypothesis that investors are more under-react to firms that have high information uncertainty than firms that have low information uncertainty, as well as second hypothesis that the degree of under-reaction tends to dominate during recession period.

Table 10 presents momentum returns when controlled by Fama-French three factors model on difference time frame and economic cycles. The result shows that even when momentum profits are controlled by Fama-French three factors model, momentum returns are higher during recession period than expansion period. In other words, investors are more under-react to high information uncertainty firms than low information uncertainty firms, and the degree of under-reaction is driven by recession period.

## Table9  Raw momentum returns on different economic cycles and varied look back periods and holding periods

This table represents raw momentum returns when varied look back periods and holding periods over economic expansion and economic recession period. Panel A represent the period of economic expansion, while panel B represent the period of economic recession. According to the level of earnings quality which are high quality, medium quality, and low quality, for each month t, all stocks in each groups are ranked based on their past returns over a specified period (3-12 months) and then allocated into three groups which are winners group, middles group, and losers group. Winners group contains stocks that have the highest past return. Middles group contains stocks that their past returns rank in the middle. Losers group contains stocks that have the lowest past return. Momentum returns derived from the strategy that take long on winners group and short sell on losers group over a specified period (3-12 months holding periods). *t*-statistics are reported in parenthesis. * indicates that the returns are significantly greater than zero at the 0.05 level, and ** indicates that the returns are significantly greater than zero at the 0.01 level.

| Panel A: Economic expansion period | | | |
|---|---|---|---|
| Time-frame | Low quality | Medium quality | High quality |
| 3x3 | 0.028** | 0.015** | 0.019** |
|  | (4.69) | (4.09) | (4.40) |
| 3x6 | 0.013** | 0.009** | 0.011** |
|  | (3.42) | (3.28) | (3.15) |
| 3x9 | 0.009** | 0.006 | 0.007* |
|  | (2.80) | (2.95) | (2.35) |
| 3x12 | 0.003 | 0.002 | 0.002 |
|  | (1.03) | (0.77) | (0.83) |
| 6x3 | 0.044** | 0.037** | 0.035** |
|  | (9.10) | (14.99) | (11.19) |
| 6x6 | 0.025** | 0.022** | 0.019** |
|  | (7.18) | (11.84) | (7.14) |
| 6x9 | 0.015** | 0.014** | 0.010** |
|  | (5.73) | (9.36) | (4.64) |
| 6x12 | 0.009** | 0.011** | 0.006** |
|  | (3.87) | (7.90) | (3.21) |
| 9x3 | 0.048** | 0.036** | 0.034** |
|  | (11.26) | (17.62) | (13.69) |
| 9x6 | 0.034** | 0.026** | 0.022** |
|  | (9.20) | (15.52) | (11.15) |
| 9x9 | 0.022** | 0.018** | 0.014** |
|  | (7.30) | (12.93) | (8.21) |
| 9x12 | 0.015** | 0.014** | 0.008** |
|  | (5.70) | (11.44) | (5.84) |
| 12x3 | 0.048** | 0.035** | 0.031** |
|  | (12.81) | (17.45) | (15.16) |
| 12x6 | 0.037** | 0.028** | 0.022** |
|  | (10.89) | (16.56) | (13.10) |
| 12x9 | 0.028** | 0.022** | 0.015** |
|  | (8.98) | (15.99) | (10.76) |
| 12x12 | 0.020** | 0.016** | 0.009** |
|  | (7.37) | (14.92) | (7.12) |

Panel B: Economic recession period

| Time-frame | Low quality | Medium quality | High quality |
|---|---|---|---|
| 3x3 | 0.032** | 0.036** | 0.030** |
|  | (6.37) | (5.55) | (5.33) |
| 3x6 | 0.028** | 0.026** | 0.023** |
|  | (4.65) | (4.11) | (4.55) |
| 3x9 | 0.020** | 0.014** | 0.015** |
|  | (4.78) | (2.61) | (3.92) |
| 3x12 | 0.011** | 0.006 | 0.011** |
|  | (3.17) | (1.31) | (3.21) |
| 6x3 | 0.059** | 0.048** | 0.046** |
|  | (8.66) | (6.14) | (8.45) |
| 6x6 | 0.039** | 0.026** | 0.026** |
|  | (7.35) | (3.97) | (5.81) |
| 6x9 | 0.024** | 0.012* | 0.014** |
|  | (5.31) | (2.42) | (3.67) |
| 6x12 | 0.012** | 0.005 | 0.008** |
|  | (3.03) | (1.28) | (2.46) |
| 9x3 | 0.049** | 0.042** | 0.040** |
|  | (7.78) | (6.29) | (9.08) |
| 9x6 | 0.032** | 0.025** | 0.024** |
|  | (6.00) | (4.28) | (7.93) |
| 9x9 | 0.019** | 0.013** | 0.013** |
|  | (4.02) | (2.85) | (5.39) |
| 9x12 | 0.010** | 0.007* | 0.007** |
|  | (2.57) | (2.06) | (3.98) |
| 12x3 | 0.038** | 0.041** | 0.031** |
|  | (6.78) | (7.29) | (8.76) |
| 12x6 | 0.026** | 0.030** | 0.020** |
|  | (5.24) | (6.33) | (8.16) |
| 12x9 | 0.016** | 0.020** | 0.013** |
|  | (3.72) | (5.50) | (6.62) |
| 12x12 | 0.009** | 0.014** | 0.008** |
|  | (2.66) | (5.11) | (4.70) |

