Does the increase in liquidity attenuate returns anomalies in the Thai stock markets?

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การเพิ่มขึ้นของสภาพคล่องลดผลตอบแทนจากความผิดปกติของตลาดหลักทรัพย์ในไทยหรือไม่?

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From Chordia et al. (2014), in the recent period of increased liquidity, the majority of US stock market returns anomalies have attenuated. However, as Thailand is a retail-based stock market, the stock market returns anomalies might not attenuate in the period of increased liquidity. In this paper, I use data from SET and mai markets from 2005 to 2019 to conduct time series regression to test the hypothesis. My finding is, first, apart from momentum returns anomalies in the mai market, the size, value, and momentum returns anomalies still exist in Thai stock markets. Second, most of the returns anomaly (4 out of 6) in Thai stock markets are not statistically attenuate over time. Finally, the results from the time series regression suggest that the increase in liquidity does not attenuate the returns anomalies in the Thai stock markets. In addition, I run panel regressions (both fixed and random effects estimations) to check the robustness, and the results are similar to time series regression. The conclusion remains that the increase in liquidity does not attenuate the returns anomalies in the Thai stock markets.

Field of Study:	Finance	Student's Signature ....
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Supapat Sangkavadana

TABLE OF CONTENTS

Page

Introduction

We saw from (Chordia et al., 2014) that in the recent period of increased liquidity, the majority of US stock market returns anomalies attenuated. However, we cannot simply apply this conclusion to the Thai stock markets. The reason is that the majority of investors in the Thai stock markets are retail or individual investors, who are considered uninformed investors. From (Chordia et al., 2011), if the increase in liquidity mostly comes from uninformed investors, the stock market may become more volatile and less efficient. Hence, for the retail-based stock markets such as Thailand, even though there is an uptrend in liquidity in Thai stock markets, we might see a different result to (Chordia et al., 2014). In other words, the stock market returns anomalies in Thailand might not attenuate in the recent period of increased liquidity.

In the U.S. market, (Chordia et al., 2011) found that the recent uptrend in the turnover was largely due to institutional investors. Institutional investors are considered as informed investors since they can trade more effectively on private information and findings of cross-sectional return predictability. Hence, as the turnover increases, the intraday volatility decreases and the stock price follows more closely to a random walk. As a result, the U.S. stock markets become more efficient. Consequently, (Chordia et al., 2014) reported that, as liquidity increases, the economic and statistical significance of many famous US stock market returns anomalies attenuates.

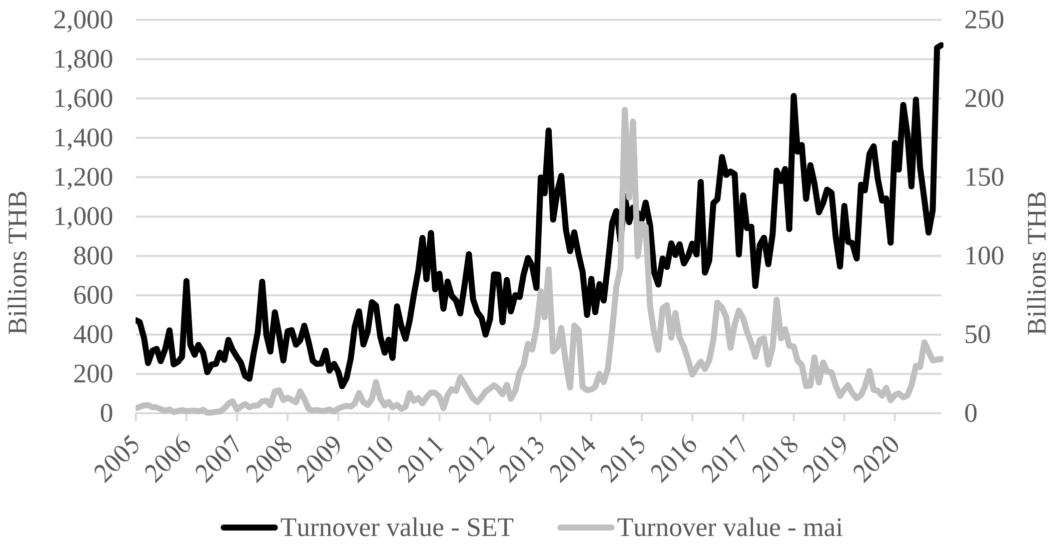

Figure 1: This figure shows the turnover value of the SET and mai markets from 2005 to 2020. The turnover value of the SET market is on the left axis and the turnover value of the mai market is on the right axis.

The figure above shows the turnover value of the SET and mai markets from 2005 to 2020. The turnover value represents the number of shares traded multiplied by the closing price for each stock. This is obtained from the Datastream via data type "turnover by value (VA)". At the end of 2020, the turnover value of the Stock Exchange of Thailand (SET) and the Market for Alternative Investment (mai) are THB 1,872 billion and THB 34 billion respectively. From 2005 to 2020, the turnover value of the SET market increases by around 9 percent CAGR. At the same time, the turnover value of the mai market increases faster than the SET market, which is around 16 percent CAGR. However, even though there is an uptrend in liquidity in Thai stock markets, we cannot assume that the economic and statistical significance of returns anomalies of Thai stock markets will attenuate in the same way as the U.S. stock markets. With the differences in the majority of investors between US and Thai stock markets, the outcome of the increase in liquidity might be different. For Thai stock markets, the majority of investors in both SET and mai are retail or individual investors, which account for over 40% and 90% respectively[1]. Retail investors are considered uninformed investors. According to (Chordia et al., 2011), if the increase in liquidity mostly comes from uninformed investors, the market may become more volatile and less efficient. Hence, given the majority of investors in the Thai stock markets are retail investors, the stock market returns anomalies in Thailand might not attenuate even though there is an uptrend in liquidity.

All the works of the effect of liquidity on the stock market returns anomalies are conducted in the U.S., U.K., and other developed stock markets. With the difference in the structure of investors between developed and developing stock markets, the effect of liquidity on the stock market returns anomalies might be different. Hence, this research will expand the knowledge of the effect of liquidity on the stock market returns anomalies in the environment of developing stock markets such as Thai stock markets.

