การถือครองหลักทรัพย์และเพดานการถือครองหลักทรัพย์ของนักลงทุนต่างชาติ กับความเร็วในการปรับตัวของราคาหลักทรัพย์ในตลาดทุนไทย

นายศรัณยกร อังคณากร

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FOREIGN OWNERSHIP, FOREIGN LIMIT AND THE SPEED OF PRICE ADJUSTMENT IN THAI CAPITAL MARKET

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ศรัณยกร อังคณากร : การถือครองหลักทรัพย์และเพดานการถือครองหลักทรัพย์ของนักลงทุนต่างชาติ กับความเร็วในการปรับตัวของราคาหลักทรัพย์ในตลาดทุนไทย. (FOREIGN OWNERSHIP, FOREIGN LIMIT AND THE SPEED OF PRICE ADJUSTMENT IN THAI CAPITAL MARKET) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ดร.รัฐชัย ศีลาเจริญ, 66 หน้า.

วิทยานิพนธ์ฉบับนี้มีวัตถุประสงค์เพื่อศึกษาความได้เปรียบเชิงข้อมูลของนักลงทุนต่างชาติ โดยศึกษาจากความแตกต่างของการถือครองหลักทรัพย์ของนักลงทุนต่างชาติและความเร็วในการปรับตัวของราคาหลักทรัพย์ นอกจากนี้ยังศึกษาความแตกต่างของข้อจำกัดการถือครองของนักลงุทนต่างชาติซึ่งอาจเป็นปัจจัยแท้จริงที่ทำให้ผลตอบแทนในปัจจุบันของหลักทรัพย์ที่มีมูลค่าตลาดน้อยความสัมพันธ์กับผลตอบแทนในอดีตของหลักทรัพย์ที่มีมูลค่าตลาดมากซึ่งถูกพบในประเทศไทย ในการศึกษาจะใช้ข้อมูลจากตลาดหลักทรัพย์แห่งประเทศไทยตั้งแต่เดือนมกราคม พ.ศ. 2544 ถึงเดือนธันวาคม พ.ศ. 2551 โดยวิธีการศึกษาแบ่งออกเป็นการใช้ Vector autoregressive model เพื่อทดสอบว่า ผลตอบแทนของหลักทรัพย์ที่มีการถือครองของนักลงทุนต่างชาติต่ำหรือเพดานการถือครองต่ำ มีความสัมพันธ์กับผลตอบแทนในอดีตของหลักทรัพย์ที่มีการถือครองของนักลงทุนต่างชาติสูงหรือเพดานการถือครองสูง ส่วนการทดสอบการตอบสนองที่ต่อข่าวดีและข่าวร้ายที่แตกต่างกันจะใช้ Asymmetric regression ในขณะที่สมการถดถอยแบบ Dimson market beta ใช้เพื่อทดสอบสมมติฐานว่า ความเร็วในการปรับตัวที่ต่างกันของราคาหลักทรัพย์เกิดจากความสามารถที่แตกต่างกันในการตอบสนองต่อข้อมูลแบบ market-wide ของหลักทรัพย์ โดยในการศึกษานี้มูลค่าตามตลาดของหลักทรัพย์จะถูกใช้เป็นปัจจัยควบคุม เพื่อป้องกันผลกระทบที่เกิดขึ้นจากมูลค่าตามตลาดของหลักทรัพย์

ผลการศึกษาไม่พบว่ามีการได้เปรียบเชิงข้อมูลของนักลงทุนต่างชาติ ส่วนผลตอบแทนของหลักทรัพย์ที่มีเพดานการถือครองต่ำ มีความสัมพันธ์กับผลตอบแทนในอดีตของหลักทรัพย์ที่มีเพดานการถือครองสูง โดยการตอบสนองที่แตกต่างกันต่อผลตอบแทนของตลาดโดยใช้เป็นสัญลักษณ์แทนข้อมูลแบบ market-wide เป็นสาเหตุของความสัมพันธ์ดังกล่าวของหลักทรัพย์ที่มีระดับถือครองของนักลงทุนต่างชาติที่แตกต่างกัน แต่ไม่ใช่สาเหตุของความสัมพันธ์ดังกล่าวที่พบในหลักทรัพย์ที่มีเพดานการถือครองแตกต่างกัน

ภาควิชา การธนาคารและการเงิน ลายมือชื่อนิสิต .....

สาขาวิชา การเงิน ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก R. Seelajaroen

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SARUNYAKORN AUNGKANAGORN : FOREIGN OWNERSHIP, FOREIGN LIMIT AND THE SPEED OF PRICE ADJUSTMENT. THESIS ADVISOR : RUTTACHAI SEELAJAROEN, 66 pp.

This thesis examines whether foreign investors have an information advantage to local investors. By assuming the source of lead-lag relation comes from the difference in the speed of price adjustment to information and information advantages, the paper tests whether stocks with higher foreign ownership adjust faster to new information. This hypothesis is motivated by the common believe that foreign investors are better informed than local investors. Moreover, the paper also examines whether the difference in levels of foreign ownership and foreign limit can be claimed as the causes of cross-autocorrelation in stock returns, which has been found in Thailand. Data is obtained from January 2001 to December 2008 from the Stock Exchange of Thailand. This research performs three different models; the vector autoregressive (VAR) model, asymmetric regression and Dimson beta regression.This paper controls for the firm size. VAR shows that returns of low foreign ownership stocks lead returns of high foreign ownership stocks and returns of high foreign limit stocks lead returns of low foreign limit stocks. It means foreign investors do not have an information advantage over locals and degrees of foreign limit can delay information diffusion. The asymmetric regression presents that there is no difference of stocks' response to good and bad market-wide news. While Dimson market beta model shows that the slow adjustment to returns on market as a proxy of market-wide information causes the lead-lag relation between high and low foreign ownership stocks but doesn't cause the lead-lag relation between high and low foreign limit stocks. Both of foreign ownership and foreign limit cannot solely be claimed as the causes of the cross-autocorrelation in stock returns found in Thailand.

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CHAPTER 1

INTRODUCTION

1.1 Background

In the last decade, many so-called "emerging" markets, including Thailand, have opened up their capital markets to foreign investors which not only increases in the market participants but also bring about an idea to examine the impact of foreign investors‘ roles in developing equity markets. There are two contradictory general views on foreign investors in emerging markets. On the one hand, Seasholes (2000) show that foreign investors, mainly come from the developed nations, in Taiwan are the information-based investors while domestic institutions and individuals seem to be the noise traders. This result has been strengthened by paper of Grinblatt and Keloharju (2000) which find that foreign investors are considered as the sophisticated investors who are better informed than domestics since foreigners and domestic financial corporations buy more stocks that perform well over the next 120 trading days than domestic individual investors in Finland. Froot, O‘Connell and Seasholes (2001) and Froot and Ramadorai (2001) shows that foreign investors are more informed and buy (sell) ahead of good (bad) news while domestic investors do the opposite. On the other hand, the result of Khanthavit (1998) show that foreign investors exhibit the positive feedback pattern which means that they tend to follow momentum strategy and trade follow the market. While Choe, Kho and Stulz (2005) and Dvorak (2006) show that domestic investors have an information advantage and better informed than foreigners.

Because prior studies have offered opposite results, it is difficult to draw a conclusion on whether domestic or foreign investors have informational advantages. Rather than comparing only the differences in trading prices between foreign and local which is subjected to factors such transaction costs and time value of money, the study is more pertinent to answer whether foreign or domestic investors have superior information and/or analytical tools by performing a test of whether the speed of price adjustment is related to foreign stock ownership. By assuming the source of lead-lag relation comes from the difference in the speed of price adjustment to information and information advantages, we expect faster price adjustments for stocks with higher foreign ownership since foreign investors are better informed than local investors.

In particular, a large body of evidence on a lead-lag effect in stock prices, in which some stocks reacts faster than others to new information that has value implications across stocks defined as *common information*, points to the result of Lo and MacKinlay (1990) which shows that current returns on a portfolio of small stocks are correlated with lagged returns on a portfolio of large stocks, but not vice versa. However, it is important to recognize that firm size per se may have little economic significance for information transmission across firms. One of possible explanations for this lead-lag effect is provided by Holden and Subrahmanyam (1992) and Foster and Viswanathan (1993),[1] who argue that the difference in level of informed investors has an impact on the tendency of some stocks to adjust more slowly (underreact) to economy-wide information than others. Subsequent studies show that these firm‘s

[1] Others who have provided similar explanations include McQueen, Pinegar, and Thorley (1996), and Connolly and Stivers (1997).

characteristics, for example, trading volume (Chordia and Swaminathan (2000)), the number of financial analysts following the stock (Brennan, Jegadeesh and Swaminathan (1993)), institutional ownership (Badrinath, Kale and Noe (1995)) and foreign ownership (Park and Chung (2007)), can be a proxy of informed investors. While another possible explanation holds that the lead-lag relation stem from the different in level of market friction facing each stock or portfolio as argued by Bae, Ozoguz and Tan (2006) which shows that foreign ownership restriction also lead to the difference in the speed of price adjustment.

In addition, Chang, McQueen and Pinegar (1999) find that cross-autocorrelation that found by Lo and MacKinlay (1999) is not a uniquely US phenomenon because the evidences of cross-autocorrelation also exist in six Asian markets including Thailand. They document monthly returns on a portfolio of small stocks are correlated with the lagged returns on a portfolio of large stocks. However, this study falls short only at the lead-lag relation in stocks with different sizes but also offers no explanation for why size may be an important determinant of the speed of adjustment.

This paper performs the vector autoregression (VAR) to test whether foreign investors can be regarded as informed investors and lead stock prices to the faster speed of price adjustment. We hypothesize that foreign ownership leads to the faster speed of price adjustment ant that foreign investors are more informed. Therefore, returns of stocks with high foreign ownership lead returns of stocks with low foreign ownership. Moreover, many prior studies suggest that the presence of market frictions can delay the information diffusion in the market and cause the stock prices to adjust

more slowly to market-wide information, generating the differences in the speed of price adjustment across stock returns. As Bae, Ozguz and Tan (2006) confirms that higher foreign investment limit can reduce the delay of individual stock prices respond to the global and local market information so the paper also tests whether the market friction proxied by the foreign limit can be claimed as a cause of the cross-autocorrelation in stock returns in Thailand. Furthermore, we also test whether the lead-lag relations between high foreign ownership (foreign limit) and low foreign ownership (foreign limit) firms are depended on the asymmetric responses to good and bad news since McQueen, Pinegar and Thorley (1996) reports that the cross-autocorrelation is primarily associated with a slow response to good, but not to bad, market-wide news. Lastly, the paper performs the Dimson beta regression (Dimson (1979)) to test the speed of price adjustment relative to a common market factor which is represented by the market index returns. In contrast, the VAR tests measure speed of adjustment of two portfolios relative to one another. However, both VAR and Dimson beta regressions do capture similar lead-lag effects.

This paper will control for firm size because we have already know from the results of Lo and MacKinlay (1990) and Chang, McQueen and Pinegar (1999) that size is related to the speed of adjustment; otherwise finding that the foreign investors are positively associated with the speed of adjustment would not allow us to distinguish our hypothesis from a pure size effect. To minimize the effect of nonsynchronous trading on cross-autocorrelations, returns of stocks that did not trade at date t or t-1 are excluded from the computation of portfolio returns for date t. While the survivorship bias is avoided by taken into account both currently listed firms and firms that used to be listed in the stock market.

1.2 Research Objectives

The objective in studying the association between foreign investors and the speed of price adjustment is to examine whether the difference in level of foreign ownership and ownership restriction can be claimed as the causes of cross-autocorrelation that had been found in Thailand documented by Chang, McQueen and Pinegar (1999). Initially, this study focuses on examining whether foreign investors, regarded as informed traders, are really better informed by looking at the lead-lag relation for the firms held by different level of foreign ownership. The returns of stocks with high foreign ownership should lead returns of stocks with low foreign ownership. Then, the paper will study further whether ownership restriction can be regarded as the market friction which will make returns of stocks with high accessibility lead returns of stocks with low accessibility. After that, the paper aims to test whether the lead-lag relation across securities is different between good or bad news. To shed additional light on continuing debates in the literature, the paper examines that whether the slow adjustment to market-wide information of some stocks can be claimed as the source of lead-lag relation.