Table10  Momentum returns when controlled by Fama-French three factors model on
different economic cycles and varied look back periods and holding periods

This table represents momentum returns that controlled by Fama-French three factors model when varied look back periods and holding periods over economic expansion and economic recession period. Panel A represent the period of economic expansion, while panel B represent the period of economic recession. According to the level of earnings quality which are high quality, medium quality, and low quality, for each month t, all stocks in each groups are ranked based on their past returns over a specified period (3-12 months) and then allocated into three groups which are winners group, middles group, and losers group. Winners group contains stocks that have the highest past return. Middles group contains stocks that their past returns rank in the middle. Losers group contains stocks that have the lowest past return. Momentum returns derived from the strategy that take long on winners group and short sell on losers group over a specified period (3-12 months holding periods). *t*-statistics are reported in parenthesis. * indicates that the returns are significantly greater than zero at the 0.05 level, and ** indicates that the returns are significantly greater than zero at the 0.01 level.

| Panel A: Economic expansion period | | |
| --- | --- | --- |
| Time-frame | Low quality | Medium quality | High quality |
| 3x3 | 0.013 | 0.006 | 0.005 |
| | (1.56) | (0.87) | (0.70) |
| 3x6 | 0.002 | -0.003 | -0.003 |
| | (0.33) | (-0.54) | (-0.57) |
| 3x9 | -0.003 | -0.007 | -0.006 |
| | (-0.46) | (-1.47) | (-1.19) |
| 3x12 | -0.005 | -0.011$^*$ | -0.009 |
| | (-0.85) | (-2.14) | (-1.75) |
| 6x3 | 0.019$^*$ | 0.008 | 0.006 |
| | (2.55) | (1.64) | (1.23) |
| 6x6 | 0.006 | -0.002 | -0.004 |
| | (1.02) | (-0.37) | (-0.85) |
| 6x9 | -0.001 | -0.007 | -0.009 |
| | (-0.10) | (-1.48) | (-1.79) |
| 6x12 | -0.005 | -0.009$^*$ | -0.011$^*$ |
| | (-0.84) | (-2.09) | (-2.34) |
| 9x3 | 0.024$^{**}$ | 0.009 | 0.006 |
| | (3.66) | (1.93) | (1.17) |
| 9x6 | 0.014$^*$ | 0.002 | -0.001 |
| | (2.30) | (0.40) | (-0.22) |
| 9x9 | 0.005 | -0.004 | -0.006 |
| | (0.87) | (-0.81) | (-1.33) |
| 9x12 | -0.001 | -0.007 | -0.009$^*$ |
| | (-0.11) | (-1.44) | (-1.99) |
| 12x3 | 0.025$^{**}$ | 0.010$^*$ | 0.005 |
| | (4.13) | (2.18) | (1.10) |
| 12x6 | 0.017$^{**}$ | 0.005 | -0.001 |
| | (2.88) | (1.01) | (-0.15) |
| 12x9 | 0.009 | 0.000 | -0.006 |
| | (1.66) | (0.00) | (-1.21) |
| 12x12 | 0.003 | -0.003 | -0.009 |
| | (0.63) | (-0.64) | (-1.86) |