The significance of this research is that it will expand the existing knowledge on the effect of liquidity on the stock market returns anomalies in the developing stock markets. This expanded knowledge will give the policymakers in the developing stock markets a deeper understanding of the effect of liquidity. Hence, they will have an effective and correct tool to promote stock market efficiency.

[1] The Stock Exchange of Thailand - Investor Types

Literature review

Several literatures study the stock market returns anomalies and the reasons why they attenuate or disappear. (Chordia et al., 2014) studied several famous equity market returns anomalies in the U.S. stock markets and found that, as the liquidity and trading activity increased, the economic and statistical significance of returns anomalies attenuated. During the post-decimal period (i.e. after January 2001) when there was a reduction in trading costs and an improvement in liquidity, the characteristic premiums, estimated from the Fama-MacBeth coefficients, of many famous returns anomalies in the U.S. stock markets declined toward zero. Also, they found that an increase in hedge fund assets, short interest, and aggregate share turnover led to a decline in the profitability of the returns anomaly-based trading strategies. The results indicated that the arbitrageurs exploited the returns anomaly-based trading strategies, which decreased both the economic and statistical significance of the returns anomalies. In other words, an increase in liquidity and trading activity improved capital market efficiency.

From (Schwert, 2003), there was evidence that many famous returns anomalies did not hold up after they got published by researchers. The weekend effect, the dividend yield effect, the small-firm turn-of-the-year effect became weaker after they got published. Also, the size effect and the value effect disappeared after the papers got published. At the same time, practitioners began to implement the strategies derived from these papers. Because of exploitation by arbitrageurs, many famous returns anomalies did not hold up after they got published.

(McLean & Pontiff, 2016) investigated the return predictability of 97 variables that were shown to predict cross-sectional stock returns. They separated the sample into 3 periods, which were before the publication, the original study period, and after the publication. They reported that the portfolio returns from the period before publication were lower than the portfolio returns from the original study's sample period by 26%. This was the effect of statistical bias. Also, they reported that the portfolio returns from the period after publication were lower than the portfolio returns from the original study's sample period by 58%. Subtracting this by the effect of statistical bias, the effect of publication-informed trading is 32%.

In contrast, (Mashruwala et al., 2006) showed the reasons why arbitrageurs did not take trading positions to eliminate accrual mispricing. They found 2 reasons that prevented arbitrageurs from eliminating accrual returns anomalies, which were a lack of close substitutes and transaction costs. The accrual returns anomaly was concentrated in stocks with high idiosyncratic risk. Hence, it was extremely difficult for arbitrageurs to find close substitutes and took positions to eliminate accrual mispricing. Also, the accrual returns anomaly was concentrated in stocks with low prices and trading volumes. This posed a high transaction cost to arbitrageurs and hence, prevented arbitrageurs from eliminating accrual returns anomalies.

Most of the literature that study stock market returns anomalies use data from the U.S. stock markets. There are a few literatures that extend the sample size to the international stock markets. From (Jacobs & Müller, 2020), they investigated pre and post-publication return predictability of 241 cross-sectional returns anomalies in 39 international stock markets. In international markets (other than the U.S. market), returns anomalies were strong in both pre and post-publication, and the magnitude of these returns anomalies was related to arbitraged costs. It was only in the U.S. stock markets that returns anomalies significantly declined in the post-publication period.

From (Auer & Rottmann, 2019), they extended the work of (Chordia et al., 2014) in 2 different ways. They used a more advanced econometrics methodology and included other developed stock markets (other than the U.S. market). They found evidence that, both in the U.S. and other developed stock markets, the increase in liquidity did not decrease the returns of returns anomalies. Also, they reported that there was no persistent negative link between arbitrage portfolio returns and share turnover in both time-series and the cross-sectional dimension.

Looking at the returns anomalies in the Thai stock markets, there are several literatures indicate that the stock market returns anomalies still exist in Thailand. From (Bunsaisup, 2014), during the study period (March 2005 to May 2013), size and value strategies outperformed Thai stock markets. From (Hussaini, 2016), from 1999 to 2013, there was a size premium in the SET but no evidence of the premium in the value strategy. (Hussaini et al., 2016) found that, from 2010 to 2013, there was a statistically significant positive momentum profit in the large size stocks category. From (Sareewiwatthana, 2012), there was evidence that, throughout the period from 1999 to 2010, the value investment strategy, which was based on the PEG ratio, generated higher returns than the total return of the SET index.

In addition, other studies indicate that the stock market returns anomalies still exist in Thailand. From (Kaennakham, 2014), the evidence suggested that, from 2000 to 2015, the combined momentum strategy, which combined price, revenue, and earnings momentum strategies, can generate a return of 1.26% per month using the sample from the SET. From (Reankittiwat, 2016), there was evidence that, from 2000 to 2015, the SET exhibited a strong seasonality pattern for value premium returns anomaly.

However, (Sukpitak & Hengpunya, 2016) studied the evolution of Hurst exponent, as a measure of market efficiency, of the SET index over time using the Detrended Fluctuation Analysis ('DFA)' method. They found that the Hurst exponent of the SET index during the study period (from 2^{nd} May 1975 to 31^{st} March 2015) decreased to the ideal value, which was 0.5. This means that, during the study period, the SET index became more efficient. Also, they found that the Hurst exponent of the mai index deviated from the ideal value. When comparing to the mai index, the SET index, which was larger and more liquid than the mai index, was more efficient, and that the market size and liquidity positively affected the market efficiency.

In summary, several literatures study the stock market returns anomalies. Liquidity plays an important role to determine the returns from returns anomalies and stock market efficiency. The main reason is because of the exploitation by arbitrageurs. However, they use data from the U.S. stock markets. Looking at the international level, many researchers report that returns anomalies in developed countries other than the U.S. persist. Looking deeper into the Thai stock markets, several literatures indicate that returns anomalies still exist in the Thai stock markets. However, no literature studies whether they have attenuated or disappeared.

Hypothesis development

From (Chordia et al., 2014), an increase in liquidity and trading activity attenuate the economic and statistical significance of returns anomalies in the U.S. stock markets. However, given the differences in the majority of investors between US and Thai stock markets, the main question that this paper would like to address is ‘In the Thai stock markets, does the increase in liquidity attenuate returns anomalies?’. The main hypothesis is the increase in liquidity will not attenuate returns anomalies in the Thai stock markets.

