PUEY UNGPHAKORN INSTITUTE
FOR ECONOMIC RESEARCH

Daily Movements in the Thai Yield Curve: Fundamental and Non-Fundamental Drivers

by

Jakree Koosakul

June 2016

Discussion Paper

No. 30

Daily Movements in the Thai Yield Curve: Fundamental and Non-Fundamental Drivers*

Jakree Koosakul

Bank of Thailand**

Abstract

This paper attempts to identify the key determinants of daily yield movements in the Thai government bond market. It finds that Thai short-term yield movements are solely driven by domestic factors, namely policy rate expectations and bond supply. By contrast, longer-tenor yields are also found to be affected by global factors, namely global monetary conditions and global risk appetite. Apart from these "fundamental" factors, the net-buying pressures of foreign players, and not those of domestic investors, are also found to exert significant influence over the Thai medium and long rates. Taken alone, this finding may appear somewhat alarming as it implies that foreign activity can be a significant source of market volatility. Further investigations suggest, however, that the detected foreign influence may be due to informational reasons; foreign investors lead yield movements because they provide price-relevant "private" information to the market. Viewed in this light, the detected foreign influence may not altogether be so detrimental, at least insofar as normal periods are concerned.

Keywords: sovereign bond yields, market microstructure, foreign participation

JEL classification: D82, E43, E44, G12

* The author is grateful to Wipawin Promboon, Piti Disyatat and Chanate Sarunchatinon for their insightful comments and constant support throughout the project. Special thanks also go to colleagues from the Financial Markets Department and participants at the PIER Research Exchange, especially Pawinee Chitmongkolsamur, Vilada Meeyam, Naruemol Wesaratchakit, Penluk Lothuvachai, Jarathvit Saitharnthong, Nawarat Tantisiriwat, Nasha Ananchotikul, Warapong Wongwachara, Kiatipong Ariyapruchya and Supachoke Thawornkaiwong. Lastly, the author is also thankful to the Thai Bond Market Association, whose dataset is heavily utilized in this paper. All remaining errors in the paper are the author's own.

** The views expressed in the paper do not necessarily reflect the views of the Bank of Thailand.

I. Introduction

The Thai bond market has grown significantly in the aftermath of the Asian financial crisis of 1997. In part, this reflects the authorities' attempt to develop an alternative financing avenue for the Thai economy, which up until the crisis had relied heavily on bank-based intermediation of mainly short-term external credit to finance long-term domestic investments. As illustrated during the crisis, such dependency was unhealthy for Thailand as it exposed the economy to a dual mismatch that eventually became problematic when investors lost confidence in the economy. This realization, coupled with the need to fiscalize the economy's post-crisis restructuring costs, became the motivation for the development of a deep and liquid local currency bond market in Thailand.

As a result of the ongoing efforts put in by the relevant stakeholders over the years[1], the Thai bond market is now not only an important financing avenue for the Thai economy[2], but also a market on which the central bank relies heavily in its conduct of monetary policy. Despite its growing importance, an understanding of the factors that drive yield movements remains mainly based on event-specific analyses and observations. In addition, there has also been no systematic attempt to study the heterogeneous behavior of different players in the market in relation to their tendency to lead price movements.

Having a clear understanding of what moves bond yields is important for several reasons. For one, such information allows policymakers to be more informed of the constraints that they face in their policy conduct and what they can do to maneuver around such limitations. For example, if global factors are found to be an important driver of domestic bond yields to the extent that this is likely to complicate the asset price channel of monetary policy in certain circumstances, then perhaps other policy options may be more suitable to achieve the central bank's objective in such situations. In addition, a better understanding of the role played by the different types of investors in the price determination process may be useful for crafting policies to deepen the bond market further. For example, while foreign investors are often viewed as a significant source of market volatility, their presence could have benefits in terms of providing liquidity or leading price discovery in the market. Viewed in this light, one may need to reconsider policies aimed at limiting foreign participation.

---

[1] These range from the establishment of the necessary infrastructures, such as the development of the government bond yield curve and the improvement of the primary dealer and bidding system, to the development of complimentary markets such as the private repo market. To a certain extent, the deepening of the market has also benefited from several regional efforts, such as the Asia Bond Markets Initiative (ABMI) through ASEAN+3 and the Asian Bond Fund (ABF) initiative through EMEAP.

[2] As depicted in Figure A in the Appendix, the Thai bond market has experienced remarkable growth over the years and is now gradually approaching the size of both the stock market and the banking sector, which are traditional financing avenues for the Thai economy.

With this motivation, this paper aims to provide some preliminary stylized facts about such information. More specifically, the objectives of this paper are twofold. Firstly, taking the traditional view that asset price movements are ultimately governed by macroeconomic and, to a certain extent, financial factors (which are collectively considered "fundamental factors" in this paper), the paper investigates *which* of these factors are the most relevant in explaining the day-to-day movements of the different tenors of the Thai government bond yields. Secondly, the paper also investigates whether non-fundamental factors, namely the buying/selling pressures of different market players, are also responsible for the daily yield fluctuations. Put differently, are there certain types of investors that lead price movements in the market? Because in a frictionless market investors' trading activity should exert no material influence over asset price, this second objective is tantamount to testing whether friction exists in the Thai bond market, and, if so, what kind of friction.

Apart from expanding the geographical scope of the existing studies on both the fundamental and non-fundamental determinants of sovereign bond yields, the paper also makes two additional contributions to the extant literature. Firstly, unlike previous studies that often rely on low-frequency - namely, monthly or quarterly - data, the paper makes use of high-frequency, *daily*, data. More specifically, to overcome the standard limitation that macroeconomic data are not available on a high-frequency basis, the paper makes use of financial markets data to proxy for daily changes in macroeconomic conditions. In addition, to study the impact of investors' trading activity on bond yields, the paper also makes use of a novel dataset that consists of over five years worth of daily transactions undertaken by *all* market participants in the Thai bond market. To the extent that the use of these higher-frequency data allows us to better isolate the effects of the different relevant factors that may end up cancelling one another out if lower frequency data are used, the approach adopted in this paper may permit us to achieve a more precise identification than is the case in the existing literature.[3]

Secondly, when examining the non-fundamental determinants of yield movements, the paper also introduces some innovative elements to the extant literature on market microstructure. More specifically, to distinguish between the two frictional paradigms (information versus inventory) that allow investors' trading activity to have a material influence over asset price movements, several studies have relied on the following two identifying assumptions: 1) the duration of price impact of investors' activity differs under the two paradigms; and 2)

[3] In a way, the approach is similar in spirit to the large body of literature that examines the impact of macroeconomic announcements on yield movements (for a review of the literature, see, for instance, Fleming and Remolona, 1997). The only distinction is that, if one is to take the view that any element of macroeconomic news surprises should already be reflected in the select few financial markets variables, the specification adopted in this paper can be viewed as slightly more parsimonious.

observing heterogeneity of price impact from different investor types necessarily rules out the inventory effect. Arguing that there are circumstances in which such assumptions may not be strictly valid, the paper proposes two alternative identifying strategies to differentiate between the two frictional paradigms that may have generated the observed results in the Thai context.