1.3 Contributions

The contributions of this article are; firstly, the paper will provide the evidence whether foreign investors can be regarded as informed investors in Thai equity market by assuming the source of lead-lag relation comes from the difference in the speed of price adjustment to information and information advantages, the prices of equities held by higher level of informed investors will react to information faster. It is inconclusive evidence on whether foreign or domestic investors actually have informational advantages since most evidences that hold foreign investors as informed

investors are exhibited only in Korea so the paper can help to express whether it is an unique character of foreign investors in Korea or a general character of foreign investors that also hold in Thai capital markets which imply that foreign activity enhances the informational and allocation role of securities markets thereby making markets more efficient. Moreover, the paper also attests whether the restriction on foreign ownership or foreign limit can be considered as the market friction which will benefit to the regulators and it also support the view of financial liberalization to relieve the restriction for improving market efficiency.

1.4 Hypotheses

1.4.1 The lagged returns of stocks with high foreign ownership can predict the current returns of stocks with low foreign ownership.

1.4.2 The lagged returns of stocks with high accessibility or foreign limit can predict the current returns of stocks with low accessibility or foreign limit.

1.4.3 The lead-lag relation between low foreign ownership and high foreign ownership stocks is due to the slow adjustment to good news rather than bad news.

1.4.4 The lead-lag relation between low foreign limit and high foreign limit stocks is due to the slow adjustment to good news rather than bad news.

1.4.5 Stocks with low foreign ownership adjust more slowly than stocks with high foreign ownership when compared to the common market information.

1.4.6 Stocks with low accessibility or foreign limit adjust more slowly information than stocks with high accessibility or foreign limit when compared to the common market information.

1.5 Research Structure

The study is divided into 5 chapters. Chapter1 introducing the research background which relating to the area of study, followed by the purpose of research, hypotheses and research structure. Chapter 2 provides overview of a number of literature reviews on topics regarding to the aspects of informed, uninformed investors, foreign ownership and speed of price adjustment which come from secondary sources. Chapter 3 outlines the research method. The explanation of the methodology for this research, which includes data collection, and analytical framework, will be presented in this chapter. The empirical results are presented and analysed in Chapter 4. Analysis and discussion are contained with two models namely VAR and Dimson beta regression. Chapter 5 concludes the study and provides an overview of important findings of the research.

CHAPTER 2

LITERATURE REVIEW

This chapter reviews the previous studies that related to the evidence on the cross-autocorrelations, the alternative explanations on lead-lag relationship, foreign ownership in Thailand and the argument on foreign investors as the informed investors.

2.1 Evidence on the cross-autocorrelations

Many studies suggest that the presence of market frictions causes some stock prices to adjust more slowly to market-wide information than others, generating differences in the speed of adjustment across stock returns. That is, the main economic source for the lead-lag cross-autocorrelation is the slow diffusion of information across stocks. There are a number of theories that suggest a link between the speed of information diffusion and limited stock market participation (Merton (1987), Basak and Cuoco (1998), Shapiro (2002), and Hou and Moskowitz (2005)). These studies suggest that many economics forces are responsible for the slow diffusion of information in the equity market. The list of potential candidates includes information costs, institutional forces, noise traders, stale limit orders, market maker inventory policy, transaction costs, short sale constraints, and other types of market frictions and institutional constraints which can delay the process of information incorporation for less visible, segmented firms.

Merton (1987) hold that the importance of information costs and institutional restrictions in the information acquisition and dissemination process might be sources

of slow of information diffusion. Diamond and Verrecchia (1987) argue that short sale constraints can slow down the response of stock prices to new information, especially when the information is negative. Mech (1993) shows that stock prices respond to new information more rapidly when price changes are large relative to the bid-ask spread. Extending the work in Kyle (1985), Holden and Subrahmanyam (1992) and Foster and Viswanathan (1993) demonstrate that the presence of more informed investors leads to faster stock price adjustment to new information. Chan (1993) presents a model based on incomplete information in which cross-sectional differences in the signal quality can give rise to asymmetric cross-autocorrelations. Badrinath, Kale and Noe (1995) develop a multi-period model in which the information set-up cost and/or prudence restrictions (as postulated by Merton (1987)) lead to a lead-lag relation between institutionally "favored" firms and "unfavored" firms. Finally, Peng (2002) constructs a learning model in which incomplete information, in the form of an information capacity constraint faced by the representative investor, causes a delay in the price adjustment process.

2.2 Alternative hypotheses

Lead-lag cross-autocorrelations have been identified as an important component of stock price dynamics. The bulk of the evidence, therefore, points to slow diffusion of common information as the main source of the observed cross-autocorrelation patterns. Lo and MacKinlay (1990) find that weekly stock returns are positively cross-autocorrelated with a distinct lead-lag pattern between firms of different size: lagged returns on big firms are correlated with current returns on small firms, but not vice versa. Recently the lead-lag effect is predominantly an intra-industry phenomenon: returns on big firms lead returns on small firms within the

same industry. As a result of Hou (2003), industry leaders lead industry followers, value firms lead growth firms (within the same industry), and firms with low idiosyncratic volatility lead their highly volatile industry peers, controlling for firm size. But there is little evidence of a lead-lag effect across industries. The studies of Holden and Subrahmanyam (1992); Foster and Viswanathan (1993); Brennan, Jegadeesh and Swaminathan (1993); Badrinath, Kale and Noe (1995) indicate that when the number of informed investors is larger, share price responds faster to new information.

Even though the lead-lag relation was originally observed between returns on large-firm and small-firm portfolios, it is important to recognize that firm size per se may have little economic significance for information transmission across firms. It may, however, be highly correlated with some firm characteristics that are relevant. Many factors that positively correlate to the market capitalization have been employed as proxies of informed investors. Brennan, Jegadeesh and Swaminath(1993) study the effect of analyst coverage on the speed of price adjustment and conclude that the stock prices of firms followed by many analysts react more rapidly to aggregate shocks than do those followed by few analysts assuming that the number of informed investors for a given stock increases with the number of financial analysts following the stock. Even adjusting for firm size, many analyst firms also tend to respond more rapidly to market returns than do few analyst firms. This relation, however, is nonlinear, and the marginal effect of the number of analysts on the speed of price adjustment increases with the number of analysts. Christensen, Smith and Stuerke (2004) find that the market reaction to a firm‘s earnings announcement is faster when the firm is followed by more analysts. Chan

and Hameed (2006) study the relationship between the stock price synchronicity and analyst activity in emerging markets. They found that when stocks are followed by more analysts, it incorporate greater market-wide information but lesser firm-specific information. Moreover, when analyst-followers increase, the stock price synchronicity also increases.

While other hypotheses of lead-lad effect are plausible, Badrinath, Kale and Noe (1995) focus on information set-up costs and legal restrictions surrounding the investment activity of institutional portfolio managers. They found that when equity portfolios are formed on the basis of the level of institutional ownership in firms, the returns on the portfolio of firms with the highest levels of institutional ownership lead the returns of portfolios with lower levels of institutional ownership by as much as two months. On the other hand, when portfolios are size-based, the lead-lag period is generally no more than one month. The significance of the institutional ownership-based lead-lag relation persists, in monthly as well as in weekly returns, even after controlling for firm size. This indicates that the stock price performance of firms with high institutional ownership, and not the performance of large firms, is a leading indicator of subsequent equity market performance. It is, thus, possible that the primary path for information transmission in equity markets is between returns on institutionally favored and institutionally unfavored firms. It‘s consistent with the result from Boehmer and Kelley (2005), stocks with higher institutional ownership are priced more efficiently and also that increases in institutional trading volume are associated with greater efficiency.

Recent research also supports the hypothesis of the ownership level. Park and Chung (2007) examine the relation between the speed of price adjustment and stock

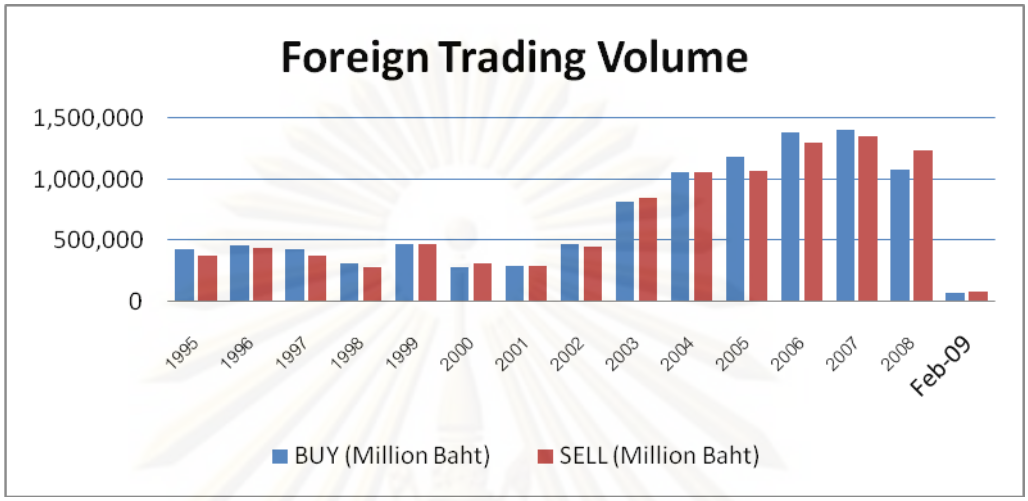
ownership by foreign and local institutional investors using data from the Korean stock market. They show that returns of portfolios with high foreign institutional ownership lead returns of stocks with low foreign institutional ownership, especially after foreign ownership restriction is lifted. Likewise, returns of stocks with high local institutional ownership lead returns of stocks with low local institutional ownership. These results support the idea that foreign institutional (local institutional) investors have faster access to or processing power of new information than local institutional (local individual) investors. These studies are crucial in the sense that they can help to explain the process of information transmission in stock markets.

Anyway, some research point to other causes of lead-lag effect. Chordia and Swaminathan (2000) argue that the trading volume is the source of the lead-lag effect between high volume firms and low volume firms and caused by low volume firms adjusting more slowly to market-wide information. This paper contributes to the above literature by showing that slow diffusion of industry-wide information determines the lead-lag effect.

2.3 Foreign ownership in Thailand: Fact & Figures

The role of foreign investors in Thai equity markets has continuously increased over the decades noticed by the value of stock they held and their daily trading volume. Every action of foreign investors is important and meaningful to the trend of Thai stock index. Foreigners tend to focus on the stocks of the large scale or blue ship firms which its level of transparency and governance seem to quite high (Kang and Stulz(1995)). For example, those listed companies likely concentrate in SET50 group which one-third of its members have foreign ownership up to the foreign limit.

Figure 1 The foreign trading volume from 1995 to February 2009



Source: Stock Exchange of Thailand

When considering the value, Thailand stock exchanges, one of emerging market, is quite small compared with some emerging markets like Korea, Hong Kong and Indonesia so the volume of foreign trading and their ownership could yield the significant impact to the index (Bailey and Jagtiani(1993)). As research from Kasikorn shows that the positive correlation between net trade volume of foreign investors and the return of Thai market index has increased, especially for the last six months compared with the last 4-years period. So it evidences that foreign trading position has explicitly related to the SET index‘s returns. This study performs a formal test of the conjecture that foreign investors lead the market by examining whether returns of stocks with high foreign ownership lead returns of stocks with low foreign ownership.

Figure 2 Foreign net trading volume and its monthly returns

Source: KResearch issue 2212, June 2008

Many studies have discovered the different effects of foreign investment on firms. Sudarat (2006) test whether foreign investment is a mechanism for improving corporate governance in emerging markets. The results show that when foreign industrial companies buy large stakes, there is no improvement in corporate governance. It appears that foreign industrial investors act as insiders: they favor weak corporate governance because it allows them to exploit minority shareholders. In contrast, purchases of minority stakes by foreign institutional investors lead to improvements in corporate governance. While foreign ownership does not affect volatility in the absence of cross-listing, foreign ownership raises the variance of stock returns. This effect is found to operate in part through increases in volume traded on the domestic market following the listing, and through an identifiable increase in the volatility of information net of volume effects (Coppejans and Domowitz (2000)).