The important argument that the increase in liquidity will attenuate returns anomalies is the ability of investors to arbitrage. Arbitrageurs need sufficient financial knowledge and advanced technology to arbitrage returns anomalies effectively. From (Chordia et al., 2011), compared to the institutional investors, retail investors have less financial knowledge about the cross-sectional return predictability and less technology to effectively exploit the returns anomalies.

In addition, retail investors are considered noise traders. (Foucault et al., 2011) showed that the trading activity of retail investors has a positive effect on the volatility of stock returns. Moreover, from (Chordia et al., 2011), retail investors are more prone to behavioral and emotional errors than institutional investors. By definition from (Black, 1986), people who trade on noise are willing to trade even though from an objective point of view they would be better off not trading. The reason is perhaps they think the noise they are trading on is information, or perhaps they just like to trade

From the reason given above, if the increase in liquidity mostly comes from retail investors, the market may become more volatile and returns anomalies may not attenuate. According to the SET website (as of 14 July 2020), the majority of investors of both SET and mai are retail investors, which account for over 40% and 90% respectively. Since the majority of investors in Thai stock markets are retail investors, which are considered as uninformed investors, there is a high probability that, in contrast to (Chordia et al., 2014), the increase in liquidity in the Thai stock markets might not attenuate the stock market returns anomalies.

From the literature review section above, researchers have found several stock market returns anomalies in the U.S. stock markets that are statistically and economically significant. Looking at the evidence from Thai stock markets, I found 3 stock market returns anomalies that are statistically and economically significant. They are specified as follow;

1.) **size:** stocks with small market capitalization generate higher returns than stocks with a large market capitalization (Banz, 1981). This is measured as the firm's market capitalization.

2.) **value:** stocks with a high book-to-market ratio generate higher returns than stocks with a low book-to-market ratio (Basu, 1977). This is measured as the firm's book value for the fiscal year-end in a calendar year divided by the firm's market capitalization.

3.) **momentum:** stocks with good (bad) past performance will generate good (bad) returns in the future (Jegadeesh & Titman, 1993) This is measured as the cumulative return on the stock over the 11 months ending at the beginning of the previous month.

Hence, there will be 3 hypotheses. First, the size, value, and momentum returns anomalies still exist in the Thai stock markets. Second, the size, value, and momentum returns anomalies will not attenuate over time. Finally, the increase in liquidity will not attenuate the size, value, and momentum returns anomalies in the Thai stock markets.

Data Description

The sample consists of all common stocks listed on both SET and mai. The stock returns, the stock returns anomaly variables (i.e. the market capitalization and the book-to-market ratio), the stock market returns, and the stock market value turnover will be collected from the Datastream (published by Refinitiv). Also, the stock market capitalization will be collected from the SET website. Following (Cotter & McGeever, 2018), stocks that are not considered common stocks, e.g. closed-end funds or real estate investment trust, will be excluded from the sample. Also, to avoid the survivorship bias, the dead or delisted stocks will be included in the sample. The stocks must have a return history of at least 24 months.

The cumulative return on the stock over the prior 11 months will be calculated. At a given month, the stock must have non-missing values of each of the 3 returns anomaly variables (the market capitalization, the book-to-market ratio, and the cumulative return on the stock over the prior 11 months). If the stocks consistently have missing values, they will be excluded from the sample. The T-bill 1-month rate will be used as the risk-free rate. This will be collected from the Bank of Thailand.

As the data of the T-bill 1-month rate started in 2005, the sample will be from the beginning of January 2005 to the end of December 2019. I start by collecting the stock returns and the stock returns anomaly variables (i.e. the market capitalization and the book-to-market ratio) from the Datastream. Dead stocks are included in the sample to avoid a survivorship bias. The data that I collect are required to be equity security (TYPE=EQ), a Thai firm (GEOGN=Thailand), and major security (MAJOR=Y). The total number of stocks (both active and dead stocks) in Thailand (from both SET and mai markets) from the beginning of January 2005 to the end of December 2019 collected from the Datastream are 1,167 stocks.

Next, they are filtered by following the procedure from (Cotter & McGeever, 2018). This filtering technique minimizes any issue that might cause misleading inferences and improve data reliability. The criteria used for filtering data and the number of stocks dropped in each criterion are described below;

Process	Number of stocks
Stocks in Thailand (both from SET and mai, and dead and active) collected from the Datastream	1167
Stocks that are not considered as common stocks (e.g. REIT, funds, and rights)	340
Stocks that don't have enough data (e.g. returns history at least 24 months) and are a potential outliner	121
Remaining stocks	**706**

Table 1: This table presents the number of remaining stocks after applying the filtering techniques from Cotter and McGeever (2018)

1. Stocks that are not considered as common stocks, for example, REIT, funds, and rights, are dropped. The total number of stocks dropped are 340 stocks.
2. Stocks that do not have enough data, e.g. returns history less than 24 months, are dropped. The total number of stocks dropped are 121 stocks.

To reduce the potential influence of outliner, any stock returns that is greater than or equal to 1000%, less than or equal to 100%, any stock market capitalization that is less than THB 1.5 million, or any stock book-to-market ratio that is less than or equal to 0 is set to missing. After filtering data, the total number of remaining stocks are 706 stocks. They can be categorized as the table below;

	The remaining stocks		
	SET	**mai**	**Total**
Active	503	125	628
Dead	74	4	78
Total	577	129	706

Table 2: This table presents the categorized remaining stocks after conducting the filtering technique. The remaining stocks are categorized as to whether they belong to the SET or the mai market, and whether they are currently active or dead.