A preview of the paper's main results is as follows. First, results from a regression analysis suggest that the day-to-day movements of the different tenors of government bond yields can be explained by different macroeconomic and financial factors. Specifically, short-term yield movements are found to be mainly influenced by changes in the outlook of the domestic economy, which are proxied by changes in the implied forward rates obtained from the Nelson-Siegel (1987) model, as well as changes in bond supply. On the other hand, longer-term yield movements can be attributed to both domestic (outlook and country risk premia) and global (U.S. monetary condition and global risk aversion) factors, with the importance of the latter generally increasing as the tenor of bond increases.

Second, when the baseline model is augmented by additional variables that represent the bond net-purchase (the so-called order flow) of local and foreign investors, it is found that for the medium- and long-term segments, the daily yield movements are also significantly affected by the order flow of foreign investors, and not by that of local investors. This confirms the general observation by the market participants that foreign players tend to be "price leaders" in these market segments, which can be perhaps be explained by their generally more "aggressive" behaviours, such as their tendency to suddenly enter or withdraw from the market in large size following a change in market sentiments. Local investors, on the other hands, tend to be more careful in their market timing and trade in smaller size.

In addition to re-highlighting the importance of global factors, the significance of the foreign order flow variable also points to evidence that friction exists in the relevant segments of the Thai bond market. Further, but admittedly preliminary, investigations indicate that the detected friction is likely to be of the informational kind. Specifically, foreign flows have a material impact on bond yields because they reveal price-relevant "private" information to Thai dealers, who then price such information into their quotes. In this respect, the presence of foreign players in the Thai bond market may not altogether be so detrimental; instead of causing volatility, these investors may actually have simply been supporting the price discovery process in the market where the underlying fundamentals themselves happen to be volatile. Efforts could, nevertheless, be made by the relevant authorities to promote the sophistication/activeness of local players, such that the market's price discovery process is not too dependent on foreign or, for that matter, any single group of investors in the market. This will, in turn, ensure that the Thai bond market's price formation process will continue to be resilient in the face of idiosyncratic shocks that may cause certain groups of

investors to behave irrationally in certain market environments.

The remaining parts of the paper are organized as follows. The following section provides an overview of the related literature. Section III outlines the relevant features of the Thai government bond market. Section IV discusses the empirical models and the dataset used. The empirical results are discussed in Section V. Section VI provides some further discussions on the potential form of market friction that may have generated these results. Section VII concludes.

II. Related Literature

Given the natural importance of a sovereign bond market to a number of stakeholders in the economy, it comes as no surprise that there exist a good number of studies on the determinants of sovereign bond yields. This paper is particularly related to two strands of literature: one relying on "fundamental" factors as the source of yield movements, and another on market frictions.

A. Fundamental determinants of bond yields

In much of the traditional literature, studies on the determinants of asset prices often rely on "fundamental" factors as the major source of their variability. This practice is not surprising given that several economic models readily exist to motivate the *a priori* relevance of several of these factors.[4] Empirically, a number of fundamental factors have been identified to exert significant influence over sovereign bond yields. Among domestic factors, Poghosyan (2012) finds a strong relationship between sovereign bond yields and potential output growth as well as government debt-to-GDP ratio. Using a different measure of fiscal sustainability, Faini (2006) and Laubach (2009) find that fiscal deficit is also significantly associated with the observed changes in sovereign bond yields. Pijak (2013) finds that monetary policy and inflation are important determinants of domestic government bond yields in emerging market economies (EMEs). And Gadanecz et al. (2014) empirically confirm the importance of exchange rate risk in influencing emerging markets' local currency bond yields.

Given the interlinked nature of today's global financial markets, it comes as no surprise that international factors have also been found to significantly affect sovereign bond yields. Among these factors, global liquidity condition, often proxied by the U.S. Treasury (UST) yields, and global risk appetite, often proxied by the VIX, are the most standard determinants. Gonzalez-Rozada and Levy-Yeyati (2008), for instance, find that fluctuations in foreign currency bond yields in EMEs can be largely explained by changes in global liquidity conditions (changes in UST yields) and risk appetite (high-yield corporate bond spreads in advanced

[4] For a brief discussion of the theoretical motivations behind some of the factors explored in the empirical literature, see, for example, Poghosyan (2012).

economies). Examples of other studies examining the importance of global factors include Eichengreen and Mody (2000), McGuire and Schrijvers (2003), Hartelius et al. (2008), and Bellas et al. (2010).

While a vast number of the studies on the determinants of sovereign bond yields have traditionally focused on advanced economies, there is a growing body of research that focuses on EMEs. This increasing interest potentially reflects the growing significance of the sovereign debt market as an important source of government financing in these countries. Peiris (2010), Miyajima et al. (2012) and Gadanecz et al. (2014) are notable examples of such studies. While the list of candidate determinants in these studies appears to be sufficiently comprehensive, the studies often rely on low frequency data when conducting their regression analyses. By utilizing high frequency data extracted from financial markets variables, the first part of this paper, which seeks to identify the fundamental determinants of the Thai government bond yields, aims to contribute to this growing body of research by exploring the more short-term, and therefore potentially less spurious, dynamics of yield movements.

B. Investors' trading activity as a potential determinant of bond yields

The focus on fundamental factors in much of the traditional literature of asset pricing is understandable given the often-invoked assumption of a frictionless market. Under this assumption, non-fundamental factors, such as the trading activity of market participants, play no role in influencing asset price, which adjusts only when new fundamental information is revealed to the market.

Over the years, however, asset-pricing models based on fundamental variables alone have enjoyed somewhat limited success in explaining actual observed price dynamics. This is especially so for the foreign exchange (FX) market, where the explanatory power of purely fundamentals-based models is found to be essentially zero.[5] For other markets where the models' performance may not be so poor, the traditional framework that incorporates only macroeconomic information still seems at odds when one observes significant market movements on days where there is no new macroeconomic information revealed to the market at all.

In light of the fundamental models' limited success, more recent studies have tried to introduce several forms of market friction to better explain asset price variations that arise from non-fundamental factors, such as investors' trading activity. One notable example among these is the incorporation of asymmetric information. Beginning from the pioneering works by Bagehot (1971),

[5] Meese and Rogoff (1983), for instance, show that a random walk model is able to perform as well as any of the major structural exchange rate models used in the 1970s in terms of out-of-sample forecasting accuracy.

Glosten and Milgrom (1985) and Kyle (1985), models based on asymmetric information explore the idea that certain market players may entertain significant informational advantage over others. [6] Because of the existence of such informational asymmetry, whenever there is a significant aggregate buying or selling pressure (the so-called "order-flow"), market makers may choose to adjust their quotes in the attempt to mitigate potential adverse selection costs. In such a setting, asset price is therefore not only driven by public information about the underlying fundamentals, but also by private information conveyed to the market through order flow.