The relation between foreign ownership and information transmission has been studied by Kim and Yi (2008). They found that, firstly, stock price informativeness, stock price incorporated by the firm-specific information, increases significantly with the intensity of trading by foreign investors and domestic institutional investors. Second, trading by foreign investors facilitates the incorporation of firm-specific information into stock prices to a greater extent than trading by domestic institutions. Third, among domestic institutions with different investment horizons, short-term institutions such as securities companies play a more important role in accelerating firm-specific information capitalization into stock prices, compared with long-term institutions such as banks and insurance companies. Finally, results indicate that the complete abolishment of foreign ownership restrictions in 1998 has significantly improved the information role of foreign investors in the Korean stock market.

2.4 Are foreign investors are more informed ?

Many studies compare the investment performance between foreign and domestic investors in an effort to determine whether foreign or domestic investors have superior information and analytical tools. Grinblatt and Keloharju (2000), using data from Finland, find that foreign investors tend to be momentum investors, buying past winning stocks and selling past losers. Domestic investors, particularly households, tend to be contrarians. The distinctions in behavior are consistent across a variety of past-return intervals. The portfolios of foreign investors seem to outperform the portfolios of households, even after controlling for behavior differences. Seasholes (2000) shows that foreign investors buy (sell) ahead of good (bad) earnings announcements in Taiwan while domestic investors do the opposite. Froot, O'Connell

and Seasholes (2001) and Froot and Ramadorai (2001) find that foreign investors trade ahead of better returns. Bae, Ozguz and Tan (2006) confirm that greater foreign investment limit can reduce the delay of individual stock prices respond to the global and local market information. These studies suggest that foreign investors are better informed and more sophisticated than their domestic counterparts.

In contrast, other studies report that the performance of foreign investors is no better than domestic investors. Shukla and van Inwegen (1995) show that UK money managers underperform American money managers when picking US stocks. Kang and Stulz (1997) find no evidence that foreign investors outperform domestic investors in Japan. Coval and Moskowitz (1999) find that mutual fund managers are better at picking stocks of firms that are close to where they are than stocks of firms from a more distant location. Choe, Kho and Stulz (2005) show that foreign money managers in Korea pay more than domestic money managers when they buy and receive less when they sell for medium and large trades. They attribute this result to the fact that prices move more against foreign investors than domestic investors before trades because foreign investors trade more on intraday momentum signs than domestic investors as less informed traders often do. Dvorak (2005) shows that domestic investors can make profits greater than foreign investors by using transaction data from Indonesia. The study also shows that domestic clients of global brokerages have higher profits than foreign clients of global brokerages, suggesting that the combination of local information and global expertise leads to higher profits.

In this chapter, we have reviewed many prior researches that related to our area of study. As can be seen the evidence on whether foreign investors are more

informed is far from conclusive. In the next chapter, we will mention to the analytical framework that will be employed to test our research question.

CHAPTER 3

METHODOLOGY

This chapter, methodology, refers to the overall approach to the paper process, from theoretical underpinning to the hypothesis development, the collection and analysis of the data.

3.1 Hypothesis Development

For the relation between foreign ownership and the speed of price adjustment, many arguments support foreign investors in saying that they are sophisticated investors with superior investment skills which help to analyze market conditions and make informed investment decisions. Grinblatt and Keloharju (2000) and Seasholes (2000) hold that foreign institutions perform better than domestic institutions because the foreign institution have better access to expertise and talent. Seasholes (2000) shows that foreign investors buy (sell) ahead of good (bad) earnings announcements in Taiwan while domestic investors do the opposite. Froot, O'Connell and Seasholes (2001) and Froot and Ramadorai (2001) find that foreign investors trade ahead of better returns. If the latter explanation holds, the information advantage will lead foreign investors to act faster so the portfolios with high foreign ownership would lead the portfolios with low foreign ownership and the lead-lag relation is due to the slow diffusion of common information to some stocks.

H_1: *The lagged returns of stocks with high foreign ownership can predict the current returns of stocks with low foreign ownership.*

For the relation between the degree of accessibility or foreign limit and the speed of stock price adjustment, there are a number of theories that suggest a link between the speed of information diffusion and limited stock market participation (see e.g. Merton (1987)). These studies suggest that the presence of market frictions causes some stock prices to adjust more slowly to market-wide information than others, generating differences in the speed of adjustment across stock returns. The restriction on foreign ownership can be a cause of market frictions. Hence, stocks with low restriction or high degree of foreign limit can adjust faster to new information and lead stocks with high restriction or low degree of foreign limit.

H_2: *The lagged returns of stocks with high accessibility or foreign limit can predict the current returns of stocks with low accessibility or foreign limit.*

In addition, McQueen, Pinegar and Thorley (1996) find that the cross-autocorrelation puzzle is primarily associated with a slow response by some stocks to good, but not to bad, market-wide news.

H_3: *The lead-lag relation between low foreign ownership and high foreign ownership stocks is due to the slow adjustment to good news rather than bad news*.

H_4: *The lead-lag relation between low foreign limit and high foreign limit stocks is due to the slow adjustment to good news rather than bad news.*

In contrast, the VAR tests measure speed of adjustment of two portfolios relative to one another. Many prior studies show that the lead-lag relation can also be captured when we measure the speed of adjustment of each stock or portfolio

relative to a single common benchmark, which is helpful in comparing the speed of adjustment across individual stocks or portfolios.

H_5: *Stocks with low foreign ownership adjust more slowly than stocks with high foreign ownership when compared to the common market information*.

H_6: *Stocks with low accessibility or foreign limit adjust more slowly information than stocks with high accessibility or foreign limit when compared to the common market information.*

3.2 Data Collection

There are many sources of data for doing a paper. However, the methods are generally categorized into two types: primary and secondary methods. In order to obtain adequate and accurate data, both primary and secondary data are necessarily required for doing paper. Nevertheless, this paper uses only secondary data.

This study focuses on the returns of stocks with high foreign ownership (foreign limit) compared with the returns of stocks with low foreign ownership (foreign limit). For the study period from January 2001 to December 2008, the daily returns and trading volume data is obtained from Data stream for stocks listed on the Stock Exchange of Thailand (SET). The study period starts from January 2001 because it‘s a period after the financial crisis, corporate governance was widely promoted, the floating exchange rate regime was implemented and the foreign restrictions are relaxed in Thailand. These made changes to the investment environment and also led foreign investment to be different from the period before and their consequences still in position up until the current period. The data on foreign ownerships obtain from the SET Market Analysis and Reporting Tool (SET SMART).

In avoiding the survivorship bias, all listed firms during the study period will be used in the computation of portfolio returns until it out the market.

For foreign limit, stocks within the same sector can expose to the different foreign limit and more than a half of stocks in SET are limited within 49%. For example, in energy and utilities sector, foreign limit of PTT is 30% but of TOP is 40%. In banking sector, foreign limit of KTB is 25% while of SCB is 45.81%. However, there are about forty stocks that foreign investors are allowed to hold up to 100% such as TSTH from construction materials sector, UOBKH from finance and securities sector, SVOA from information and communication technology sector and ESSO from energy and utilities sector. So the difference of foreign limit provide a natural setting to study the impact on the speed of price adjustment.

3.3 Analytical Framework

Quantitative analysis is used to analyze the association between the foreign ownership, foreign limit and the speed of price adjustment.

This research performs three different models, following e.g. Park and Chung (2007) and Chordia and Swaminathan (2000), to analyze how foreign ownerships and ownership restriction affect the speed of price adjustment to new information. The vector auto-regression (VAR) model below will be used to test Granger Causality. The VAR model can show whether the returns of stocks with high foreign ownership (degree of foreign limit) is able to predict the returns of stocks with foreign ownership (degree of foreign limit). After that, the asymmetric regression following McQueen et al. (1996) is employed to investigate the asymmetric responses to good news and bad news. While Dimson beta regression using zero-investment portfolios is performed to

test further the speed of price adjustment hypothesis which holds that the cross autocorrelation in stock returns stem from the tendency of some stocks adjusting more slowly to economy-wide information than others.

3.3.1 Portfolios' Formation

The paper will perform two different approaches to form portfolios in order to test for the different objectives. First is to examine the effects of the different level in foreign ownership on the speed of stock price adjustment. Second is to examine the effects of the different degree of foreign limit on the speed of stock price adjustment. Both of measures for constructing portfolio, then, will be tested by the vector auto-regression (VAR) model, the asymmetric regression and Dimson beta regression.

For the first measure, the paper investigates the different information advantages between the foreign and local investors by looking at their different in level of ownership and the speed of stock price adjustment. All listed companies will be categorized into four groups by their market value of equity at the ended of each quarter. Within each market value quartile, stocks then will be classified into four subgroups according to foreign ownership, yielding 16 subgroups. This paper uses a conditional double sort methodology that ensures an equal number of stocks within each of the 16 subgroups. Foreign ownership in each firm will be measured by the percentage of share's value held by foreign ownership. Within each market value quartile, the study assigns the stocks with the lowest foreign ownership as subgroup _L,' and the stocks with the highest foreign ownership as subgroup _H'.

For the second measure, the paper investigates the different in degree of foreign ownership limit and the speed of stock price adjustment. All listed companies

will be categorized into four groups by their market value of equity at the ended of each quarter. Within each market value quartile, stocks then will be classified into four subgroups according to foreign limit, yielding 16 subgroups. This paper uses a conditional double sort methodology that ensures an equal number of stocks within each of the 16 subgroups. Foreign limit in each firm will be measured by the percentage of total shares can be held by foreign investors. Within each market value quartile, the study assigns the stocks with the lowest foreign limit as subgroup ‗L,' and the stocks with the highest foreign limit as subgroup ‗H'.

We control the effect of nonsynchronous trading on cross-autocorrelations by dropping returns of stocks that did not trade at date t or t-1 from the computation of portfolio returns for date t. This ensures that the daily returns of any stock that did not trade for two consecutive days are excluded from the computation of portfolio returns for those two days and the following day. This method is more suitable than using only frequently traded stocks, for example, in SET50 or SET100. Otherwise, it will leave only few stocks in portfolios after construction.

Thereafter, this paper employs two different sorting method portfolios to perform a test in each different model.

3.3.2 Vector Autoregression (VAR) model

In this section, the study conducts a vector auto-regression (VAR) analysis to examine the lead-lag effect between portfolio H and portfolio L using equation below.

$$r_{L,t} = a_0 + \sum_{k=1}^{K} a_k \, r_{L,t-k} + \sum_{k=1}^{K} b_k \, r_{H,t-k} + u_t \qquad (1)$$

$$r_{H,t} = c_0 + \sum_{k=1}^{K} c_k \, r_{L,t-k} + \sum_{k=1}^{K} d_k \, r_{H,t-k} + v_t \qquad (2)$$

Following Brennan, Jegadeesh and Swaminathan (1993) and Chordia and Swaminathan (2000), the VAR tests has been employed to test whether returns of portfolio H lead returns of portfolio L. $r_{L,t}$ and $r_{H,t}$ are the returns of portfolios L and H, respectively. The lead-lag effects between the returns of these two portfolios can be tested using a bivariate vector autoregression[2]. The returns of portfolio H lead returns of portfolio L if the sum of the slope coefficients corresponding to return H in equation (1) is greater than zero ($\sum_{k=1}^{K} b_k > 0$). The ability of lagged returns of H to predict current returns of L is better than the ability of lagged returns of L to predict current returns of H. This hypothesis will be tested by examining if $\sum_{k=1}^{K} b_k > \sum_{k=1}^{K} c_k$ which is referred as the *cross-equation test*. This test is crucial to establishing that returns of portfolio H lead returns of portfolio L.