From the table above (table 2), the total number of stocks belong to the SET market are 577 stocks and the total number of stocks belong to the mai market are 129. The total number of current active stocks are 628 stocks and the total number of dead stocks are 78. Most of the stocks are currently active and belong to the SET market, which accounts for a total of 503 stocks or 71.24% of the total number of remaining stocks. There are only 4 stocks that are currently dead and belong to the mai market, which account for 0.57% of the total number of remaining stocks. The summary statistics of the remaining stocks are presented in the table below;

Markets	Variable	Obs	Mean	Std. Dev.	Min	Max
SET	**Returns (%)**	86,728	0.99	14.93	-98.96	999.56
	Market Capitalization (million)	86,761	20,800	75,000	8	1,620,000
	B/M	84,474	1.020219	1.050318	0.000377	63.475510
	Cumulative returns 11 months (%)	84,564	10.99	51.36	-223.27	999.56
	Turnover	192	0.07	0.02	0.03	0.13
mai	**Returns (%)**	13,569	0.59	15.46	-78.30	410.34
	Market Capitalization (million)	13,577	1,440	1,940	7	27,000
	B/M	13,228	0.720640	1.181442	0.001068	26.890000
	Cumulative returns 11 months (%)	12,206	7.76	59.21	-219.05	602.18
	Turnover	192	0.17	0.11	0.02	0.59

Table 3: This table presents summary statistics of the monthly stock returns, the stock returns anomaly variables, and the value-weighted monthly stock market share turnover.

From the table above (table 3), the summary statistics of the monthly stock returns, the stock returns anomaly variables, and the value-weighted monthly stock market share turnover, are presented separately between the SET and mai market. For the SET market, the average and standard deviation of monthly stock returns are 0.99% and 14.93%. The minimum and maximum of the monthly stock returns are -98.96% and 999.56%. The average and standard deviation of the market capitalization are THB 20,800 million and 75,000 million. The minimum and maximum of the market capitalization are THB 7.79 million and 1,620,000 million. The average and standard deviation of the book-to-market are 1.02 times and 1.05 times. The minimum and maximum of the book-to-market are 0.0003774 times and 63.48 times respectively. The average and standard deviation of the cumulative returns for 11 months are 10.99% and 51.36%. The minimum and maximum of the cumulative returns for 11 months are -223.27% and 999.56%. The average and standard deviation of the value-weighted monthly stock market share turnover are 0.07 times and 0.02 times. The minimum and maximum value-weighted monthly stock market share turnover are 0.03 times and 0.13 times.

For the mai market, the average and standard deviation of the monthly stock returns are 0.59% and 15.46%. The minimum and maximum monthly stock returns are -78.30% and 410.34%. The average and standard deviation of the market capitalization are THB 1,440 million and 1,940 million. The minimum and maximum of the market capitalization are THB 6.92 million and 27,000 million. The average and standard deviation of the book-to-market are 0.72 times and 1.18 times. The minimum and maximum of the book-to-market are 0.0010684 times and 26.89 times. The average and standard deviation of the cumulative returns for 11 months are

7.76% and 59.21%. The minimum and maximum of the cumulative returns for 11 months are -219.05% and 602.18%. The average and standard deviation of the value-weighted monthly stock market share turnover are 0.17 times and 0.11 times. The minimum and maximum of the value-weighted monthly stock market share turnover are 0.02 times and 0.59 times respectively.

In sum, the average monthly stock returns of the SET market is higher than the mai market with a lower standard deviation. The average market capitalization of the SET market is considerably higher than the mai market. Therefore, I expect that the book-to-market of the SET market would be lower than the mai market. However, the average book-to-market of the SET market is higher than the mai market. In this case, the SET market represents the value stock market, rather than the mai market. The average cumulative returns for 11 months of the SET market is higher than the mai market with a lower standard deviation. Lastly, the average value-weighted monthly share turnover of the SET market is lower than the mai market. The reason is that the market capitalization of the SET market is considerably higher than the mai market. Since the average value-weighted monthly share turnover is a ratio of monthly trading volume to market capitalization, the average value-weighted monthly share turnover of the SET market is lower than the mai market.

Methodology

As there are 3 hypotheses, they will be addressed in 3 stages. First, the hypothesis that the size, value, and momentum returns anomalies still exist in the Thai stock markets will be tested. Following (Cotter & McGeever, 2018), I will form the returns anomalies-hedged portfolios, calculate the monthly returns of the portfolios, and evaluate their statistical significance.

To form the returns anomalies-hedged portfolios, at the beginning of the month, stocks will be ranked based on the value of a given returns anomaly variable in the prior month. The variable for size returns anomaly is the firm's market capitalization. The variable for value returns anomaly is the book-to-market ratio. The variable for momentum returns anomaly is the cumulative return on the stock over the prior 11 months. Then, the stocks will be split into 10 equally subsamples. The extreme top portfolio will be longed and the extreme bottom portfolio will be shorted. To calculate the monthly returns of the returns anomalies-hedge portfolios ($r_{i,t}$), at the end of the month, the extreme top portfolio will be sold and the extreme bottom portfolio will be bought.

From the hypothesis stated above that the size, value, and momentum returns anomalies still exist in the Thai stock markets, the monthly returns of returns anomalies-hedged portfolios will be statistically significant.

Second, the hypothesis that the returns anomalies in Thailand will not attenuate over time will be tested. Following (Chordia et al., 2014), I will use the exponential decay model to test whether the size, value, and momentum returns anomalies in Thailand attenuate over time. The equation is specified as follow;

$$R_{i,t} = \alpha_0 exp(\beta_1 t + u)$$

where $R_{i,t} = 1 + r_{i,t}$ and $r_{i,t}$ is the monthly returns of the returns anomalies-hedged portfolios specified above. $t = 1, 2, ..., T$ represents a time index. The time index (t) will be scaled to be between -1 and 1 so that the mean of the time index is 0. Then, the parameter β_1 will be estimated in the log-linear form to see the trend behavior of the returns of the returns anomalies-hedged portfolios. From the hypothesis that the returns anomalies in the Thai stock markets will not attenuate over time, the parameter β_1 should not be statistically significant. In other words, as time passes by, the returns anomalies-hedged portfolio returns persist.