Apart from asymmetric information, inventory risk is another principal form of friction that allows trading activity to have an impact on asset price. Based on the works by Garman (1976), Stoll (1978), and Ho and Stoll (1981 and 1983), the inventory control paradigm of market microstructure concerns the strategic pricing behavior of dealers in the management of their inventory positions. Models based on this paradigm assert that in the process of providing immediacy to their customers, risk-averse dealers have to actively adjust their price to compensate for the undesired inventory risk that they have to bear from such services.[7] Because of this active price adjustment, an order flow from a customer has a direct impact on asset price.

Empirically, the view that investors' order flow has a real impact on asset price, whether through the information channel or the inventory channel, is strongly supported by data. For the informational channel, while the focus has traditionally been on the stock and FX markets where private information is likely to be most prevalent[8], there is also a growing body of research on the bond market. Utilizing data for the UST market, Cohen and Shin (2003), Brandt and Kavajecz (2004) and Green (2004) show that that aggregate order flow contains information relevant to explaining bond yield movements. Covering the same market, Valseth (2010) finds that the information content of order flow varies among different investor types, with dealers' order flow being far more informative than their customers'. Beyond the UST market, the importance of

[6] This informational advantage can be strictly private in nature, such as when certain market participants have exclusive access to insider information about firm-specific future cash flows in the stock market. Alternatively, as per the more recent interpretation offered by Evan and Lyons (2002) and Bacchetta and van Wincoop (2006), informational advantage can also be in the form of better analytical and technical ability to interpret public news. That is, even in markets where the traded instruments' cash flows are fixed and known to all participants (i.e. the bond market), asymmetric information can still exist if players have heterogeneous interpretations about what public news implies about the value of the traded instruments, and certain players (are thought to) possess superior ability to interpret such information.

[7] For example, a dealer receiving a sale order from his/her customer may wish to bid price downward to compensate for the risk that asset price may go down further after the transaction is finalized.

[8] See, for instance, Evans and Lyons (2002), Payne (2003) and March and O'Rouke (2005).

private information to the price formation process of a bond market is also confirmed in the case of Italy (Girardi and Impenna, 2013) and South Korea (Park et al., 2015).

The empirical literature that relies on the inventory channel to explain the observed market dynamics is also substantial. Utilizing data from the New York Stock Exchange market, Madhavan and Smidt (1993) show that the evolution of specialists' inventories in this market exhibits characteristics consistent with the inventory paradigm. Huang and Stoll (1997), also covering the stock market, similarly finds that inventory control cost is a significant, although small, component of the bid-ask spreads. They also find that the size of the component tends to increase materially for medium and large trades. For the FX market, Lyons (1993) finds that the price dynamics observed in the market can be characterized by both the information paradigm and the inventory paradigm.

Armed with knowledge of the potential mechanisms through which investors' order flow can affect asset price as proposed and explored in previous studies, the second objective of this paper is to explore the relevance of such mechanisms to the Thai government bond market. Specifically, it seeks to determine whether the net-buying pressure of investors is also a significant driver of Thai bond yield movements. It also attempts to identify the potential form of friction that may have generated the observed results.

III. The Thai Government Bond Market

This section provides a brief overview of the features of the Thai government bond market that are relevant to the discussions in the preceding sections.

A. Market structure

Like bond markets in other countries, the Thai government bond market consists of the primary and the secondary segments. The primary segment is where government bonds and bills are first issued to the market through regular auctions held by the Ministry of Finance (MOF) through a platform provided by the Bank of Thailand (BOT). While a wide range of market participants are allowed to participate in most of these auctions, only a limited number of authorized participants (MOF primary dealers), mainly commercial banks, have access to the auctions of some of the most liquid (benchmark) instruments. To acquire such a privilege, one of the requirements set by the MOF is that they act as market makers in the over-the-counter (OTC) secondary market. In addition, they are also required to submit reference yields on government securities to the Thai Bond Market Association (ThaiBMA) at the end of each day. From these data, the ThaiBMA constructs the interpolated government bond yield curve for market reference on a daily basis.

In the secondary market, in addition to the customer segment where dealers trade with end-customers, there is also an interdealer segment. This is where dealers trade among themselves to manage their short-term inventory positions. For example, a dealer that does not have the specific security being demanded by their customer may enter the interdealer market to obtain such a security. Conversely, a dealer receiving a sale order may wish to enter the interdealer market to reduce their position that results from such a trade.

All dealers in the Thai government bond markets are required to report the details of their individual trades to the ThaiBMA, including information on counterparty identity, transaction size, trade date, and their side of the trade. Through this requirement, the ThaiBMA is in possession of a complete dataset that includes *all* transactions that take place in the secondary market, whether they be in the interdealer or the customer segments. It is through this unique dataset that this paper is able to, subject to some limitations outlined below, construct investor-specific order flow variables as well as a measure of the market's trading liquidity.

B. Major participants

Based on the ThaiBMA dataset, Figures 1 provides information on the profile of major participants in the Thai secondary government bond markets. Based on trading volume data between January 2010 and July 2015, it can be seen that commercial banks are by far the most active players. This result should come as no surprise, however, given their primary role as market makers. Disregarding the trading volume of commercial banks and securities companies, which are market markers, the relative importance of end-customers in the different market segments can be gauged. From Figure 2, it can be seen that at the short- and very long-maturity segments of the market, local investors, namely asset management companies and insurance companies, are the main players, accounting for more than 50% of the total trading volume. At the middle- and long-maturity segments, on the other hand, foreign investors are the main players, accounting for roughly 40% of total volume.

Figure 1: Profile of Investor by Trading Volume
(data from 1/2010 to 7/2015)

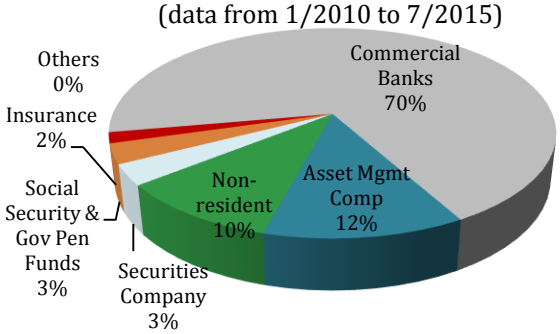
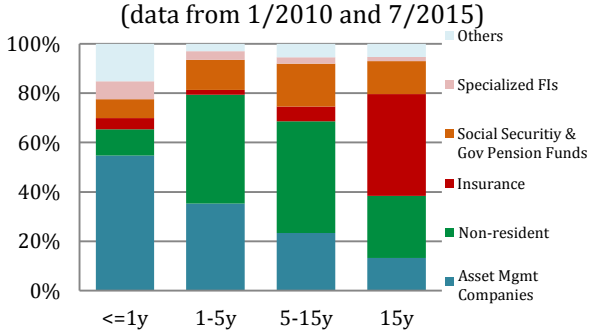


Figure 2: Maturity-specific Profile of End-customers by Trading Volume
(data from 1/2010 and 7/2015)



Source: Author's calculation based on ThaiBMA's data

Oftentimes, it is argued among the market participants that the behaviors of local and foreign investors in the Thai bond market are quite different. More specifically, the latter are seen as more aggressive in the sense that they tend to enter or withdraw from the market in a rather abrupt manner, typically depending on the market sentiments at the global or regional level. In contrast, the former are generally more careful in their market timing. Given these behavioral differences, it is often observed that bond yields generally move more in the direction consistent with foreign players' trades, at least for the tenors where they are active participants.