3.3.3 Asymmetric Regression

Following McQueen, Pinegar and Thorley (1996), we employ the following asymmetric regression to investigate the asymmetric response of the returns of one portfolio to positive and negative returns of the other portfolio:

$$r_{B,t} = \alpha_0 + \sum_{k=1}^{K} \beta_{B,t-k} r_{B,t-k} + \sum_{k=0}^{K} \beta_{B,t-k}^{UP} (r_{A,t-k} \times D_{A,t-k}) + \sum_{k=0}^{K} \beta_{B,t-k}^{DN} (r_{A,t-k} \times (1 - D_{A,t-k})) + u_{B,t} \quad \ldots(3)$$

Where $r_{A,t}$ and $r_{B,t}$ are the returns of portfolio A and B, respectively. Portfolio A is portfolio found in VAR that their returns lead returns on another portfolio called

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[2] Since the regressors are the same for both regressions, the VAR can be efficiently estimated by running ordinary least squares (OLS) on each equation individually.

portfolio B. $D_{A,t-k}$ is a dummy variable and equals to one if $r_{A,t}$ is positive including zero, and zero otherwise. It can be shown that portfolio B adjusts more slowly to good market-wide news emanating from portfolio A than to bad news if and only if the contemporaneous beta associated with the positive returns of portfolio A, $\beta_{B,0}^{UP}$, is less than that associated with the negative returns of portfolio A, $\beta_{B,0}^{DN}$, and the sum of the lagged betas corresponding to positive returns of portfolio A, $\sum_{k=1}^{K}\beta_{B,t-k}^{UP}$, is greater than that to negative returns of portfolio A, $\sum_{k=1}^{K}\beta_{B,t-k}^{DN}$. In terms of the asymmetric regression in equation (3), this translates into examining whether $\beta_{B,0}^{UP} < \beta_{B,0}^{DN}$ and $\sum_{k=1}^{K}\beta_{B,t-k}^{UP} > \sum_{k=1}^{K}\beta_{B,t-k}^{DN}$. The rationale behind this result is that if portfolio *B* responds more sluggishly to good market-wide news released from portfolio *A* than to bad news, it should respond less to today‘s good market-wide news than to today‘s bad news, and respond more to past good market-wide news than to past bad news. It should be noted that in order to make a conclusion about the asymmetric response, the above two conditions should hold simultaneously.

3.3.4 Dimson Beta Regressions

In the VAR tests, the study controls for size-related differences in speed of adjustment by forming four size portfolios and estimating the VAR within each size quartile. The paper also controls for other systematic effects in our tests of speed of adjustment by running a market model regression suggested by Dimson (1979) which includes leads and lags of market returns as additional independent variables. The Dimson beta regressions allow us to analyze the pattern of underreaction or overreaction of portfolio returns to market returns. They also allow us to measure the speed of adjustment of each stock or portfolio relative to a single common

benchmark, which is helpful in comparing the speed of adjustment across individual stocks or portfolios. In contrast, the VAR tests measure speed of adjustment of two portfolios relative to one another. However, both VAR and Dimson beta regressions do capture similar lead-lag effects.

Following Brennan, Jegadeesh and Swaminathan (1993) and Chordia and Swaminathan (2000) to perform Dimson beta regression, the study construct the zero-investment portfolio On that is long in portfolio H and short in portfolio L by subtracting portfolio L from portfolio H. Then, regression model (4) below relates the return on the zero net investment portfolios to the contemporaneous, lead, lagged return on the market portfolio.

$$r_{O,t} = \alpha_0 + \sum_{k=1}^{K} \beta_{O,t-k} r_{m,t-k} + \beta_{O,0} r_{m,t} + \sum_{k=1}^{K} \beta_{O,t+k} r_{m,t+k} + u_{O,t} \qquad (4)$$

Where $\beta_{O,k} = \beta_{H,k} - \beta_{L,k}$. The hypothesis expects that portfolio H adjusts faster to new market information than portfolio L, if and only if the contemporaneous beta of portfolio H ($\beta_{H,0}$) is greater than the contemporaneous beta of portfolio L($\beta_{L,0}$). And the sum of the lagged betas of portfolio H ($\sum_{k=1}^{K} \beta_{H,t-k}$) is less than the sum of the lagged betas of portfolio L ($\sum_{k=1}^{K} \beta_{L,t-k}$).

Hence, the contemporaneous betas from the Dimson regressions should be positive ($\beta_{O,0} > 0$) and the sum of the lagged betas is negative ($\sum_{k=1}^{K} \beta_{O,t-k} < 0$). The basic intuition behind this result is that if portfolio H responds more rapidly to market-wide information than portfolio L, its sensitivity to today's common information (market return) should be greater than that of portfolio L. In the same vein, since portfolio L responds sluggishly to contemporaneous information, it should

respond more to past common information (lagged market returns). The important thing to note here is that the speed of adjustment (relative to the market portfolio) is a function of both the contemporaneous beta and the lagged betas.

CHAPTER 4

EMPIRICAL FINDINGS

The findings are presented at this stage by divided into four parts; summary of the portfolios‘ descriptive statistics, results from empirical test using VAR model, asymmetric regression and Dimson market beta regression.

4.1 Descriptive Statistics

Table 1 and Table 2 present the descriptive statistics of portfolios formed by two different sorting methods.

Table 1 presents descriptive statistics for 16 size-foreign ownership portfolios. The equal weighted average daily returns of stocks are calculated within each portfolio. The evidence shows that returns of portfolios in smallest size are highest (0.17, 0.11, 0.07, 0.12, respectively) and vary across the other sizes. Therefore, the remaining size effect is small enough to further analyze the16 market value-foreign ownership portfolios. Within each firm size quartile, the average portfolio returns among subgroups show no systematic variation across foreign institutional ownership groups so the mean portfolio returns do not suggest any relationship between foreign ownership and average stock returns.

Table 1 Summary Statistics for Size-Foreign Ownership Portfolios

Summary statistics for size-foreign ownership portfolios are computed over 2001-2008. Stocks are classified into four groups according to the market value of equity at the beginning of each quarter from 2001 to 2008. Within each market value quartile, we further classify stocks into four subgroups according to foreign ownership. FRij refers to a size-foreign ownership portfolio of size i and foreign ownership j. i=1 refers to the smallest size portfolio and i=4 refers to the largest size portfolio. Similarly j=1 refers to the lowest foreign ownership and j=4 refers to the highest foreign ownership portfolio. For each portfolio, we calculate equal-weighted mean daily returns. Statistics of portfolio size, foreign ownership and trading volume are obtained as follows: First, the cross-sectional statistics (median and mean) of size, foreign ownership and trading volume are computed for each portfolio for each quarter. Then the yearly cross-sectional statistics of each portfolio are averaged over time and reported below. *N* refers to the average number of firms in each portfolio each quarter. The size figures are in millions of Baht. Foreign ownership numbers represent as a percentage of total shares. Trading volume shows as a percentage of turnovers. Table also shows first-order autocorrelation, and the sum of the first 10 autocorrelations.

Market Value of Equity Quartile	*Foreign Ownership Quartile*		*Statistics for Daily Returns*					*Foreign Ownership (%)*		*Market value (millions)*		*Trading Volume (%)*	
			Mean (%)	*Std. Dev. (%)*	*First order autocorrelation*	*Sum of first 10 autocorrelation*	*N*	*Med.*	*Mean*	*Med.*	*Mean*	*Med.*	*Mean*
1 (Smallest)	1 (L)	FR11	0.17	2.43	-0.11	0.13	26	0.04	0.06	185.00	205.69	0.193	1.860
	2	FR12	0.11	1.69	0.02	0.17	26	0.89	1.13	243.21	243.69	0.210	1.585
	3	FR13	0.07	1.60	0.01	0.21	26	5.29	6.22	252.92	256.26	0.086	1.279
	4 (H)	FR14	0.12	1.87	-0.06	0.16	26	36.81	36.96	264.31	253.99	0.171	1.334
2	1 (L)	FR21	0.05	1.40	0.07	0.31	26	0.30	0.37	756.73	810.59	0.412	3.986
	2	FR22	0.01	1.38	0.01	0.26	26	2.60	2.95	783.44	825.86	0.478	3.976
	3	FR23	0.04	1.35	0.04	0.22	26	11.33	12.06	859.33	875.13	0.267	7.553
	4 (H)	FR24	0.07	1.31	0.07	0.31	26	35.36	38.09	774.66	816.12	0.182	1.493
3	1 (L)	FR31	0.01	1.37	0.06	0.25	26	1.13	1.36	2039.27	2287.84	0.526	2.380
	2	FR32	0.01	1.44	0.07	0.25	26	7.96	8.03	2285.00	2416.01	0.573	6.621
	3	FR33	0.01	1.30	0.06	0.27	26	19.82	20.46	2474.76	2560.55	0.347	2.020
	4 (H)	FR34	0.02	1.25	0.09	0.30	26	46.18	49.48	2571.42	2653.70	0.130	0.980
4 (Largest)	1 (L)	FR41	-0.04	1.50	0.11	0.26	26	5.98	6.55	8664.63	17335.41	0.346	3.343
	2	FR42	0.03	1.37	0.09	0.24	26	20.80	20.64	9359.23	49531.06	0.260	0.838
	3	FR43	0.02	1.60	0.06	0.17	26	33.59	33.86	16723.81	33984.15	0.339	0.790
	4 (H)	FR44	0.01	1.38	0.06	0.14	26	48.66	55.89	11324.49	28622.63	0.219	0.517

Table 2 Summary Statistics for Size-Foreign Limit Portfolios

Summary statistics for size-foreign limit portfolios are computed over 2001-2008. Stocks are classified into four groups according to the market value of equity at the beginning of each quarter from 2001 to 2008. Within each market value quartile, we further classify stocks into four subgroups according to foreign limit. LRij refers to a size-foreign limit portfolio of size i and foreign limit j. i=1 refers to the smallest size portfolio and i=4 refers to the largest size portfolio. Similarly j=1 refers to the lowest foreign limit and j=4 refers to the highest foreign limit portfolio. For each portfolio, we calculate equal-weighted mean daily returns. Statistics of portfolio size, foreign limit and trading volume are obtained as follows: First, the cross-sectional statistics (median and mean) of size, foreign limit and trading volume are computed for each portfolio for each quarter. Then the yearly cross-sectional statistics of each portfolio are averaged over time and reported below. *N* refers to the average number of firms in each portfolio each quarter. The size figures are in millions of Baht. Foreign limit numbers represent as a % of shares. Trading volume shows as a percentage of turnovers. Table also shows first-order autocorrelation, and the sum of the first 10 autocorrelations.

Market Value of Equity Quartile	*Foreign Limit Quartile*		*Statistics for Daily Returns*					*Foreign Limit (%)*		*Market value (millions)*		*Trading Volume (%)*	
			Mean (%)	*Std. Dev. (%)*	*First order autocorrelation*	*Sum of first 10 autocorrelation*	*N*	*Med.*	*Mean*	*Med.*	*Mean*	*Med.*	*Mean*
1 (Smallest)	1 (L)	LR11	0.10	2.16	-0.14	0.03	26	25.00	23.92	216.03	219.48	0.094	0.986
	2	LR12	0.15	1.91	0.01	0.21	26	33.68	34.68	204.89	220.33	0.073	1.916
	3	LR13	0.20	1.97	0.15	-0.09	26	48.93	47.29	166.19	183.04	0.238	1.500
	4 (H)	LR14	0.06	1.58	-0.01	-0.51	26	49.00	53.89	350.50	335.14	0.302	1.714
2	1 (L)	LR21	0.04	1.18	0.11	0.29	26	27.86	27.79	724.05	790.71	0.104	1.261
	2	LR22	0.04	1.42	0.25	0.17	26	43.88	42.32	668.76	722.31	0.313	6.378
	3	LR23	0.05	1.34	0.16	0.32	26	48.68	48.36	760.54	781.36	0.450	4.235
	4 (H)	LR24	0.02	1.45	0.36	0.31	26	49.00	58.22	1075.79	1038.72	0.650	4.575
3	1 (L)	LR31	0.06	1.10	0.31	0.34	26	28.84	27.92	2404.92	2536.79	0.205	1.394
	2	LR32	0.00	1.34	0.31	0.46	26	43.16	43.23	1807.77	2083.46	0.474	2.510
	3	LR33	-0.01	1.50	0.37	0.33	26	49.00	49.00	2121.44	2133.10	0.621	4.729
	4 (H)	LR34	0.00	1.45	0.15	0.15	26	49.04	61.29	3254.78	3179.58	0.274	4.786
4 (Largest)	1 (L)	LR41	0.03	1.31	0.24	0.43	26	25.00	25.18	9522.02	34177.31	0.219	0.900
	2	LR42	0.03	1.56	0.21	0.29	26	38.64	37.48	19894.35	56713.87	0.294	1.077
	3	LR43	-0.02	1.49	0.33	0.45	26	49.00	48.72	6392.07	17946.33	0.274	1.152
	4 (H)	LR44	-0.01	1.50	0.27	0.51	26	49.00	63.61	14801.29	20378.82	0.367	0.966

Although there is no clear cross-sectional relation between average portfolio returns and foreign ownership, there seems to be a weak negative relation between the average volatility of portfolio returns and foreign ownership. This negative relation suggests either that foreigner prefer less volatile stocks[3], or that higher foreign ownership stabilizes the return volatility of the underlying stocks. The first-order autocorrelation and the sum of the first ten autocorrelations of daily returns have no relation to the level of foreign ownership and firm size. The first-order autocorrelation in daily portfolio returns seem to be unrelated with foreign ownership in each size and most of them are positive. Moreover, the sum of the first 10 autocorrelations of the daily portfolio returns is positive.