Finally, following (Auer & Rottmann, 2019), I will use time series regression to test the third hypothesis that the increase in liquidity will not attenuate returns anomalies in the Thai stock markets. In addition, I will run the panel regressions to check the robustness and ensure that the result of time series regression is not driven by some specifics methodology. For time series regression, based on the equation from (Avramov et al., 2016), the equation is as follow;

$$r_t = \alpha_0 + \beta_1 turn_t + \beta_2 RMRF_t + \beta_3 SMB_t + \beta_4 HML_t + e_t$$

where $t = 1, 2, \ldots, T$ represents a time index. The dependent variable is the monthly returns of the returns anomalies-hedged portfolios (r_t) specified above at the time t. The model will be estimated separately for 3 returns anomalies (size, value, and momentum) and 2 markets (SET and mai). There are 4 independent variables in the equation.

The first independent variable is the value-weighted monthly share turnover ($turn_t$) at time t. From (Auer & Rottmann, 2019), there is no single unambiguous proxy for stock market liquidity. Many researchers use the bid-ask spread or the aggregate trading volume as a proxy for stock market liquidity. In this study, I follow (Chordia et al., 2014) and use the value-weighted monthly share turnover as a proxy for the stock market liquidity. This turnover is calculated as a value-weighted ratio of monthly trading volume to market capitalization.

The value-weighted monthly share turnover ($turn_t$) that I use is at time t. From (Amihud, 2002) and (Avramov et al., 2016), they used the level of market illiquidity in the prior month. The assumption behind this is that the expected market illiquidity positively affects the stock excess returns or the strength of the momentum returns anomaly. In other words, if investors anticipate higher market illiquidity, they will price the stocks so that the stocks generate higher returns. While this might hold, (Chordia et al., 2014) used the current level of market liquidity. The assumption behind this is that an increase in the current liquidity facilitates trading activity, and hence attenuates the current returns anomalies. The turnover is the proportion of trading volume to market capitalization. The increase in trading activity at time t will increase the trading volume and will be reflected in the increase in turnover at time t. Also, the increase in trading activity at time t will affect the stock price and attenuate the current returns anomalies. Hence, the value-weighted monthly share turnover that I use is at time t.

The other 3 independent variables are the Fama-French 3 factors at time t, including the market factor ($RMRF_t$), the size factor (SMB_t), and the book-to-market factor (HML_t). The Fama-French 3 factors are included in the model to adjust the market, size, and value risks since some part of returns anomalies-hedged portfolios can be explained by the risk premium. The market factor ($RMRF_t$) is measured by excess return on the Thai stock index (SET or mai) over the 1-month T-bill rate. To calculate the size (SMB_t) and the book-to-market factors (HML_t), the sample will be divided into 6 portions. According to (Auer & Rottmann, 2019), in the case of size, they use the 80th percentile breakpoint for international securities (small- and big-market capitalization portfolios). For value, they use the 70th and 30th percentiles regardless of the market (low-, medium- and high-book-to-market portfolio).

Market Capitalization

80th			
Small High	Big High		
Small Medium	Big Medium	**70th** **30th**	**Book-to-Market**
Small Low	Big Low		

Table 4: Division of sample according to market capitalization and book-to-market ratio

The size factor (SMB_t) is measured by the average returns of small market capitalization stocks minus the average returns of big market capitalization stocks. The formula for calculating the size factor (SMB_t) is as below;

$$SMB_t = 1/3(Small\ Low_t + Small\ Medium_t + Small\ High_t) - 1/3(Big\ Low_t + Big\ Medium_t + Big\ High_t).$$

The book-to-market factor (HML_t) is measured by the returns of high book-to-market stocks minus the returns of low book-to-market stocks. The formula for calculating the book-to-market factor (HML_t) is as below;

$$HML_t = ½(Small\ High_t + Big\ High_t) - ½\ (Small\ Low_t + Big\ Low_t)$$

These Fama-French 3 factors are used for adjusting the market risk, the size factor risk, and the value factor risk.

From the hypothesis that the increase in liquidity will not attenuate the stock market returns anomalies in the Thai stock markets, the slope coefficient (β_1) should not have a predictive value. In other words, the slope coefficient should not be statistically significant.

For the robustness check, I will start with the fixed effect estimator. The main assumption is that there might be some unobserved hidden characteristics that affect the dependent variables which can be correlated with the independent variables. Based on the equation from (Avramov et al., 2016), the equation is as follow;

$$r_{i,t} = \alpha_0 + \beta_1 turn_{i,t} + \beta_2 RMRF_{i,t} + \beta_3 SMB_{i,t} + \beta_4 HML_{i,t} + (v_i + u_{i,t})$$

where i = 1, 2, …, N represents the returns anomalies-hedged portfolios, $t = 1, 2, \ldots, T$ represents a time index and $cov(v_i, X_{i,t}) \neq 0$. In this case, the fixed-effects or Within estimator will be used for removing the fixed effect. The equation is as follow;

$$r_{i,t} - \bar{r}_i = \beta_1(turn_{i,t} - \overline{turn}) + \beta_2(RMRF_{i,t} - \overline{RMRF}) + \beta_3(SMB_{i,t} - \overline{SMB}) + \beta_4(HML_{i,t} - \overline{HML}) + (u_{i,t} - \bar{u}_i)$$

However, if the unobserved hidden characteristics have no structural relationship with the independent variables, the random effects estimator will provide a more efficient estimation. The model is as follow;

$$r_{i,t} = \alpha_0 + \beta_1 turn_{i,t} + \beta_2 RMRF_{i,t} + \beta_3 SMB_{i,t} + \beta_4 HML_{i,t} + (v_i + u_{i,t})$$

where $cov\left(v_i, X_{i,t}\right) = 0$. In this case, the pooled generalized least square (GLS) will be used for removing the random effect. The equation will be as follow;

$$r_{i,t} - \theta\bar{r}_i = \alpha_0(1-\theta) + \beta_1(turn_{i,t} - \theta\overline{turn}_i) + \beta_2(RMRF_{i,t} - \theta\overline{RMRF}) + \beta_3(SMB_{i,t} - \theta\overline{SMB}) + \beta_4(HML_{i,t} - \theta\overline{HML}) + (w_{i,t} - \theta\bar{w}_i)$$

where $w_{i,t} = v_i + u_{i,t}$ and $\theta = 1 - (\frac{\sigma_u^2}{\sigma_u^2 + T\sigma_v^2})^{\frac{1}{2}}$. Both estimators (the fixed-effects estimator, and the pooled generalized least square) will be estimated and the results will be compared using the Hausman test. Also, both will be estimated simultaneously between 2 markets (SET and mai).