In light of this heterogeneity, the paper makes a distinction between local and foreign players when analyzing the effects of investor-specific order flow on bond yield movements. While the groups of investors active in the Thai bond market are, as seen in Figures 1 and 2, much more heterogeneous than implied by such a bifurcation, econometric issues – those related to finding a valid instrument for each of the investor-specific order flow variables - have precluded the possibility of a further disaggregation. Notwithstanding this limitation, if one is to take the view that the different groups of local players should not differ too distinctly from one another, the current bilateral distinction should be meaningful enough to capture important price dynamics in the market.

IV. Empirical Model and Data

A. Fundamental determinants of Thai yield movements

To examine the fundamental determinants of the Thai government bond yields' daily movements, the paper's baseline specification takes the following form:

$$\Delta yield_t = \alpha + \Delta \boldsymbol{D_t}'\beta + \Delta \boldsymbol{X_{t-1}}'\eta + e_t \qquad (1)$$

where $yield_t$ denotes the Thai nominal government bond yield, and $\boldsymbol{D_t}$ and $\boldsymbol{X_{t-1}}$ are the vectors of domestic and global factors, respectively. As the Δ notation suggests, all variables are modeled in first-differences to ensure stationarity. For the domestic variables, including the dependent and the explanatory factors, Δ denotes the changes in their values from working day t-1 to working day t. In contrast, for global factors, the changes are from working day t-2 to working day t-1. This reflects the timing differences between Thailand and the U.S., whereby events occurring in the latter on working day t-1 will not affect events in the former until working one t.[9]

On the list of potential explanatory variables, as discussed in Section II the

[9] For example, changes in UST yield on Thursday U.S. time will not be reflected into Thai yields until Friday Thai time, as the Thai market will already have closed on Thursday Thai time when such an event occurs in the U.S.

standard domestic macroeconomic determinants of sovereign bond yields explored in previous studies include GDP growth, inflation, and fiscal sustainability. Because the objective of this paper is to examine the *high-frequency* dynamics of yield movements, namely at the daily level, assessing the impact of such standard variables is not feasible due to data availability issues. Instead, the paper utilizes financial markets variables to proxy for these standard determinants.

Specifically, the $\boldsymbol{D_t}$ vector includes the following variables:

- *Policy rate expectation*: to capture the market's perception of economic outlook related to both GDP growth and inflation, the paper uses the implied overnight forward rate on the next Monetary Policy Committee (MPC) meeting date, obtained from the Nelson-Siegel (1987) model. All else equal, an increase (decrease) in the rate reflects the market participants' view that there is a higher probability that the MPC will hike/not cut (cut/not hike) the policy rate in its next meeting. This can result from their upward (downward) revision of expected GDP growth or inflation level, potentially following the Thai authorities' announcements of favorable (unfavorable) key economic figures. Both of these scenarios should have a positive (negative) impact on bond yields.
- *Country credit risk*: instead of using debt-to-GDP ratio or fiscal position, the paper uses the 5-year Thai sovereign CDS spread, which is available daily and the change of which should instantaneously reflect any new information relevant to the credit risk of the country. As an increase (decrease) in the CDS value should represent the market's perception of higher (lower) credit risk of the Thai government, the variable is expected to have a positive coefficient.
- *Stock market condition*: the inclusion of this variable reflects the view that the stock and bond markets may be substitutes, whereby (un)favorable conditions in the former should lead investors to direct funds away from (into) the latter, thereby decreasing (increasing) the asset value in the latter market. With this view, the stock market value, represented by the Stock Exchange of Thailand (SET) index, should have a positive impact on the Thai government bond yields.
- *Exchange rate uncertainty*: in the presence of high (low) exchange rate uncertainty, investors may require high (low) bond yield premium to compensate for such risk before being willing to invest in the local currency bond market. To capture this element of uncertainty in the Thai context, the paper uses the exchange rate volatility series implied from the 1-month USDTHB options.
- *Bond supply*: while standard frictionless models suggest that supply and demand should not have an impact on asset price, more recent studies

(see, for example, Vayanos and Vila, 2009) suggest that in the presence of certain frictions, such as in the case where investors have specific preferences for certain maturities of bonds and where risk-averse arbitrageurs are only willing to connect the segmented markets if they receive appropriate yield compensation, the maturity-specific supply of bonds should also have an impact on the price of the relevant bonds.[10] Specifically, if there is an increase (decrease) in bond supply such that the arbitragers are required to hold more (less) duration risk in the aggregate, they should require more (less) premium, leading to higher (lower) yields.

On the list of global factors, the paper follows the standard literature such that the $\boldsymbol{X_{t-1}}$ vector includes two variables: namely *global monetary condition* and *investor risk appetite*. All else equal, an improvement in the global monetary condition, often signified by a reduction in UST yield, should simultaneously decrease the yields of government bonds in various countries as the easy conditions prompt investors to search for higher returns elsewhere, easing conditions in these countries also. Therefore, one would expect the sign on UST yield to be positive. Similarly, given that a higher global risk aversion level should prompt international investors to require higher compensation when investing offshore, the sign on the global risk appetite variable, often proxied by the VIX, should also be positive.

Based on the notion that the different tenors of government bond yields may be influenced by different factors, Equation 1 is to be estimated on four separate market segments by maturity, namely short-term (0-1 year), medium-term (1-5 year), long-term (5-15 year) and very long-term (more than 15 year). In accordance with this disaggregation, four specific tenors of bond yields are chosen to represent the yield movement in each market segment, namely 6-month, 3-year, 10-year and 15 year yields, respectively. Data on interpolated yields are obtained from ThaiBMA's website.

For the explanatory variables, data for the overnight forward rate on the next MPC meeting date are obtained from BOT Financial Markets Department's internal estimates. Data for the Thai 5-year CDS, SET index, 1-month USDTHB implied volatility, the VIX, and UST yields are obtained from Bloomberg. For UST yields, the tenors are chosen to be consistent with the tenors of the Thai yields, except for the very long-term segment where 10-year UST yield is used because data on 15-year UST yield are not available. Data on the maturity-specific amount

[10] In this light, the supply variables should not strictly speaking be included in the baseline "fundamental" specification. Nevertheless, since these variables are not the focus of the paper when it examines the non-fundamental determinants of yield movements, they are included in this subsection for simplicity.

of bond outstanding are obtained from the BOT's database.[11]

Equation 1 is to be estimated using ordinary least squares (OLS). The sample period is between January 2010 and July 2015, which gives a total of 1337 observations. Heteroscedasticity-and-autocorrelation-consistent (HAC) standard errors are used to account for the possibility of non-standard errors. For variables where the market is likely to look at the change in their values in terms of basis points, namely the interest rate and the CDS variables, the first-differenced form Δ is obtained simply by subtracting today's value from yesterday's value. For other variables where the market is likely to also be interested in the reference point from which their value changes, namely the stock index, implied volatility, bond supply, and the VIX, Δ is instead modeled in the percentage change form.