Table 1 shows that within each market value quartile, the mean market value increases with foreign ownership. Thus, even after we control for the market value of equity, the size effect remains among subgroups classified by foreign ownership. However, the differences in market value among subgroups within each market value quartile are relatively small compared to the differences across market value groups while trading volume exhibits an inverse relation with foreign ownership.

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[3] For example, Kang and Stulz (1997) show that foreign investors in Japan overweight shares of firms in manufacturing industries, large firms, firms with good accounting performance, firms with low unsystematic risk, and firms with low leverage. Dalquist and Robertson (2001) show that foreign investors in Sweden prefer to hold stocks of large firms, firms paying low dividends, and firms with large cash positions on their balance sheets. They also find that market liquidity and presence in international markets characterize foreign holdings better than firm size alone.

Table 2 presents descriptive statistics on the 16 size-foreign limit portfolios. The equal weighted daily mean returns of stocks are negatively related to firm size and highest in the smallest size. Within each firm size quartile, the average portfolio returns among subgroups show no monotonic variation across foreign limit groups so the mean portfolio returns do not suggest any relationship between foreign limit and average stock returns. While average volatility roughly decreases with foreign limit within the second, third and forth market quartile, it seems to increase with foreign limit in the first market quartile. The first-order autocorrelation in daily portfolio returns seem to be unrelated with foreign limit in each size and most of them are also positive except for portfolio LR11 (-0.14) and LR14 (-0.01). The sum of the first ten autocorrelations of the daily portfolio returns is positive, but except for two portfolios in the smallest size. The median and mean foreign limit does not increase across the same foreign limit portfolio with different size quartile. Moreover, median and mean market values of portfolios suggest no clear relationship with the foreign limit while the median and mean of trading volume is positively related to foreign limit.

If security prices adjust slowly to information, then price increases (decreases) will be followed by increases (decreases). This would give rise to positive autocorrelation in stock returns. The portfolio autocorrelation evidence in Table 1 and Table 2 (except for two portfolios of size 1) is consistent with the hypothesis that returns of stocks with high foreign ownership and foreign limit adjust faster to common information.

Even if the autocorrelation evidence is consistent with the hypothesis that the prices of high foreign ownership stocks adjust more rapidly to information, it is

important to point out that autocorrelations are not likely to provide unambiguous inferences on the differences in speed of adjustment. To see this clearly, consider two stocks A and B. Suppose that the return on stock A responds to both today‘s market information and yesterday‘s market information and the return on stock B responds only to yesterday‘s market information. Stock A, which adjusts faster to information, would exhibit positive autocorrelation in daily returns. On the other hand, stock B, which adjusts more slowly to information, would exhibit *zero* autocorrelation. Cross-autocorrelations, on the other hand, do not suffer from this problem. Therefore, in the rest of the paper, we focus our attention on differences in cross-autocorrelations.

Table 3 Number of lags by Akaike Information Criteria

FRij refers to a size-foreign ownership portfolio of size i and foreign ownership j. i=1 refers to the smallest size portfolio and i=4 refers to the largest size portfolio. Similarly j=L refers to the lowest foreign ownership and j=H refers to the highest foreign ownership portfolio. LRij refers to a size-foreign limit portfolio of size i and foreign limit j. i=1 refers to the smallest size portfolio and i=4 refers to the largest size portfolio. Similarly j=L refers to the lowest foreign limit and j=H refers to the highest foreign limit portfolio.

	Number of lags
Panel A: Size-Foreign Ownership Portfolios	
FR1L and FR1H	7
FR2L and FR2H	3
FR3L and FR3H	4
FR4L and FR4H	3
Panel B: Size-Foreign Limit Portfolios	
LR1L and LR1H	4
LR2L and LR2H	3
LR3L and LR3H	5
LR4L and LR4H	2

4.2 Vector Autoregression

The paper estimates the VAR using daily returns of two extreme foreign ownership (foreign limit) portfolios in each size quartile. In performing VAR, this paper use the time-series data so the paper will, firstly, perform a test of stationary using Augmented Dickey-Fuller test for preventing the results from the spurious regression problem stem from nonstationary time-series and its result is presented in Appendix. After that, the numbers of suitable lags have to be figure out by using Akaike Information Criteria (AIC). The preferred model is the one with the lowest AIC value because AIC relates to Sum of Squared Residual (SSR) and those models will provide lowest Sum of Squared Residual (SSR). The result of suitable number of lags is presented in Table 3.

Table 4 Vector Autoregression

The following VAR is estimated using daily data from 2001-2008:

$$r_{L,t} = a_0 + \sum_{k=1}^{K} a_k r_{L,t-k} + \sum_{k=1}^{K} b_k r_{H,t-k} + u_t$$

$$r_{H,t} = c_0 + \sum_{k=1}^{K} c_k r_{L,t-k} + \sum_{k=1}^{K} d_k r_{H,t-k} + v_t$$

The LHS variable is the returns on the lowest or the highest foreign ownership (foreign limit) portfolio within each size quartile. Low and High represent the sum of the slope coefficients of the lagged returns on the low foreign ownership (foreign limit) portfolio and lagged returns on the high foreign ownership (foreign limit) portfolio, respectively. L(-1) and H(-1) represent the slope coefficients of the one-lag returns of the low foreign ownership (foreign limit) portfolio and the high foreign ownership (foreign limit) portfolio (a_1 and b_1 or c_1 and d_1), respectively. Adj. R-square is the adjusted coefficient of determination. *t-statistics* and *F-statistics* are

calculated to test on whether the slope coefficients on lagged returns are significantly different from zero. Z(A) is the Z-statistic corresponding to the cross-equation null hypothesis $\sum_{k=1}^{K} b_k = \sum_{k=1}^{K} c_k$ in each bivariate VAR. The alternative hypothesis is $\sum_{k=1}^{K} b_k > \sum_{k=1}^{K} c_k$. The significance levels for Z(A) are based on upper-tail tests. All statistics are computed based on White heteroskedasticity corrected standard errors. Panel A presents VAR results using daily returns of size-foreign ownership portfolios. Panel B presents VAR results using daily returns of size-foreign limit portfolios *, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Panel A: Size-Foreign Ownership Portfolios						
LHS	L(-1)	Low	H(-1)	High	Adj. R-square	Z(A)
FR1L	-0.12***	-0.03	0.06*	0.22**	0.0265	-0.92
FR1H	0.05**	0.23***	-0.09***	-0.02	0.0223	
FR2L	0.04	0.19***	0.03	0.07	0.0192	-76.61***
FR2H	0.07**	0.21***	0.01	0.04	0.0207	
FR3L	-0.01	0.14**	0.10*	0.05	0.0163	-82.50***
FR3H	0.04	0.25***	0.04	0.02	0.0248	
FR4L	0.07*	0.22**	0.02	0.01	0.0202	-25.19***
FR4H	-0.02	0.08	0.07	0.07	0.0067	
Panel B: Size-Foreign Limit Portfolios						
LHS	L(-1)	Low	H(-1)	High	Adj. R-square	Z(A)
LR1L	-0.17	-0.24	0.12	0.25*	0.0309	10.06***
LR1H	0.09***	0.22***	-0.07*	-0.02	0.0223	
LR2L	-0.05	0.04	0.08**	0.13**	0.0150	47.65***
LR2H	0.00	0.02	0.09**	0.23***	0.0201	
LR3L	0.04	-0.04	0.02	0.17***	0.0145	30.42***
LR3H	0.08	0.07	0.00	0.20**	0.0154	
LR4L	0.02	0.01	0.04	0.11	0.0083	4.86***
LR4H	0.11	0.09	-0.01	0.11	0.0171	

After acquire the suitable number of lags, we estimate VAR using the according lags. All regressions are estimated with the White heteroskedasticity correction for standard errors. The White correction and the use of lagged dependent variables as regressors result in the use of asymptotic statistics for making statistical inferences. Table 4 presents the result from VAR regressions. Low and High represent the sum of the slope coefficients of the lagged returns on the low volume portfolio and the lagged returns on the high volume portfolio, respectively. L(-1) and H(-1) represent the slope coefficients of the one-lag returns of the low volume portfolio and the high volume portfolio (a_1, b_1, c_1 and d_1), respectively. Panel A presents VAR results using daily returns of size-foreign ownership portfolios, Panel B presents VAR results using daily returns of size-foreign limit portfolios and Panel C presents VAR results using daily returns of size-volume portfolios

Panel A summaries the result from four VAR regressions with respect to foreign ownership. Firstly, the result shows that lagged returns on high foreign ownership portfolio (High) can weakly predict current returns on both low and high foreign ownership portfolios in each size quartile except for portfolio FR1H (-0.02) since most of them are positive but only one of them is statistically significant (0.22). In contrast, lagged returns on low foreign ownership portfolio (Low) can predict current returns on both low and high foreign ownership portfolios because most of the sums of the slope coefficients corresponding to lagged returns of low foreign ownership portfolio (Low) is positive and statistically significant (i.e., 0.23, 0.19 and 0.21).

Secondly, the paper is focusing on the low foreign ownership portfolios (FR1L, FR2L, FR3L and FR4L). The sum of the slope coefficients corresponding to lagged returns of high foreign ownership portfolio (High) is positive (i.e., 0.07, 0.05 and 0.01) but only one of them (0.22) is statistically significant. Conversely, the sum of the slope coefficients corresponding to their own lagged returns (Low) is positive and statistically significant (0.19, 0.14 and 0.22). Moreover, in each low foreign ownership portfolio, the sums of slope coefficient responding to lagged of low foreign ownership portfolios (Low) is greater than the sums of slope coefficient responding to lagged of high foreign ownership portfolios (High) except only for portfolio FR1L. So, current returns on low foreign ownership portfolio tend to correlate to their own lagged returns rather than to lagged returns on high foreign ownership portfolio.

On the other hand, when focusing on high foreign ownership portfolio (FR1H, FR2H, FR3H and FR4H), the sums of the slope coefficients corresponding to lagged returns of low foreign ownership portfolio (Low) is positive and significant at the one percent level (0.23, 0.21 and 0.25) in every size quartile, except for portfolio FR4H (0.08). Furthermore, in each high foreign ownership portfolio, the sums of slope coefficient responding to their own lagged returns (High) is statistically insignificant and lower than the sums of slope coefficient responding to lagged of low foreign ownership portfolios (Low). So, current returns on high foreign ownership portfolio seem to correlate to lagged returns on low foreign ownership portfolio more than their own lagged returns.