The results of both fixed and random effects estimations should be similar to the result of time series regression. The slope coefficient (β_1) should not have a predictive value. In other words, the increase in liquidity will not attenuate the stock market returns anomalies in the Thai stock markets.

Result

First hypothesis

As there are 3 hypotheses, the result will be presented in 3 stages. The first hypothesis is the size, value, and momentum returns anomalies still exist in the Thai stock markets. Following (Cotter & McGeever, 2018), I form the returns anomalies-hedged portfolios by, at the beginning of the month, ranking stocks based on the value of a given returns anomaly variable in the prior month. The extreme top portfolio will be longed and the extreme bottom portfolio will be shorted. To calculate the monthly returns of the returns anomalies-hedge portfolios ($r_{i,t}$), at the end of the month, the extreme top portfolio will be sold and the extreme bottom portfolio will be bought. Finally, I calculate the average monthly returns and evaluate the statistical significance. The average monthly returns of the returns anomaly-hedged portfolios and their corresponding p-values are presented below;

	The average monthly returns ($\bar{r}_{i,t}$)	
	SET	**mai**
Size	0.0184***	0.0158***
	(0.0002)	(0.0081)
Value	0.0310***	0.0187**
	(0.0000)	(0.0260)
Momentum	0.0106***	0.0001
	(0.0097)	(0.9929)

*Table 5: This table presents the average monthly returns of the returns anomaly-hedged portfolios and their corresponding p-values. p-values are stated in parentheses below each average monthly return. ***, ** and * indicate significance at a 1%, 5% and 10% level.*

From the table above (table 5), most of the average monthly returns of returns anomaly-hedged portfolios are positive and statistically significant. In the SET market, the average monthly returns of the size, value, and momentum-hedged portfolios are positive and statistically significant, ranging from 1.06% per month for the momentum-hedged portfolio to 3.1% per month for the value-hedged portfolio. In the mai market, the average monthly returns of the size and value-hedged portfolios are positive and statistically significant, ranging from 1.58% per month for the size-hedged portfolio to 1.87% per month for the value-hedged portfolio. However, the average monthly returns of the momentum-hedged portfolios is not statistically significant. The average monthly returns is only 0.01% per month.

This result shows that apart from the momentum returns anomalies in the mai market, the size, value, and momentum returns anomalies still exist in the SET and mai markets. This result is similar to (Bunsaisup, 2014), (Hussaini et al., 2016), and (Sareewiwatthana, 2012) that the size, value, and momentum returns anomalies are statistically significant in the Thai stock markets.

In addition, the average monthly returns of value-hedged portfolios in both SET and mai market are very large in an economic sense. In the SET market, the average monthly returns of value-hedged portfolios is 3.1% per month, which is approximately 44.25% per annum. In the mai market, the average monthly returns of value-hedged portfolios is 1.87% per month, which is approximately 24.9% per annum. Whereas the average monthly stock returns of the SET and mai markets are 0.99% per month (approximately 12.55% per annum) and 0.59% per month (approximately 7.31 per annum) respectively. The average monthly returns of returns anomaly-hedged portfolios that can earn over 20% per annum are also found in the U.S. market by (Chordia et al., 2014), and in the U.K. market by (Cotter & McGeever, 2018).

Second hypothesis

The second hypothesis is the returns anomalies (size, value, and momentum returns anomalies) in Thailand will not attenuate over time. To test this hypothesis, I follow (Chordia et al., 2014), by using the exponential decay model. The equation is specified as follow;

$$R_{i,t} = \alpha_0 exp(\beta_1 t + u)$$

where $R_{i,t} = 1 + r_{i,t}$ and $r_{i,t}$ is the monthly returns of returns anomalies-hedged portfolios calculated from the first hypothesis. $t = 1, 2, \ldots, T$ represents a time index. The time index (t) will be scaled to be between -1 and 1 so that the mean of the time index is 0. Then, the parameter β_1 will be estimated in the log-linear form to see the trend behavior of the monthly returns of returns anomalies-hedged portfolios. The exponential decay models are estimated separately for 3 returns anomalies (size, value, and momentum) and 2 markets (SET and mai). The estimated coefficients (β_1) of the exponential time trend and their corresponding p-value are presented in the table below;

	The estimated coefficients (β_1)	
	SET	**mai**
Size	-0.0151**	0.0190*
	(0.0460)	(0.0580)
Value	-0.0241***	-0.0034
	(0.0000)	(0.8250)
Momentum	-0.0014	-0.0095
	(0.8390)	(0.5180)

*Table 6: This table presents the estimated coefficients (β_1) of the exponential time trend and their corresponding p-values. p-values are stated in parentheses below each coefficient. ***, ** and * indicate significance at a 1%, 5% and 10% level, respectively.*

From the SET market, the estimated coefficients (β_1) of the size and value-hedged portfolios are negative and statistically significant. They show that the monthly returns of the size and value-hedged portfolios statistically and significantly decrease over time. However, even though the estimated coefficient of the momentum-hedged portfolio is negative, it is not statistically significant. In the mai market, the estimated coefficient of the size-hedged portfolios is positive and statistically significant. This shows that the monthly returns of the size-hedged portfolio statistically and significantly increase over time. However, even though the estimated coefficients of the value and momentum-hedged portfolios are negative, they are not statistically significant.

In sum, only the size and value returns anomalies in the SET market attenuate over time. The momentum returns anomaly in the SET market does not show a sign of attenuation. Also, the size, value, and momentum returns anomalies in the mai market do not attenuate over time. Most of the returns anomalies (4 out of 6) in Thailand are not statistically attenuate over time. This finding is in contrast to the evidence in the U.S. market from (Chordia et al., 2014), and the evidence in the U.K. market from (Cotter & McGeever, 2018). They documented significant attenuation for size, value, and momentum anomalies in the U.S. market, and momentum and short-run return reversal anomalies in the U.K. market.