Before proceeding further, Table 1 presents the correlation coefficients of the dependent and independent variables, for preliminary inspection. It can be seen that, consistent with existing beliefs drawn from market observations, the factor that has by far the highest correlation with changes in short-term yield is changes in policy rate expectations, which are proxied by changes in the implied forward rate. Other factors, both global and domestic, do not have high correlations with changes in short-term yield, although they could still have a significant association once other factors have been controlled for in a regression framework. Turning to medium-term yields onward, it can be seen that changes in the Thai rates are fairly strongly associated with changes in UST yields, suggesting the importance of global monetary conditions in dictating the movements of Thai medium rates onward. `

Lastly, Table A in the Appendix provides the correlation matrix between the independent variables. It can be seen that there are two groups of variables that are fairly correlated with one another, one consisting of the SET index, 5-year CDS spread, and the VIX, and another of the VIX and UST yields. This information is kept in mind when Equation 1 is estimated in the following section, to make sure that any conclusion drawn will not be affected by the potential multicollinearity issue.

[11] The construction of the supply variable corresponds to the four market segments for which Equation 1 is estimated. That is, the supply variables are split into four categories by remaining maturity: 0-1 year (short-term), 1-5 years (medium-term), 5-15 years (long-term) and 15+ years (very long-term). For the latter three segments, the set of bonds that are used to construct the supply variables consists only of loan bonds (LBs), which are issued by the government. For the 0-1 year segment, in addition to LBs, the set also includes government-issued Treasury bills (TBs) and BOT-issued cash management bills (CMBs). The reason for the inclusion of non-government-issued CMBs is because during the sample period there were times when the government had stopped issuing TBs, which means that at certain point CMBs constituted the majority of short-term debts being traded in the market. This led market participants who were obliged to submit reference yields to the ThaiBMA to construct the daily yield curve to base their short-term rate submission on the yields at which CMBs were being traded.

Table 1: Correlation between Dependent and Independent Variables
(sample period: 01/2010 - 07/2015)

Variable		Change in Thai Bond Yield (bps.)			
		6M	3Y	10Y	15Y
Change in Domestic Factors	Implied Forward Rate (bps)	0.46	0.20	0.09	0.09
	SET Index (%)	0.00	0.02	-0.05	-0.04
	5Y Thai CDS (bps)	-0.02	-0.04	0.02	0.02
	Implied FX Volatility (%)	-0.02	0.03	0.04	0.04
	ST Bond Supply (%)	0.04	0.02	0.02	0.01
	MT Bond Supply (%)	0.03	-0.01	-0.03	-0.02
	LT Bond Supply (%)	-0.04	0.00	0.01	0.00
	VLT Bond Supply (%)	0.01	-0.01	-0.03	0.02
Change in Global Factors	VIX (%)	-0.02	-0.06	-0.04	-0.04
	6M UST Yield (bps)	-0.01	0.05	0.03	0.01
	3Y UST Yield (bps)	0.00	0.18	0.23	0.23
	10Y UST Yield (bps)	0.02	0.24	0.28	0.27

B. Investors' order flow and yield movements

To examine whether investors' buying/selling pressures are also relevant in explaining bond yield movements, Equation 1 is extended into the following specification:

$$\Delta yield_t = \alpha + \Delta \boldsymbol{D_t'}\beta + \Delta \boldsymbol{X_{t-1}'}\eta + \gamma_1 flow_{t,l} + \gamma_2 flow_{t,f} + e_t \qquad (2)$$

where $flow_{t,l}$ and $flow_{t,f}$ denote the time t net-purchase amount of bonds (that is, the order flow) that local and foreign investors obtain from / sell to their dealers, respectively.

An empirical problem in estimating Equation 2 using OLS is the potential existence of a simultaneity problem that, if present, will bias the obtained OLS estimates. In our case, the problem will arise if investors follow a feedback trading strategy, whereby they trade in response to movements in bond yields, a phenomenon empirically documented by Cohen and Shin (2003).[12] In light of this endogeneity issue, Equation 2 is to be estimated using the generalized method of moments (GMM) technique, where each of the order flow variables is to be instrumented for by its first lag.[13]

Data on the daily order flow of local and foreign players in the Thai government bond market are obtained from ThaiBMA's dataset, which contains information on all the transactions carried out by registered dealers in the market. The dataset therefore allows the author to calculate the net-purchase amount –

[12] In the Thai context, Chai-Anant and Ho (2008) also document such a behavior in the equity market.
[13] With the exception of the long-term specification, where the second lag is used as it appears to be a stronger instrument based on the Stock-Yogo (2005) critical values.

defined as the difference between the aggregate bond purchase and the aggregate bond sale - that local and foreign investors transacted with their dealers in a given day. Given that we are estimating four separate regressions for four tenors of bond yield, like the bond supply variables the order flow variables are also split into four categories, corresponding to net-purchases of bonds with remaining maturity of 0-1 year (short-term), 1-5 years (medium-term), 5-15 years (long-term) and 15+ years (very long-term).[14]

Table 2 presents the correlation coefficients between the order flow variables and changes in the corresponding tenor of bond yield, for preliminary inspection. Interestingly, it can be seen that for every tenor of yield considered, the correlation between local order flow and yield movements is positive. This is fairly surprising given that investors' net-buying pressure should have a *negative* effect on bond yield. This finding is, nevertheless, not inconsistent with our initial hypothesis that the direction of causality can also go from yield movements to order flow: a positive yield change may cause investors to buy more and vice versa. If anything, this observation further confirms the validity of our thinking that a GMM approach would be most suitable in light of the potential endogeneity issue. Turning to foreign order flows, it can be seen that, despite the potential endogeneity issue, the coefficients are mostly negative. The magnitude of the coefficient also appears fairly strong for the long term segment. This finding provides us with our first preliminary evidence that market players' trading activity could perhaps also be a significant determinant of the observed yield movements in the Thai bond market.

Table 2: Correlations between Order Flow and Changes in Government Bond Yield

	Local	Foreign
Short-term	0.06	0.07
Medium-term	0.08	-0.04
Long-term	0.21	-0.22
Very long-term	0.04	-0.01

Before proceeding to next section, it is important to point out that in this paper the order flow of each investor type is only identified with an additional assumption. Specifically, while the ThaiBMA dataset is relatively complete, it does not have information on the initiator of each individual trade. Therefore, it is *a priori* unclear whether each trade would constitute a buying or selling pressure on bond yield. To overcome this data limitation, the author makes an assumption that whenever end-customers trade with their dealers, the former are always the initiator of the trade. With this assumption, which is not uncommon in the

[14] Like the bond supply variables, the order flow variables used in the short-term specification also include TBs and CMBs, while for other market segments the variables only include LBs.

literature[15], we are able to identify the net-buying pressures from local and foreign investors. What we are *not* able to identify, however, is the pressure in the interdealer market. Consultation with the BOT bond desk indicates that bank players also trade for proprietary reasons, the pressures from which also tend to move yields on a regular basis. Without more detailed data, however, we are not able to incorporate this into the empirical framework and leave this as an area for future research.