Even though, the above evidences report inversely result as expected in hypothesis, the paper still test formally whether the ability of lagged high foreign

ownership portfolio returns, $r_{H,t-1}$, to predict current low foreign ownership returns, $r_{L,t}$, is better than the ability of lagged low foreign ownership portfolio returns, $r_{L,t-1}$, to predict current high foreign ownership portfolio returns, $r_{H,t}$. In brief, the paper calculates the asymptotic Z-statistic, Z(A), to test the null hypothesis that the sums of the slope coefficients across equations are equal ($\sum_{k=1}^{K} b_k = \sum_{k=1}^{K} c_k$) against the alternative hypothesis ($\sum_{k=1}^{K} b_k > \sum_{k=1}^{K} c_k$) . The null hypothesis is accepted in each size quartile. However, when adjust the alternative hypothesis to be $\sum_{k=1}^{K} b_k < \sum_{k=1}^{K} c_k$, the null hypothesis is rejected in every size quartile. Overall, the results provide strong evidence that returns on low foreign ownership portfolios lead returns on high foreign ownership portfolios rather than inversely. The economic implication of these results is returns on stocks with higher local investor holdings lead returns on stocks with lower local investor holdings and local investors seem to adjust faster to new information than foreign investors in aspect of lead-lag relation. The results imply that, if considering the lead-lag relation, foreign investors measured by foreign ownership seem to be less informed and do not have the information advantage over local investors in Thailand which affirm many prior research (see e.g. Kang and Stulz (1997), Choe, Kho and Stulz (2005) and Dvorak (2005))

Panel B summaries the result from four VAR regressions regarding foreign restriction or foreign limit. Firstly, the result shows that lagged returns on high foreign limit portfolio (High) can strongly predict current returns on both low and high foreign limit portfolios in each size quartile except for portfolio LR1H (-0.02) since most of sums of the slope coefficients corresponding to lagged returns of high foreign limit portfolio (High) are positive and five of them is statistically significant (0.25,

0.13, 0.23, 0.17 and 0.20). In contrast, lagged returns on low foreign limit portfolio (Low) can weakly predict current returns on both low and high foreign limit portfolios because almost all of sums of the slope coefficients corresponding to lagged returns of low foreign limit portfolio (Low) statistically insignificant.

When concerning on the low foreign limit portfolios (LR1L, LR2L, LR3L and LR4L), the sum of the slope coefficients corresponding to lagged returns of high foreign limit portfolio (High) is not only positive but also statistically significant (i.e., 0.25, 0.13 and 0.17). Conversely, the sum of the slope coefficients corresponding to their own lagged returns (Low) is positive only in LR2L and LR4L (0.04 and 0.01, respectively) but none of them is statistically significant. Moreover, in each low foreign limit portfolio, the sums of slope coefficient responding to lagged of high foreign limit portfolios (High) is greater than the sums of slope coefficient responding to lagged of low foreign limit portfolios (Low). Thus, current returns on low foreign limit portfolio tend to correlate to lagged returns on high foreign limit portfolio rather than to their own lagged returns.

Nonetheless, when looking on high foreign limit portfolio (LR1H, LR2H, LR3H and LR4H), the sums of the slope coefficients corresponding to lagged returns of low foreign limit portfolio (Low) are positive (0.02, 0.07 and 0.09) in every size quartile but significant at the one percent level (0.22) in size quartile 1. In addition, the sums of slope coefficient responding to their own lagged returns (High) are positive (0.11) and statistically insignificant (0.23 and 0.20) but it is closely to zero (-0.02) in size quartile 1. In each size quartile but size quartile 1, the sums of slope coefficient responding to their own lagged returns (High) is higher than the sums of

slope coefficient responding to lagged of low foreign limit portfolios (Low). Therefore, current returns on high foreign limit portfolio seem to correlate to their own lagged more than lagged returns on low foreign limit portfolio returns except for size quartile 1.

Then, the paper is continuing by focusing on the ability of lagged returns on high foreign limit portfolio in predicting current returns on low foreign limit portfolio. The paper test formally whether the ability of lagged high foreign limit portfolio returns, $r_{iH,t-1}$, to predict current low foreign limit returns, $r_{iL,t}$, is better than the ability of lagged low foreign limit portfolio returns, $r_{iL,t-1}$, to predict current high foreign limit portfolio returns, $r_{iH,t}$. In every size quartile, the evidence shows that the sum of slope coefficients on portfolio H's lagged returns (High) in portfolio LR1L, LR2L, LR3L and LR4L (0.25, 0.13, 0.17 and 0.11) is greater than the sum of slope coefficients on portfolio L's lagged returns (Low) in portfolio LR1H, LR2H, LR3H and LR4H (0.22, 0.02, 0.07 and 0.09). In addition, the paper also calculates the asymptotic Z-statistic, Z(A), to test the null hypothesis that the sums of the slope coefficients across equations are equal ($\sum_{k=1}^{K} b_k = \sum_{k=1}^{K} c_k$) against the alternative hypothesis ($\sum_{k=1}^{K} b_k > \sum_{k=1}^{K} c_k$) . The null hypothesis is rejected in every size quartile. Overall, the results provide strong evidence that returns on high foreign limit portfolios lead returns on low foreign limit portfolios, but not vice versa. The economic implication of these results is returns on stocks with higher foreign limit or higher degree of accessibility lead returns on stocks with lower foreign limit or lower degree of accessibility. Stocks with higher degree of accessibility seem to adjust faster

to new information than with lower degree of accessibility in aspect of lead-lag relation.

On the whole, our result shows that a foreign limit is significant determinants of lead-lag cross-autocorrelations. This result indicates that common market information is incorporated first into the price of stocks that are relatively less restricted and then subsequently transmitted to other stocks. Thus, we cannot reject the idea that foreign ownership restriction creates an obstacle to information diffusion process. The evidence strengthens prior results (see e.g. Merton (1987) and Bae, Ozguz and Tan (2006)) that the importance of institutional restrictions in the information acquisition and dissemination process cause a slow diffusion of information.

The results of VAR are useful in comparing the speed of price adjustment by measuring speed of adjustment of two portfolios relative to one another. But we also examine further the asymmetric response of lead-lag relation to good and bad news by using the asymmetric regression.

4.3 Asymmetric Regression

At this stage, we analyze further the led-lag relation which is possible asymmetric between good and bad news by employing asymmetric regression. In testing hypothesis that good market-wide news travels more slowly than bad market-wide news, the contemporaneous beta corresponding to the positive returns of leading portfolio, $\beta_{B,0}^{UP}$, should be significantly lower than the contemporaneous beta corresponding to the negative returns of leading portfolio, $\beta_{B,0}^{DN}$. While the sum of the

lagged betas corresponding to positive returns of leading portfolio, $\sum_{k=1}^{K}\beta_{B,t-k}^{UP}$, should be significantly greater than the sum of the lagged betas corresponding to negative returns of portfolio, $\sum_{k=1}^{K}\beta_{B,t-k}^{DN}$ because it means the lagged portfolio's returns are corresponded more to contemporaneous negative returns and past positive returns of leading portfolio. Table 5 reports the estimates of asymmetric regression. LHS is slow adjustment portfolios' returns according to VAR. Panel A and B present the results of size-foreign ownership portfolios and size-foreign limit portfolios, respectively. All standard errors are corrected for generalized heteroskedasticity using the White correction.

The LHS variable is the returns on portfolio B that is led by another portfolio called A found in VAR. $D_{A,t-k}$ is a dummy variable and equals to one if $r_{A,t}$ is positive including zero, and zero otherwise. $\sum_{k=1}^{K}\beta_{B,t-k}$ is the sum of betas corresponding to their own lagged returns. $\beta_{B,0}^{UP}$ is the contemporaneous beta associated with the positive returns of portfolio A and $\beta_{B,0}^{DN}$ is the contemporaneous beta associated with the negative returns of portfolio A. $\sum_{k=1}^{K}\beta_{B,t-k}^{UP}$ is the sum of the lagged betas corresponding to positive returns of portfolio A, and $\sum_{k=1}^{K}\beta_{B,t-k}^{DN}$ is the sum of the lagged betas corresponding to negative returns of portfolio A. Adj. R-square is the adjusted coefficient of determination. *t-statistics* and *F-statistics* are calculated to test on whether the slope coefficients on lagged returns are significantly different from zero. F_1 is F-statistic corresponding to the null hypothesis that $\beta_{B,0}^{UP} = \beta_{B,0}^{DN}$ against the alternative hypothesis that $\beta_{B,0}^{UP} < \beta_{B,0}^{DN}$. F_2 is F-statistic corresponding to the null hypothesis $\sum_{k=1}^{K}\beta_{B,t-k}^{UP} = \sum_{k=1}^{K}\beta_{B,t-k}^{DN}$ against the alternative hypothesis

that $\sum_{k=1}^{K}\beta_{B,t-k}^{UP} > \sum_{k=1}^{K}\beta_{B,t-k}^{DN}$. All statistics are computed based on White heteroskedasticity corrected standard errors. Panel A presents results using daily returns of size-foreign ownership portfolios. Panel B presents results using daily returns of size-foreign limit portfolios. *, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Table 5 Asymmetric Regression

The following regression is estimated to examine the asymmetric response of the returns of one portfolio to positive and negative returns of the other portfolio for the sample period from January 2001 to December 2008:

$$r_{B,t} = \alpha_0 + \sum_{k=1}^{K}\beta_{B,t-k}r_{B,t-k} + \sum_{k=0}^{K}\beta_{B,t-k}^{UP}(r_{A,t-k} \times D_{A,t-k}) + \sum_{k=0}^{K}\beta_{B,t-k}^{DN}(r_{A,t-k} \times (1 - D_{A,t-k})) + u_{B,t}$$

Panel A: Size-Foreign Ownership Portfolios

LHS	$\sum_{k=1}^{K}\beta_{B,t-k}$	$\beta_{B,0}^{UP}$	$\sum_{k=1}^{K}\beta_{B,t-k}^{UP}$	$\beta_{B,0}^{DN}$	$\sum_{k=1}^{K}\beta_{B,t-k}^{DN}$	Adj R-square	F_1	F_2
FR1H	-0.0634	0.1232*	0.2868***	0.3903***	0.1565	0.1237	6.5354**	1.2470
FR2H	0.0166	0.4408***	0.2106***	0.6659***	-0.0306	0.3909	5.0464**	6.3015**
FR3H	-0.0393	0.4916***	0.1694***	0.7369***	0.1244*	0.5063	7.3335***	0.4041
FR4H	0.0614	0.7321***	-0.0626	0.8167***	-0.1383	0.7117	1.9738	0.6103

Panel B: Size-Foreign Limit Portfolios

LHS	$\sum_{k=1}^{K}\beta_{B,t-k}$	$\beta_{B,0}^{UP}$	$\sum_{k=1}^{K}\beta_{B,t-k}^{UP}$	$\beta_{B,0}^{DN}$	$\sum_{k=1}^{K}\beta_{B,t-k}^{DN}$	Adj R-square	F_1	F_2
LR1L	-0.3354	0.3889***	0.4733***	0.6690***	0.0028	0.1921	7.4679***	4.0933**
LR2L	0.0252	0.3276***	0.0550	0.6493***	-0.0552	0.4107	17.4911***	1.8986
LR3L	-0.0733	0.4643***	0.1691**	0.5851***	-0.0193	0.5083	2.7128*	4.7918**
LR4L	-0.0600	0.6836***	0.0584	0.7821***	-0.0671	0.7206	1.8329	3.1967*

Panel A of Table 5 reports the results of size-foreign ownership portfolios. It shows that returns of high foreign ownership portfolios (FR1H, FR2H FR3H and FR4H) are significantly positively correlated with both positive and negative contemporaneous returns of low foreign ownership portfolios (FR1L, FR2L FR3L and FR4L) since all of $\beta_{B,0}^{UP}$ and $\beta_{B,0}^{DN}$ are significantly positive. However, the sum of the lagged betas corresponding to positive returns of low foreign ownership portfolios. $\sum_{k=1}^{K}\beta_{B,t-k}^{UP}$, is significantly positive (0.2868, 0.2106 and 0.1694) in size quartile 1, 2 and 3, but it is close to zero (-0.0626) in size quartile 4. The sum of the lagged betas corresponding to negative returns of low foreign ownership portfolio is positive (0.1565 and 0.1244) in size quartile 1 and 3 and negative (-0.0306 and -0.1383) in size quartile 2 and 4. For hypothesis testing, even if F_1 shows that the null hypothesis of $\beta_{B,0}^{UP} = \beta_{B,0}^{DN}$ is rejected in size quartile 1, 2 and 4, but F_2 reports that the null hypothesis $\sum_{k=1}^{K}\beta_{B,t-k}^{UP} = \sum_{k=1}^{K}\beta_{B,t-k}^{DN}$ is rejected only in size quartile 2. Therefore, we conclude that, generally, there is no significantly different effect between good and bad market-wide information on the speed of price adjustment.