Panel B: Economic recession period

| Time-frame | Low quality | Medium quality | High quality |
|---|---|---|---|
| 3x3 | 0.011 | 0.020$^{*}$ | 0.009 |
| | (1.56) | (2.21) | (1.19) |
| 3x6 | 0.011 | 0.011 | 0.005 |
| | (1.32) | (1.24) | (0.67) |
| 3x9 | 0.001 | -0.002 | -0.002 |
| | (0.21) | (-0.27) | (-0.36) |
| 3x12 | -0.009 | -0.012$^{*}$ | -0.006 |
| | (-1.91) | (-2.12) | (-1.41) |
| 6x3 | 0.036$^{**}$ | 0.025$^{*}$ | 0.027$^{**}$ |
| | (3.64) | (2.25) | (3.40) |
| 6x6 | 0.018$^{*}$ | 0.004 | 0.007 |
| | (2.33) | (0.45) | (1.16) |
| 6x9 | 0.003 | -0.009 | -0.003 |
| | (0.50) | (-1.34) | (-0.63) |
| 6x12 | -0.009 | -0.016$^{**}$ | -0.008 |
| | (-1.69) | (-3.39) | (-1.76) |
| 9x3 | 0.033$^{**}$ | 0.020$^{*}$ | 0.021$^{**}$ |
| | (3.45) | (2.07) | (3.20) |
| 9x6 | 0.016 | 0.003 | 0.006 |
| | (1.90) | (0.30) | (1.17) |
| 9x9 | 0.002 | -0.009 | -0.005 |
| | (0.29) | (-1.34) | (-1.33) |
| 9x12 | -0.008 | -0.015$^{**}$ | -0.010$^{*}$ |
| | (-1.39) | (-3.13) | (-3.07) |
| 12x3 | 0.019$^{*}$ | 0.017$^{*}$ | 0.007 |
| | (2.13) | (2.00) | (1.26) |
| 12x6 | 0.008 | 0.008 | -0.002 |
| | (1.10) | (1.09) | (-0.47) |
| 12x9 | -0.001 | -0.001 | -0.009$^{*}$ |
| | (-0.14) | (-0.23) | (-2.51) |
| 12x12 | -0.008 | -0.007 | -0.013$^{**}$ |
| | (-1.44) | (-1.52) | (-3.90) |

In conclusion, during recession period, the degree of under-reaction on average is higher than expansion period. The result shows that momentum returns on low quality, medium quality, and high quality during recession period is higher than expansion period by 0.2 percent, 0.4 percent, and 0.4 percent, respectively for raw return, and 0 percent, 0.3 percent, and 0.5 percent, respectively when controlled for Fama-French three factors model. As a result, it can be suggested that the degree of under-reaction is dominated during recession period. The explanation is given in term of loss aversion proposed by Kahneman and Tversky (1984) [13]. During economic expansion, most investors on average are making profits, while they anticipate loss on their investment during economic recession. The behavior of under-reaction can be explained that, in general, investors are more sensitive to a loss than a gain of similar magnitude when making a decision under uncertainty environment. This can be implied that investors prefer avoiding losses to acquiring gains, creating the behavior of under-reaction.

CHAPTER V

CONCLUSION

## 5.1 Conclusion

This paper investigates the effect of information uncertainty on investor behavior in Thailand during 1996-2010. This paper classifies groups of stocks that contain different degree of information uncertainty into three groups, high information uncertainty (low earnings quality), medium information uncertainty (medium earnings quality), and low information uncertainty (high earnings quality). This paper uses earnings quality as a proxy of information uncertainty. For each earnings quality group, this paper creates momentum strategy over the subsequence period. Profits from momentum strategy are derived from the behavior of under-reaction by investors. As a result, momentum profits are used as a proxy for investor behavior.

From the results of the study, there are two main conclusions. First, investors are more under-react to firms that have high information uncertainty than firms that have low information uncertainty. This is consistent with the idea provided by prior literature. For example, Hirshleifer (2001) [5] states that higher uncertainty on a group of stocks can create higher degree of psychological biases, meanings that the effect of securities misvaluation that arises from investor beliefs or psychological biases should be stronger among firms that have high level of information uncertainty. Zhang (2006) [18] concludes that the degree of delayed adjustment of market reaction to new information increases with the level of information uncertainty.

Daniel (1961) [19] shows that participants make decision where they know the odds and the possible outcomes, while they avoid making decision where the odds and possible outcomes are unknown.

Second, the degree on under-reaction is higher during economic recession than economic expansion. The result can be explained using the idea provided by Kahneman and Tversky (1984) [13] which is loss aversion. During economic expansion, most investors on average are making profits, while they anticipate loss on their investment during economic recession. The behavior of under-reaction during economic recession can be explained that, in general, investors are more sensitive to a loss than a gain of similar magnitude when making a decision under uncertainty environment. This can be implied that investors prefer avoiding losses to acquiring gains, creating the behavior of under-reaction. In addition, the result in this session can be explained through the linkage between investors sentiment and behavior. Baker and Wurgler (2006) suggest that investors with pessimistic sentiment tend to under-react more than investors with optimistic sentiment.

The findings from this paper clarify the behavior of investors under the situation that involve information uncertainty. This paper provides some insides that will make readers understand more about financial industry which seems that most investment decision cannot be explained by rational model. By understanding the psychological biases and the nature of human provided in this paper, readers are able to recognize these biases in order to improve their financial decision making.

**5.2 Area for Future Research**

Eventually, the insight provided by this study could be further explored in several aspects. The further research may change the method in identifying earnings quality which will be used as a proxy for information uncertainty. For example, instead of using earnings persistence, further research may use the accruals method to see whether the results still hold. Moreover, further research can examine how information uncertainty affects investor behavior in other countries as an out of sample test. This might be an interesting issue because the difference characteristics of investors between Thailand market and developed market, as well as the structure of the market that individual investors are dominated the market in Thailand, while institutional investors dominate most of the developed market. As a result, further research can examine whether or not the characteristics of investors and the structure of the market can make any different on this finding.

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