V. Estimation Results

A. Fundamental determinants of Thai yield movements

The regression results for Equation 1 are reported in Table 3.[16] The adjusted R-squares are between 12% - 43%, which is consistent with those reported in the existing literature. Coefficients on all the factors that are statistically significant have the expected signs, and the inferable results are generally in line with the preliminary conclusions drawn from the correlation analysis. Overall, it is clear that the day-to-day movements of the different tenors of the Thai government bond yield curve are determined by different economic and financial factors.

At the short end of the curve, the daily yield movements appear to be exclusively driven by domestic factors, namely changes in policy rate expectations and changes in bond supply. The coefficient on the former is clearly economically significant; a one basis point increase (decrease) in the expectation of the policy rate on the next MPC meeting date is found to translate into a 0.81 basis point contemporaneous increase (decrease) in the 6-month yield, a pass-through of roughly 81%. For bond supply, while the variable is statistically significant, its economic significance is somewhat limited. A one standard deviation increase in short-term bond supply (1.38%) leads to only a 0.2 basis point change in 6-month bond yield.[17] However, if one is to consider the effect of the maximum movement

[15] See, for example, Gereben et al. (2006). Consultation with the BOT bond desk does confirm that the assumption is likely to be valid for most cases in the Thai context.

[16] Strictly speaking, there is a slight modification of the model specification from the one shown in Equation 1. Specifically, an interaction term between a time dummy variable, which equals 1 for the days in the year 2010 and 2011 and 0 otherwise, and the change in the implied forward rate variable, is added to the model. This is to account for the potential structural break in the coefficient on the implied forward rate, which appears to have led to a low coefficient estimate when Equation 1 is estimated without such an interaction term. The potential economic reason for such a break is that during the year 2010, there was a sustained appreciation of the Baht leading investors to buy the currency and deposit it in the Thai short-term bond market. As a result, the Thai short-term bond yields, which are used to derive the short-end of the implied forward rates, became significantly lower than the policy rate and may not be a good reflection of market expectations during the period. The sizable gap remains in 2011 but has disappeared since. Because the interaction term simply serves to reduce the "distortion" that appears to have affected the relationship between policy rate expectations and Thai bond yield movements, it is not included in any of the regression results to conserve space.

[17] The descriptive statistics of the variables examined in this section is provided in Tables B and C in the Appendix.

of bond supply during the sample period (24%), the predicted contribution to yield change (4.8 basis point) is sizable.

For the medium-end of the curve onward, both domestic and global factors appear to be significant drivers of yield movements. Specifically, changes in the expectation of the domestic policy rate continue to play an important role in determining yield movements. The estimated magnitude does decrease, however, as the tenor increases. For the longest tenor, the pass-through drops to around 42%, which is nonetheless still economically significant. At the same time, the importance of global factors appears to increase as the tenor of bond increases, although not in a strictly monotonic manner. Specifically, the influence of global factors on Thai yields appears to be the greatest for the 10-year tenor, where coefficients on both UST yield and VIX are the highest. Even for this tenor, however, the estimated effects are not excessively high; the maximum movements of the 10-year UST yield and the VIX during the sample period (24 basis point change and 41% change, respectively) are predicted to move the Thai 10-year yield by roughly 3.4 and 1.4 basis point, respectively. The finding suggests that while significant, global factors do no exert excessive influence over the Thai yield curve, even for tenors found to be most sensitive to them.[18] Nevertheless, before downplaying the importance of global factors, one needs to be mindful of the other channel through which external factors can affect Thai bond yields – foreign investors' trading activity - an issue we investigate next in the succeeding subsection.

Apart from short-rate forecasts and global factors, exchange rate uncertainty and country credit risk also appear to be important determinants of movements in the longer tenors of the Thai yield curve. Specifically, the former enjoys statistical significance for all the tenors other than 6-month, while the latter is significant for the very long tenor (15-year). Nevertheless, their economic significance is found to be only marginal; a one standard deviation increase in the former (latter) is associated with a rise in the relevant tenors of the Thai rates by only around 0.18 basis point. Their economic significance does not increase much even if one is to consider the impact of the maximum movements in the values of these variables during the sample period.

Somewhat surprisingly, conditions of the Thai stock market are found to have no influence on yield movements for every yield tenor considered. Nevertheless, the lack of association becomes less surprising if one dives further into the investor compositions of the two markets. For the bond market, it is clear from Figures 1 and 2 that the majority of the investors are institutional investors. For the stock market, retail investors make up as much as 50% of total trading

[18] The coefficient on UST yield does increase in magnitude, however, when the sample period is reduced to only include the last few years, when the bond market participants' focus has been shifted back to developments in the U.S. after the Federal Reserve's announcement in May 2013 of its intention to scale down of its quantitative easing (QE) program.

volume [19]. It is perhaps due to this investor heterogeneity that explains the apparent disconnect between the returns in the two markets.

Apart from the significant result in the short-term specification, changes in bond supply are also found to be unimportant drivers of yield movements. This result is perhaps more surprising than the insignificance of the stock market variable as there have been several occasions in the past where market observers have attributed the observed yield movements to supply-related factors. However, further investigation reveals that it is generally the *announced* changes in supply that cause yields to move, as dealers will already have adjusted their price in accordance with the anticipated supply, sometimes long before there is an actual supply change. Because the paper has no access to information on whether the announced amount of the incoming bond issuance is above or below market expectations, which is what matters in determining the effect of the supply factor on yield movements, this complication is left to be resolved in future work.

Table 3: Impact of Fundamental Factors on Thai Bond Yields

Variable	0-1	1-5	5-15	15+
Constant	0.00E+00**	0.00E+00	0.00E+00	0.00E+00
	(0.04)	(0.68)	(0.74)	(0.69)
Policy Rate Expectation (bps. Δ)	0.8116***	0.5896***	0.4912***	0.4156***
	(0.00)	(0.00)	(0.00)	(0.00)
SET Index (% Δ)	0.0301	0.0643	-0.1048	-0.0539
	(0.34)	(0.49)	(0.44)	(0.58)
Bond Supply (% Δ)	0.0295**	-0.0291	0.0775	0.0385
	(0.05)	(0.41)	(0.23)	(0.44)
CDS Spread (bps. Δ)	0.0055	0.0018	0.0436*	0.0351**
	(0.46)	(0.91)	(0.06)	(0.05)
Implied FX Volatility (% Δ)	0.0036	0.0208	0.0336**	0.0265**
	(0.45)	(0.10)	(0.03)	(0.05)
UST Yield (bps. Δ)	-0.0551	0.1132***	0.1974***	0.1477***
	(0.14)	(0.00)	(0.00)	(0.00)
VIX (% Δ)	-0.0039	0.0002	0.0355**	0.0255**
	(0.60)	(0.99)	(0.02)	(0.03)
Adjusted R-Squares	0.43	0.12	0.12	0.12
Observation #	1344	1344	1343	1344

***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively.

Lastly, as noted in the previous section, there appear to be two groups of variables in the regression that are fairly correlated with one another: one

[19] Based on statistics provided by Pavabutr and Yan (2013).

between the SET index, 5-year CDS, and the VIX and another between the VIX and UST yields. To examine whether the conclusions drawn above are sensitive to the potential multicollinearity problem, Equation 1 is re-estimated for each of the yield tenors after the SET index, the CDS, and the VIX variables are individually dropped from the equation. The estimation results of these regressions, which are shown in Tables D-F in the Appendix, look very similar to those obtained from the full specification. This suggests that the conclusions discussed above are not sensitive to potential multicollinearity issues.