Third hypothesis

For the third hypothesis, I hypothesize that the increase in liquidity will not attenuate the returns anomalies in both SET and mai markets. For this, I use time-series regressions to test the hypothesis. Following (Avramov et al., 2016), the equation is as follow;

$$r_t = \alpha_0 + \beta_1 turn_t + \beta_2 RMRF_t + \beta_3 SMB_t + \beta_4 HML_t + e_t$$

where $t = 1, 2, \ldots, T$ represents a time index. In this equation, the dependent variable is the monthly returns of returns anomalies-hedged portfolios at time t (r_t). The independent variables are value-weighted monthly share turnover ($turn_t$), the market factor ($RMRF_t$), the size factor (SMB_t), and the book-to-market factor (HML_t) at time t. The time series regression is estimated separately for 3 returns anomalies (size, value, and momentum) and 2 markets (SET and mai). First, I estimate the time series regression using the sample from the SET market. The estimated coefficients (β_n) and their corresponding p-values are presented in the table below;

	SET			
	Turn	**RMRF**	**SMB**	**HML**
	$\boldsymbol{\beta_1}$	$\boldsymbol{\beta_2}$	$\boldsymbol{\beta_3}$	$\boldsymbol{\beta_4}$
Size	-0.1340	-0.1619***	1.3074***	0.9040***
	(0.4480)	(0.0080)	(0.0000)	(0.0000)
Value	-0.1171	0.0899*	0.1038***	1.6806***
	(0.4430)	(0.0840)	(0.3810)	(0.0000)
Momentum	0.1085	-0.0252	0.5341***	-0.6931***
	(0.6560)	(0.7610)	(0.0050)	(0.0000)

*Table 7: This table presents the estimated coefficients (β_n) from the time series regression using a sample from the SET market, and their corresponding p-values. p-values are stated in parentheses below each coefficient. ***, ** and * indicate significance at a 1%, 5% and 10% level, respectively.*

From the table above (table 7), when using the monthly returns of the size-hedged portfolio as the dependent variable, the estimated coefficients of value-weighted monthly share turnover and the market factor are negative, but the estimated coefficients of the size factor and the book-to-market factor are positive. The estimated coefficient of value-weighted monthly share turnover is not statistically significant, but the estimated coefficients of the market factor, the size factor, and the book-to-market factors are statistically significant. When using the monthly returns of value-hedged portfolios as the dependent variable, the estimated coefficient of the value-weighted monthly share turnover is negative, but the estimated coefficients of the market factor, the size factor, and the book-to-market factor are positive. The estimated coefficient of the value-weighted monthly share turnover is not statistically significant, but the estimated coefficients of the market factor, the size factor, and the book-to-market factor are statistically significant. When using the monthly returns of the momentum-hedged portfolios as the dependent variable, the estimated coefficients of the value-weighted monthly share turnover and the size factor are positive but the estimated coefficients of the market factor and the book-to-market factor are negative. The estimated coefficients of the value-weighted monthly share turnover and the market factor are not statistically significant, but the estimated coefficients of the size factor and the book-to-market factor are statistically significant.

In sum, even though some of the estimated coefficients of value-weighted monthly share turnover are negative, they are not statistically significant at all. This result shows that the value-weighted monthly share turnover does not influence the returns anomalies in the SET market. In other words, the increase in liquidity does not attenuate the returns anomalies in the SET market.

Next, I estimate the time series regression using the sample from the mai market. The estimated coefficients (β_n) and their corresponding p-values are presented in the table below;

	mai			
	Turn	**RMRF**	**SMB**	**HML**
	β_1	β_2	β_3	β_4
Size	-0.0426	-0.3242***	0.6922***	0.1758**
	(0.3770)	(0.0000)	(0.0000)	(0.0440)
Value	-0.0301	-0.1096	0.2903*	1.0639***
	(0.6350)	(0.3380)	(0.0700)	(0.0000)
Momentum	0.0012	-0.0494	-0.5918***	-0.1633
	(0.9880)	(0.7420)	(0.0050)	(0.2780)

*Table 8: This table presents the estimated coefficients (β_n) and the corresponding p-values estimated from the time series regression using the sample from of the mai market, and their corresponding p-values. p-values are stated in parentheses below each coefficient. ***, ** and * indicate significance at a 1%, 5% and 10% level, respectively.*

From the table above (table 8), when using the monthly returns of the size-hedged portfolios as the dependent variable, the estimated coefficients of value-weighted monthly share turnover and the market factor are negative, but the estimated coefficients of the size factor and the book-to-market factor is positive. The coefficient of value-weighted monthly share turnover is not statistically significant, but the estimated coefficients of the market factor, the size factor, and the book-to-market factors are statistically significant. When using the monthly returns of the value-hedged portfolios as the dependent variable, the estimated coefficients of value-weighted monthly share turnover and the market factor are negative, but the estimated coefficients of the size factor and the book-to-market factor are positive. The estimated coefficients of value-weighted monthly share turnover and the market factor are not statistically significant but the estimated coefficients of the size factor and the book-to-market factor are statistically significant. When using the monthly returns of the momentum-hedged portfolios as the dependent variable, the estimated coefficient of value-weighted monthly share turnover is positive but the estimated coefficients of the market factor, the size factor, and the book-to-market factor are negative. The estimated coefficients of the value-weighted monthly share turnover, the market factor, and the book-to-market factor are not statistically significant, but the estimated coefficient of the size factor is statistically significant.

In sum, the results of the time series regression using the sample from the mai market are almost identical to the results of the time series regression using the sample from the SET market. Even though some of the estimated coefficients of value-weighted monthly share turnover are negative, they are not statistically significant at all. This result shows that value-weighted monthly share turnover does not influence the returns anomalies in the mai market. In other words, the increase in liquidity does not attenuate the returns anomalies in the mai markets.

The results of the time series regression using the sample from both SET and mai markets show a clear picture that the increase in liquidity does not attenuate the returns anomalies in the Thai stock markets. This result is in contrast to (Chordia et al., 2014) that as the liquidity and trading activity increase, the economic and statistical significance of the returns anomalies in the U.S. market attenuated. Also, the result is in contrast to (Cotter & McGeever, 2018) that they found strong evidence of returns anomaly attenuation in the U.K. stock market. However, this result is in line with (Auer & Rottmann, 2019) that there is no significant relationship between returns and liquidity in the vast majority of the international markets.