Panel B of Table 5 reports the results of size-foreign limit portfolios. It shows that returns of low foreign limit portfolios (LR1L, LR2L LR3L and LR4L) are significantly positively correlated with both positive and negative contemporaneous returns of high foreign limit portfolios (LR1H, LR2H LR3H and LR4H) since all of $\beta_{B,0}^{UP}$ and $\beta_{B,0}^{DN}$ are significantly positive (i.e., 0.3889, 0.6690 and 0.6836). Nonetheless, the sum of the lagged betas corresponding to positive returns of low foreign limit portfolio, $\sum_{k=1}^{K}\beta_{B,t-k}^{UP}$, is positive (0.0550 and 0.0584) in size quartile 2and 4, and significantly positive (0.4733 and 0.1691) in size quartile 1 and 4. The sum of the

lagged betas corresponding to negative returns of low foreign limit portfolio is close to zero (i.e., -0.0552, -0.0193 and -0.0671) in every size quartile. For hypothesis testing, F_1 shows that the null hypothesis of $\beta_{B,0}^{UP} = \beta_{B,0}^{DN}$ is rejected in size quartile 1, 2 and 3, while F_2 reports that the null hypothesis $\sum_{k=1}^{K}\beta_{B,t-k}^{UP} = \sum_{k=1}^{K}\beta_{B,t-k}^{DN}$ is rejected in size quartile 1, 3 and 4. Overall, we conclude that there is no significant difference in the speed of price adjustment to good and bad market-wide information.

At this point, we acquire the results of VAR and asymmetric regression which provide useful information in comparing the speed of price adjustment by measuring speed of adjustment of two portfolios relative to one another. Still, the paper also analyses further on the speed of price adjustment by performing Dimson market beta regressions which allow us to measure the speed of adjustment of each stock or portfolio relative to a single common benchmark, which is helpful in comparing the speed of adjustment across individual portfolios and market returns.

4.4 Dimson Beta Regressions

To further test the speed of price adjustment hypothesis, the paper use zero investment portfolios in the Dimson beta regressions. The zero investment portfolios are constructed by subtracting portfolio L from portfolio H. Since the hypotheses expect portfolio H's returns to adjust faster to common factor information than do portfolio L's returns, the contemporaneous betas from these regressions, $\beta_{O,0}$, should be positive and the sum of lagged betas should be negative ($\sum_{k=1}^{K}\beta_{O,t-k} < 0$). The intuition behind these restrictions is as follows. If the return on portfolio H responds more rapidly to common information than the return on portfolio L then its sensitivity to today's common information (market return) should be greater than that of

portfolio L. Therefore, the contemporaneous beta of the zero investment portfolios should be positive. Additionally, since portfolio L responds sluggishly to contemporaneous factor information (current market returns), it should respond more to past common factor information (lagged market returns). Therefore, the lagged betas of the zero investment portfolios should be negative.

The paper uses the value-weighted Stock Exchange of Thailand (SET) index's return as a proxy for the market common factor. All standard errors are corrected for generalized heteroskedasticity using the White correction. Table 6 presents results from Dimson beta regressions. Panel A reports results using size-foreign ownership portfolios. Panel B reports results using size-foreign limit portfolios.

Table 6 Dimson Beta Regressions

The following regression is estimated using daily data from 2001-2008:

$$r_{O,t} = \alpha_0 + \sum_{k=1}^{K} \beta_{O,t-k} r_{m,t-k} + \beta_{O,0} r_{m,t} + \sum_{k=1}^{K} \beta_{O,t+k} r_{m,t+k} + u_{O,t}$$

Where $r_{o,t}$ is the difference between returns on portfolio H and portfolio L within each market value quartile and r_m refers to market (SET) index returns. $\sum_{k=1}^{K} \beta_{O,t-k}$ refers to the sum of lagged betas, $\beta_{O,0}$ refers to the contemporaneous beta and $\sum_{k=1}^{K} \beta_{O,t+k}$ refers to the sum of leading betas. Adj. R-square is the adjusted coefficient of determination. The suitable number of lags also follows as used in VAR. All statistics are computed based on White heteroskedasticity corrected standard errors. *t-statistics* is calculated to test on whether the slope coefficients are significantly

different from zero. *, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Panel A: Size-Foreign Ownership Portfolios					
Market Value	LHS	$\sum_{k=1}^{K}\beta_{O,t-k}$	$\beta_{O,0}$	$\sum_{k=1}^{K}\beta_{O,t+k}$	Adj. R-square
1 (Smallest)	FR1H-FR1L	0.0365	-0.0706	-0.1123	0.0015
2	FR2H-FR2L	0.0390	-0.1171***	-0.0846*	0.0297
3	FR3H-FR3L	0.0424	-0.0365**	-0.0399	0.0057
4 (Largest)	FR4H-FR4L	-0.0741**	-0.0362**	-0.0229	0.0120
Panel B: Size-Foreign Limit Portfolios					
Market Value	LHS	$\sum_{k=1}^{K}\beta_{O,t-k}$	$\beta_{O,0}$	$\sum_{k=1}^{K}\beta_{O,t+k}$	Adj. R-square
1 (Smallest)	LR1H-LR1L	0.0490	0.0866**	-0.0537	0.0039
2	LR2H-LR2L	0.0551	0.1798***	0.0295	0.0529
3	LR3H-LR3L	0.0675**	0.2190***	0.0635*	0.0990
4 (Largest)	LR4H-LR4L	0.0586**	0.0969***	0.0061	0.0393

Panel A of Table 6 shows the results of the Dimson beta regression for the size-foreign ownership portfolios. The contemporary betas of the zero-investment portfolio, $\beta_{O,0}$, is negative in every size quartile and statistically significant (-0.1171, -0.0365 and -0.0362) in size quartiles 2, 3 and 4. Furthermore, the sum of lagged betas, $\sum_{k=1}^{K}\beta_{O,t-k}$, is positive (0.0365, 0.0390 and 0.0424) in size quartile 1, 2 and 3 but significantly negative (-0.0741) in size quartile 4. Therefore, the results in Panel A do not support the hypothesis that high foreign ownership portfolios respond faster to the new information than low foreign ownership portfolios. In contrast, the results seem to advocate that low foreign ownership portfolios respond more promptly to newly arrived information than high foreign ownership portfolios. The economic implication of the results is the cross-autocorrelations discovered in VAR that low foreign ownership stocks lead high foreign ownership stocks are driven by difference in the speed of price adjustment to common factor information.

Panel B of Table 6 provides the results of the Dimson beta regression for the size-foreign limit portfolios. The contemporary betas of the zero-investment portfolio, $\beta_{O,0}$, is positive and statistically significant (0.0866, 0.1798, 0.2190 and 0.0969) in every size quartile. While, the sum of lagged betas, $\sum_{k=1}^{K}\beta_{O,t-k}$, is also positive (0.0490 and 0.0551) in size quartile 1 and 2 but significantly positive (0.0675 and 0.0586) in size quartile 3 and 4. Therefore, it cannot be concluded that the results in Panel B support the hypothesis that high foreign limit portfolios respond faster to the new information then low foreign limit portfolios, even if the contemporary beta is significantly positive but the sum of lagged betas is also positive too. Then, the economic implication of the results is the lead-lag relation between high foreign limit and low foreign limit portfolios found in VAR might not solely stem from the difference in the speed of price adjustment to market index returns as a proxy of common factor information.

4.5 Test of Robustness

Because we find an insignificant association between foreign ownership and the speed of price adjustment while there is a significant association between foreign limit and the speed of price adjustment, it is difficult to make a clear explanation of these results. We reconsider that foreign ownership and foreign limit might unexpectedly capture another firm‘s characteristic. As can be seen from Table 1 and 2, we find that median and mean of trading volume seem to be negatively correlated with foreign ownership and positively related to foreign limit after constructing portfolios so the paper turns to consider about other general arguments of the cause of cross-autocorrelation in returns of large firm and small firms still exist. As Chordia and Swaminathan (2000) suggest that it is possible that firm size might be a proxy for trading volume, the higher trading volume should lead stock prices to react faster to

the information because it is more liquid and easier to trade. And, they also show that lead-lag in stock returns in the US market stem from trading volume. Moreover, our prior results show the possibility that consistent with the speed of adjustment hypothesis, thus the paper will perform a further test of the relation between the speed of price adjustment and trading volume. The paper will test whether a lead-lag relation in Thailand, between large and small stocks, stem from trading volume since Thailand‘s stock market is also quite thin trade market compared with other emerging markets like Korea, Hong Kong and Indonesia so the volume of foreign trading and their ownership could yield the significant impact to the market (Bailey and Jagtiani (1993)) and the effects of these factors on the speed of price adjustment will be comparatively easier to show up if these relations exist.

Thus, the paper performs the VAR and Dimson market beta regressions to test whether returns on high volume portfolios lead returns on low volume portfolios and the lead-lag relation is due to returns on low volume portfolios adjust more sluggish to common market factor.

In constructing portfolios, all listed companies will be divided into four groups according to their market capitalization at the ended of each quarter. Then, stocks then will be classified into four subgroups based on their average daily trading volume by using turnover as the measure of trading volume following Chordia and Swaminathan (2000). Turnover is defined as the ratio of the number of shares traded in a day to the number of shares outstanding at the end of the day. Henceforth, trading volume refers to trading volume by turnover, unless otherwise stated. Within each market value quartile, the study assigns the stocks with the lowest trading volume as

subgroup ‗L,' and the stocks with the highest trading volume as subgroup ‗H'. Finally, the paper will employ these portfolios to test with above models.

Table 7 shows the suitable number of lags acquired by Akaike Information Criteria. So the paper uses number of lags according to Table 7 in performing VAR.

Table 7 Number of lags by Akaike Information Criteria of Size-Volume Portfolios

VRij refers to a size-volume portfolio of size i and volume j. i=1 refers to the smallest size portfolio and i=4 refers to the largest size portfolio. Similarly j=L refers to the lowest volume and j=H refers to the highest volume portfolio.

	Number of lags
VR1L and VR1H	12
VR2L and VR2H	11
VR3L and VR3H	13
VR4L and VR4H	3

Table 8 Vector Autoregression of Size-Volume Portfolios

The following VAR is estimated using daily data from 1998-2008:

$$r_{L,t} = a_0 + \sum_{k=1}^{K} a_k r_{L,t-k} + \sum_{k=1}^{K} b_k r_{H,t-k} + u_t$$

$$r_{H,t} = c_0 + \sum_{k=1}^{K} c_k r_{L,t-k} + \sum_{k=1}^{K} d_k r_{H,t-k} + v_t$$

The LHS variable is the return on the lowest or the highest volume, portfolio within each size quartile. Low and High represent the sum of the slope coefficients of the lagged returns on the low volume portfolio and the lagged returns on the high volume portfolio, respectively. L(-1) and H(-1) represent the slope coefficients of the one-lag returns of the low volume portfolio and the high volume portfolio (a_1 and b_1 or c_1 and d_1), respectively. Adj. R-square is the adjusted coefficient of determination. *t-statistics* and *F-statistics* are calculated to test on whether the slope coefficients on lagged returns are significantly different from zero. Z(A) is the *Z*-statistic corresponding to

the cross-equation null hypothesis $\sum_{k=1}^{K} b_k = \sum_{k=1}^{K} c_k$ in each bivariate VAR. The alternative hypothesis is $\sum_{k=1}^{K} b_k > \sum_{k=1}^{K} c_k$. The significance levels for Z(A) are based on upper-tail tests. All statistics are computed based on White heteroskedasticity corrected standard errors. *, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Size-Volume Portfolios						
LHS	L(-1)	Low	H(-1)	High	Adj. R-square	Z(A)
VR1L	-0.12***	-0.02	0.12***	0.21**	0.0300	29.09***
VR1H	0.01	0.13	0.09**	0.37***	0.0338	
VR2L	-0.02	0.01	0.08***	0.37***	0.0365	111.49***
VR2H	0.08**	0.10	0.04	0.33***	0.0340	
VR3L	0.01	0.09	0.02	0.10	0.0166	5.72***
VR3H	0.00	0.08	0.04**	0.25***	0.0235	
VR4L	0.00	-0.01	0.08***	0.12***	0.0245	23.63***
VR4H	0.05	0.07	0.07*	0.16*	0.0175	

Table 8 summaries the result from four VAR regressions in regard to trading volume by turnover. The result shows that lagged returns on high volume portfolio (High) can strongly predict current returns on both low and high volume portfolios in each size quartile since most of sums of the slope coefficients corresponding to lagged returns of high volume portfolio (High) are positive (i.e., 0.10, 0.12 and 0.16) and most of them are statistically significant (i.e., 0.21, 0.37 and 0.33). In contrast, lagged returns on low volume portfolio (Low) can weakly predict current returns on both low and high volume portfolios because sums of the slope coefficients corresponding to lagged returns of low volume portfolio (Low) are positive but some of them are close to zero (i.e., -0.02, 0.01 and-0.01) and all of them are statistically insignificant.