B. Investors' order flow and yield movements

The regression results for Equation 2 are reported in Table 4.[20] From the last row, it can be seen that for the short- to long-term market segments, we are not able to reject the null hypothesis that the used instruments are weak based on the Stock-Yogo (2005) critical values at 15-25% significance levels.[21] For these market segments, we can therefore be fairly confident in the consistency of the GMM estimates obtained. We are not able to reject the null hypothesis for the very long-term specification, however. As an IV procedure with weak instruments will still lead to biased results sometimes even larger than those obtained using the standard OLS technique, the 15-year specification is re-estimated with OLS.

Turning to the coefficient estimates, local investors' order flow is found to have no significant influence over yield movements for every tenor of yield considered. While the coefficient on local order flow appears to be statistically significant in the very long-term specification, it has an unexpected sign; a net-purchase by local investors leads to a *rise* in the 15-year rate. This result is somewhat unintuitive and more likely reflects the simultaneity problem that the employed OLS technique is not designed to tackle. That is, the problem discussed before when unconditional correlations are analyzed, is likely to remain present given that OLS is used to estimate the very long-term specification.

On the other hand, the order flow of foreign investors is found to have statistically significant influence over medium- and long-term yield movements, consistent with the market observations discussed in Section III. The coefficients also have the expected sign and are economically significant.[22] For the medium-term specification, a one standard deviation increase (roughly 1,331 million baht)

[20] Since the coefficients on the fundamental variables remain largely similar to those reported in the previous section, only coefficients on the order flow variables are reported to conserve space. For the full regression results, see Table G in the Appendix.

[21] 15-25% are arguably rather high significance levels. However, when the non-statistically significant local order flow variables are dropped, the significance levels do go down to 10%.

[22] A case can be made that perhaps local and foreign activities are highly correlated such that the statistical significance of foreign activity could reflect the influence of both groups. However, a correlation analysis indicates that the two variables are not highly correlated. In addition, dropping the foreign net-purchase variable does not make the local net-purchase variable significant in an economically meaningful way.

in the net-purchase of foreign investors is associated with a 1.26 basis point decline in 5-year yield. For the long-term specification, the increase (roughly 1,223 million baht) is associated with a 1.71 basis point decline in 10-year yield. The coefficients for the short-term and very long-term specifications are not statistically significant. In the former case, this is understandable since, as seen in Figure 2, foreign entities are not significant players in the short-term market segment. In the latter case, because of the potential endogeneity issue, at this stage it is perhaps impossible to draw any definitive conclusion on whether foreign players' activity has a material impact on yield movements in this market segment or not.[23]

Table 4: Impact of Investor-specific Order Flow on Thai Bond Yields

Variable	0-1	1-5	5-15	15+
Local Order Flow	1.08E-07 (1.00)	-0.0004 (0.50)	0.0005 (0.61)	0.0002* (0.10)
Foreign Order Flow	7.01E-06 (0.74)	-0.0010* (0.08)	-0.0014*** (0.01)	-0.0002 (0.73)
Observation #	1344	1344	1343	1344
Weak Instrument Rejected at %	15	15	25	N/A

***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively.

The finding in this subsection – that market pressures from different investor types have differential impact on asset price – is fully in line with previous research in this area. Examining the impact of order flow in the currency market, Marsh and O'Rouke (2005), for instance, find that financial customers tend to matter more for exchange rate determination than non-financial customers. Also covering the FX market, Gereben et al. (2006), find that, consistent with our finding, the distinction between local and foreign entities also matters in determining which kind of trade has an impact on asset price. For the bond market, Park et al. (2015) find that, for Korea's case, local and foreign players have different price effects, both in the spot and the futures markets, depending on whether their trades are expected or unexpected.

But what, exactly, are the primitive reasons why the trading activity of different investor types may have differential impact on asset price? From the market microstructure perspectives discussed in Section II, two distinct channels exist to explain why customers' demand may affect asset price: the information

[23] In the case where the bias is likely to negative, observing an insignificant coefficient on a variable that is *ex ante* expected to have a negative impact on the dependent variable can provide reasonable evidence that the variable really does not have a significant impact on the dependent variable. However, in our case, if one is to take the view that foreign players may adopt a negative feedback trading strategy, the bias could very well be positive. Observing an insignificant effect thus provides insufficient evidence that foreign players have no impact on the 15-year bond yield.

channel and the inventory channel. However, based on the reasoning discussed in some of the empirical papers (see, for example, Marsh and O'Rouke, 2005), the information channel appears to be a more convincing explanation for the observed heterogeneity of impact. This is because under the inventory paradigm, risk-averse dealers should want to demand inventory premium regardless of the type of customers they are trading with. Therefore, based on this paradigm, all types of customers should have a homogenous impact on asset price. As will be argued in the next section, however, it is not totally impossible for the inventory channel to be the underlying force behind the differential pricing influence of different investor types.

As will be discussed in the following subsection, being able to identify which of these two channels is empirically relevant for the case of Thailand has direct policy implications in terms of the initiatives that can be put in place to further promote market resiliency. In light of this, Section VI provides a preliminary attempt to differentiate between these two channels. Before proceeding to the section, however, the next subsection extends the regression framework explored in this subsection to examine the role of market liquidity in the price formation process in the Thai bond market.

C. Foreign net-buying pressures and market liquidity

Given that one of the potential underlying forces behind the influence of foreign players over Thai bond yields is inventory risk consideration, this subsection further investigates the role of market liquidity in the price formation process in the Thai market. To this end, an interaction term between the foreign order flow variable and a measure of market liquidity is added to the medium- and long-term specifications of Equation 2, where foreign order flow is found to be statistically significant. This has the aim of examining whether the extent of foreign influence also depends on the level of liquidity that prevails at the time. With this adjustment, the medium- and long-term specifications of Equation 2 become:

$$\Delta yield_t = \alpha + \Delta \boldsymbol{D}_{\boldsymbol{t}}'\beta + \Delta \boldsymbol{X}_{\boldsymbol{t-1}}'\eta + \gamma flows_{t,f} + \delta flow_{t,f} * liq_t + e_t \qquad (3)$$

where liq_t is the time t trading volume specific to each of the two market segments (trading volumes of bonds with remaining maturity between 1-5 years and 5-15 years). Data on this are again obtained from ThaiBMA's dataset. Because the variables are found to already be stationary, they enter the equation in level form.