Robustness check

For the robustness check, I run both fixed and random effects estimation. For fixed effects estimation, the equation is specified as follow;

$$r_{i,t} = \alpha_0 + \beta_1 turn_{i,t} + \beta_2 RMRF_{i,t} + \beta_3 SMB_{i,t} + \beta_4 HML_{i,t} + (v_i + u_{i,t})$$

where i = 1, 2, …, N represents the returns anomalies-hedged portfolios, $t = 1, 2, \ldots, T$ represents a time index and $cov(v_i, X_{i,t}) \neq 0$. The dependent variable is the monthly returns of returns anomalies-hedged portfolios i at time t ($r_{i,t}$). The independent variables are value-weighted monthly share turnover ($turn_{i,t}$), the market factor ($RMRF_{i,t}$), the size factor ($SMB_{i,t}$), and the book-to-market factor ($HML_{i,t}$) at time t. In this case, the fixed-effects or Within estimator will be used for removing the fixed effect. The equation is specified as follow;

$$r_{i,t} - \bar{r}_i = \beta_1(turn_{i,t} - \overline{turn}) + \beta_2(RMRF_{i,t} - \overline{RMRF}) + \beta_3(SMB_{i,t} - \overline{SMB}) + \beta_4(HML_{i,t} - \overline{HML}) + (u_{i,t} - \bar{u}_i)$$

In addition to the fixed effects estimation, the equation for the random effects estimation is specified as follow;

$$r_{i,t} = \alpha_0 + \beta_1 turn_{i,t} + \beta_2 RMRF_{i,t} + \beta_3 SMB_{i,t} + \beta_4 HML_{i,t} + (v_i + u_{i,t})$$

where $cov(v_i, X_{i,t}) = 0$. In this case, the pooled generalized least square (GLS) will be used for removing the random effect. The equation is specified as follow;

$$r_{i,t} - \theta\bar{r}_i = \alpha_0(1-\theta) + \beta_1(turn_{i,t} - \theta\overline{turn}_i) + \beta_2(RMRF_{i,t} - \theta\overline{RMRF})$$
$$+ \beta_3(SMB_{i,t} - \theta\overline{SMB}) + \beta_4(HML_{i,t} - \theta\overline{HML}) + (w_{i,t} - \theta\bar{w}_i)$$

where $w_{i,t} = v_i + u_{i,t}$ and $\theta = 1 - (\frac{\sigma_u^2}{\sigma_u^2 + T\sigma_v^2})^{\frac{1}{2}}$. Both fixed and random effects estimations are estimated simultaneously between 2 markets (SET and mai).

The estimated coefficients (β_n) and their corresponding p-values of both fixed and random effects estimations are presented in the table below;

	Turn	**RMRF**	**SMB**	**HML**
	$\boldsymbol{\beta_1}$	$\boldsymbol{\beta_2}$	$\boldsymbol{\beta_3}$	$\boldsymbol{\beta_4}$
Fixed	-0.0257	-0.1324***	0.2370***	0.4035***
	(0.4420)	(0.0040)	(0.0020)	(0.0000)
Random	-0.0374	-0.1279***	0.2393***	0.4007***
	(0.2200)	(0.0060)	(0.0020)	(0.0000)

*Table 9: This table presents the estimated coefficients (β_n) estimated from the fixed and random effects estimations, and their corresponding p-values. p-values are stated in parentheses below each coefficient. ***, ** and * indicate significance at a 1%, 5% and 10% level, respectively.*

From the table above (table 9), the estimated coefficients from the fixed and random effects estimation are almost identical. The estimated coefficients of value-weighted monthly share turnover and the market factor are negative, but the estimated coefficients of the size factor and the book-to-market factor are positive. Only the estimated coefficients of value-weighted monthly share turnover are not statistically significant. The estimated coefficient of the market factor, the size factor, and the book-to-market factors are highly and statistically significant.

Even though the estimated coefficients of value-weighted monthly share turnover are negative, they are not statistically significant. This means that value-weighted monthly share turnover does not influence the returns anomalies in the Thai stock markets. In other words, the increase in liquidity does not attenuate the returns anomalies in the Thai stock markets.

In addition, I run the Hausman test to check the random effects assumptions. In this case, the Hausman test exhibits a low chi-squared value ($\chi^2 = 0.74$) and a high p-value (0.9461). Hence, the Hausman test confirms that I cannot reject the assumptions of the random effects model.

The conclusion remains that the increase in liquidity does not attenuate the returns anomalies in the Thai stock markets.

Summary

From (Chordia et al., 2014), in the recent period of increased liquidity, the majority of US stock market returns anomalies have attenuated. However, as Thailand is the retail-based stock market, the stock market returns anomalies might not attenuate in the period of increased liquidity. Therefore, I hypothesize that the stock market returns anomalies in Thailand still exist and will not attenuate in the period of increased liquidity.

In this paper, I conduct time series regression to test the hypothesis. My finding is that apart from momentum returns anomalies in the mai market, the size, value, and momentum returns anomalies still exist in the Thai stock markets. This result is similar to (Bunsaisup, 2014), (Hussaini et al., 2016), and (Sareewiwatthana, 2012) that the size, value, and momentum returns anomalies are statistically and economically significant in the Thai stock markets. Also, most of the returns anomaly (4 out of 6) are not statistically attenuate over time. This finding is in contrast to (Chordia et al., 2014) since they documented significant attenuation for size, value, and momentum anomalies in the U.S. market. Finally, the results from the time series regression show that the increase in liquidity does not attenuate the returns anomalies in the Thai stock markets. This result is in contrast to (Chordia et al., 2014). In the Thai stock market, as the liquidity and trading activity increase, the economic and statistical significance of the returns anomalies do not attenuate. This result is in line with (Auer & Rottmann, 2019) and confirms that there is no significant relationship between returns and liquidity in the vast majority of international markets. In addition, I run panel regressions (both fixed and random effects estimations) to check the robustness. The results of panel regressions are similar to time series regression. The conclusion remains that the increase in liquidity does not attenuate the returns anomalies in the Thai stock markets.

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