If taking into account only the low volume portfolios (VR1L, VR2L, VR3L and VR4L), the sum of the slope coefficients corresponding to lagged returns of high volume portfolio (High) is not only positive (i.e., 0.10 and 0.37) but also statistically significant (0.21, 0.37 and 0.12). Conversely, the sum of the slope coefficients corresponding to their own lagged returns (Low) is positive (0.09) only in portfolio VR3L and closely to zero (-0.02, 0.01 and -0.01, respectively) in portfolios VR1L, VR2L and VR4L. But none of them is statistically significant. Overall, in each low volume portfolio, the sums of slope coefficient responding to lagged of high volume portfolios (High) is greater than the sums of slope coefficient responding to lagged of low volume portfolios (Low). Hence, current returns on low volume portfolio are correlated to lagged returns on high volume portfolio rather than to their own lagged returns.

While looking on high volume portfolio (VR1H, VR2H, VR3H and VR4H), the sums of the slope coefficients corresponding to lagged returns of low volume portfolio (Low) are positive (0.13, 0.10, 0.08 and 0.07) in every size quartile but none of them is statistically significant. Besides, the sums of slope coefficient responding to their own lagged returns (High) are positive and statistically insignificant (0.37, 0.33, 0.25 and 0.16) in every size quartile. Also, in each size quartile, the sum of slope coefficient responding to their own lagged returns (High) is higher than the sums of slope coefficient responding to lagged of low volume portfolios (Low). Therefore, current returns on high volume portfolio are more predictable by their own lagged returns than lagged returns on low volume portfolio.

After that, the paper test formally whether the ability of lagged high volume portfolio returns, $r_{H,t-1}$, to predict current low volume returns, $r_{L,t}$, is better than the ability of lagged low volume portfolio returns, $r_{L,t-1}$, to predict current high volume portfolio returns, $r_{H,t}$. In every size quartile, the results indicate that the sum of slope coefficients on portfolio H's lagged returns (High) in portfolio VR1L, VR2L, VR3L and VR4L (0.21, 0.37, 0.10 and 0.12) is greater than the sum of slope coefficients on portfolio L's lagged returns (Low) in portfolio VR1H, VR2H, VR3H and VR4H (0.13, 0.10, 0.08 and 0.07). Moreover, the paper also calculates the asymptotic Z-statistic, Z(A), to test the null hypothesis that the sums of the slope coefficients across equations are equal ($\sum_{k=1}^{K} b_k = \sum_{k=1}^{K} c_k$) against the alternative hypothesis ($\sum_{k=1}^{K} b_k > \sum_{k=1}^{K} c_k$) . The null hypothesis is rejected at one percent significant level in every size quartile. Therefore, the results provide strong evidence that returns on high volume portfolios lead returns on low volume portfolios, but not vice versa. The economic implication of these results is returns on stocks with higher trading volume seem to adjust to new information faster than with lower trading volume in aspect of lead-lag relation.

Table 9 Dimson Beta Regressions of Size-Volume Portfolios

The following regression is estimated using daily data from 1998-2008:

$$r_{O,t} = \alpha_0 + \sum_{k=1}^{K} \beta_{O,t-k} r_{m,t-k} + \beta_{O,0} r_{m,t} + \sum_{k=1}^{K} \beta_{O,t+k} r_{m,t+k} + u_{O,t}$$

Where $r_{o,t}$ is the difference between returns on portfolio H and portfolio L within each market value quartile and r_m refers to market (SET) index returns. $\sum_{k=1}^{K} \beta_{O,t-k}$ refers to the sum of lagged betas, $\beta_{O,0}$ refers to the contemporaneous beta and

$\sum_{k=1}^{K}\beta_{O,t+k}$ refers to the sum of leading betas. Adj. R-square is the adjusted coefficient of determination. The suitable number of lags also follows as used in VAR. All statistics are computed based on White heteroskedasticity corrected standard errors. *t-statistics* is calculated to test on whether the slope coefficients are significantly different from zero. *, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Size-Volume Portfolios					
Market Value	LHS	$\sum_{k=1}^{K}\beta_{O,t-k}$	$\beta_{O,0}$	$\sum_{k=1}^{K}\beta_{O,t+k}$	Adj. R-square
1 (Smallest)	VR1H-VR1L	-0.1756	0.4985***	0.1922	0.0441
2	VR2H-VR2L	-0.1603	0.5186***	0.0122	0.1315
3	VR3H-VR3L	-0.1219***	0.7170***	0.1108	0.2953
4 (Largest)	VR4H-VR4L	-0.0092***	0.5926***	0.0821**	0.3511

Table 9 provides the results of the Dimson beta regression for the size-volume portfolios. The contemporary betas of the zero-investment portfolio, $\beta_{O,0}$, is positive and statistically significant (0.4985, 0.5186, 0.7170 and 0.5926) in every size quartile. Moreover, the sum of lagged betas, $\sum_{k=1}^{K}\beta_{O,t-k}$, is negative (-0.1756 and -0.1603) in size quartile 1 and 2 but significantly negative (-0.1219 and -0.0092) in size quartile 3 and 4. Therefore, the results in Panel B strongly support the hypothesis that high volume portfolios respond faster to the new information then low volume portfolios, because the contemporary beta is significantly positive and the sum of lagged betas is significantly negative. Then, the economic implication of the results is that the cross-autocorrelations observed between high trading volume and low trading volume stocks are driven by difference in the speed of price adjustment to common factor information.

CHAPTER 5

CONCLUSION

In this paper, we, firstly, pose a question whether foreign investors is better informed in Thailand so we examine a role of foreign investment on information diffusion in Thai capital market by investigating the lead-lag relation. By examining the lead-lag relation, we also test whether the lead-lag relation in size found in Thailand is originated by the difference in foreign ownership and foreign limit since the paper use the foreign ownership as a proxy of foreign investors following firms and the foreign limit measuring the severity of the segmentation affecting a stock in local market. The paper performs to test whether foreign ownership (foreign limit) has a significant influence on the speed of price adjustment and is due to the slow diffusion of common information across stocks. We also test the possible asymmetric response to the good market-wide news and bad market-wide news.

The paper finds that, if assuming the source of lead-lag relation comes from the difference in the speed of price adjustment to information and information advantages, foreign investors are not better informed compared to locals. Even if the level of foreign ownership is a significant determinant of the lead-lag cross-autocorrelation patterns in stock returns but it is opposite to our hypothesis. Returns on high foreign ownership portfolios seem to be led by returns on low foreign ownership portfolios, but not vice versa, and there is no significantly different between speed of price adjustment to good news and to bad news. Moreover, the evidence shows that the lead-lag relation between low foreign ownership and high

foreign ownership portfolios is caused by a slow diffusion of market-wide information represented by returns on market index. Even if our results provide additional support for the slow information diffusion hypothesis, the implication of our results is that the foreign investors in Thailand do not possess information advantage over local investors and do not lead stocks prices to faster adjustment to information.

In answering of the cause of the lead-lag relation between large and small size stocks in Thailand, it does not stem from the difference in the level of foreign ownership. So, the paper shows that the degree of accessibility or foreign limit has a positive effect on the speed of price adjustment to information. As hypothesis, we find that returns on high foreign limit portfolios lead returns on low foreign limit portfolios, but not vice versa. And further test shows that there is no significantly different between speed of price adjustment to good news and to bad news. Besides, the evidence shows that the lead-lag relation between low foreign ownership and high foreign ownership portfolios is caused by a slow diffusion of market-wide information represented by returns on market index. We interpret these results as providing additional support for the view of financial liberalization in terms of greater accessibility or higher foreign limit stocks will adjust to information faster than lower accessibility or lower foreign limit stocks. But it is not solely caused by the difference in the speed of price adjustment to common factor information represented by market index returns.

However, both of foreign ownership and foreign limit cannot solely be the cause of lead-lag relation in size found in Thailand, the paper finds that these factors

coincidentally capture the trading volume so we test whether trading volume can solely be the cause of lead-lag relation between large and small size stocks in Thailand. The results of VAR and Dimson beta regression show that returns of high volume stocks lead returns of low volume stocks even if after controlling for size effect, and the above lead-lag relation is due to the slow response of low volume stocks to the common or market-wide information.

For further studies, rather than controlling for size, the paper also recommends controlling for volume when constructing portfolios to perform a test of whether foreign or local investors are better informed.

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APPENDIX

Appendix

Table 10 Test of Stationary

FRij refers to a size-foreign ownership portfolio of size i and foreign ownership j. i=1 refers to the smallest size portfolio and i=4 refers to the largest size portfolio. Similarly j=L refers to the lowest foreign ownership and j=H refers to the highest foreign ownership portfolio. LRij refers to a size-foreign limit portfolio of size i and foreign limit j. i=1 refers to the smallest size portfolio and i=4 refers to the largest size portfolio. Similarly j=L refers to the lowest foreign limit and j=H refers to the highest foreign limit portfolio. VRij refers to a size-volume portfolio of size i and volume j. i=1 refers to the smallest size portfolio and i=4 refers to the largest size portfolio. Similarly j=L refers to the lowest volume and j=H refers to the highest volume portfolio. ADF Stat is the Augmented Dickey-Fuller test statistic and the critical values follow MacKinnon (1996). Null hypothesis is that a portfolio has a unit root. Lag length is automatically chosen according to Akaike Information Criteria. *, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Portfolio	ADF Stat	Portfolio	ADF Stat	Portfolio	ADF Stat
FR1L	-7.7084***	LR1L	-13.0826***	VR1L	-7.2656***
FR1H	-19.4162***	LR1H	-22.2630***	VR1H	-8.9748***
FR2L	-8.9667***	LR2L	-8.9938***	VR2L	-8.8729***
FR2H	-9.1165***	LR2H	-8.6901***	VR2H	-11.3397***
FR3L	-8.6840***	LR3L	-9.3500***	VR3L	-7.4663***
FR3H	-18.2929***	LR3H	-8.8676***	VR3H	-10.5354***
FR4L	-11.0808***	LR4L	-26.7108***	VR4L	-10.4563***
FR4H	-9.6263***	LR4H	-9.0582***	VR4H	-11.9344***

For preventing the results of VAR from the spurious regression problem stem from nonstationary time-series, this paper performs a test of stationary using Augmented Dickey-Fuller test and its result is presented in Table 10. Since we use

only two extreme portfolios in performing VAR, Table 10 exhibits only the result of two extreme portfolios.

Table 10 suggests that the Augmented Dickey-Fuller test statistic is significant at one percent level in every portfolio. The null hypothesis that there is a unit root is rejected for all portfolios so it can be concluded that the data is stationary.

BIOGRAPHY

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