Table 5 presents the estimation results of Equation 3, which like Equation 2 is also estimated using the GMM framework.[24] From the results, it can be seen that market liquidity does have a role in the price formation process, with the

[24] Only coefficients on order flow-related variables are reported here to conserve space. For the full regression results, see Table H in the Appendix.

coefficient on the interaction term being significant for both yield tenors. The coefficients are positive, which is consistent with our prior expectation; in an environment of ample liquidity, investor net-buying pressure should have less of an impact on yield movements since, in such a situation, dealers should be relatively willing to accommodate this pressure without having to significantly adjust their quotes to protect themselves from adverse consequences.

Table 5: Examining the Role of Market Liquidity

Variable	1-5	5-15
Foreign Order Flow	-0.0019** (0.02)	-0.0039*** (0.00)
Foreign Order Flow * Trading Volume	1.03E-07* (0.09)	1.49E-07** (0.01)
Observation #	1344	1343
Weak Instrument Rejected at %	15	15

***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively.

At this point, one may be tempted to draw a connection between the result found in this subsection and the inventory paradigm of market microstructure. After all, it is this paradigm that relies on illiquidity as the underlying force behind (risk-averse) dealers' decision to adjust their quotes when servicing their customers. It is important to note, however, that the result is also *not* inconsistent with the information paradigm. As argued by Brandt and Kavajecz (2004), informed traders' order flow is informative only to the extent that it can aggregate the dispersed price-relevant information for other market participants. In a high liquidity environment, which suggests that the market participants are relatively confident in their views, the information-aggregating role of foreign investors may, therefore, not be as much needed. This scenario would also explain the positive coefficient on the interaction term.

From the above discussion, it is perhaps clearer to avid readers at this stage why being able to distinguish between the two microstructure paradigms has clear policy implications. Specifically, if it is the inventory paradigm that is at play, then based on the results in this subsection, efforts aimed at moderating excessive yield movements in the market (at least the parts caused by foreign players' activity) can be directed toward improving market liquidity. On the other hand, if the source of friction is information, then any observed price movement that appears to be "excessive" may not primitively be due to foreign activity, even when one observes significant foreign activity on that particular day. That is, foreign players could simply be acting as facilitators in the price discovery process in a market where economic fundamentals just happen to themselves be volatile. In such a situation, promoting greater liquidity may not necessarily result in more moderate price fluctuations as the underlying cause here is volatility in

fundamentals, and not volatile foreign activity per se. Instead, it may be more fruitful to direct efforts towards improving the sophistication/activeness of local players, such that the price discovery process can take place with less reliance on foreign players. With this motivation, we now turn to the next section, which attempts to distinguish between these two channels.

VI. Further Discussion: Informational Superiority or Sheer Size?

In this section, we make an attempt to identify the form of friction that may have given rise to the results found in the previous section. It is worth emphasizing at this point, however, that the aim here is to provide some empirical observations in order to form the basis for further discussion, rather than to deliver definitive conclusions, which is left for future research.

A. Some preliminary discussion

Before conducting any further empirical investigation, it is perhaps useful to have a more detailed discussion on why both paradigms of market friction can be applied to understand the observed influence of foreign players in the Thai context. Under the information paradigm, dealers adjust their quotes to protect themselves from potential adverse selection costs in the presence of informed traders. In our context, it is possible that foreign players are perceived by dealers as better informed than local players. Therefore, whenever dealers trade with foreign customers, they may feel more compelled to more actively adjust their quotes than when they trade with local customers.

At first, it may seem a little far-fetched that foreign players would have better information about where Thai yields should be traded at. However, it is clear from the previous section that the Thai medium and long rates are also significantly affected by external factors. As such, it may be the case that foreign players may be thought of as having more information about external developments than their local counterparts. This explanation would also partly help explain why foreign activities are found to have no material influence over short-term bond yields, which are exclusively determined by domestic factors. Alternatively, it is possible that local and foreign players have access to the same set of information, but through better analytical and technical ability the latter are better able to deduce what this public information implies about the current and future values of Thai yields.

Inventory risk premium is another potential explanation. Under this paradigm, risk-averse dealers adjust their quotes to compensate for the undesired inventory risks that they face when providing liquidity to their customers. As previously discussed, however, it seems rather counterintuitive that this hypothesis can be used to explain the *heterogeneous* impact of trades undertaken by different investor types. If anything, the hypothesis should predict a

homogenous impact as, after all, dealers should be expected to demand inventory risk premium regardless of whether they are dealing with local or foreign customers.

However, there remains a possibility that foreign investors may trade in larger transaction size compared to local investors. If this is the case, then it is not totally unthinkable that foreign investors would cause yields to move more, as in this case dealers would face higher inventory risks when dealing with them compared to local investors. A further examination of ThaiBMA's dataset indicates that this is indeed the case. As seen in Figures 3 and 4, which show the distribution of the transaction size of local and foreign players in the medium- and long-term market segments, foreign players tend to transact in significantly larger size compared to local players. Viewed in this light, the inventory premium hypothesis appears to be another plausible underlying force behind the influence of foreign activity in the Thai bond market.

Figure 3: Distribution of Trading Size by Investor Type (medium-term)

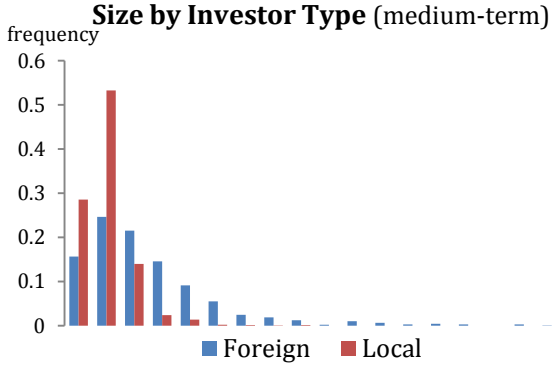
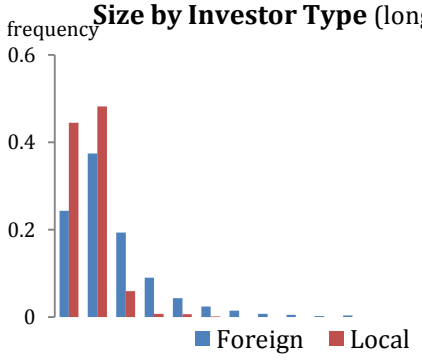


Figure 4: Distribution of Trading Size by Investor Type (long-term)



Source: Author's calculation based on ThaiBMA's data (some extreme values are not included to allow for a clearer depiction of the distribution)

B. Empirical investigation

To distinguish between the two paradigms, one common approach in the literature is to exploit the knowledge that under the two paradigms order flow is expected to affect asset price with different dynamics. Specifically, so long as order flow is associated with the market's revision of the fair value of the asset, as is suggested by the information paradigm, the price impact is argued to be permanent. On the other hand, under the inventory paradigm, order flow simply reflects dealers' attempt to manage their inventory positions. Therefore, any deviation from the asset's fundamental value caused by the order flow is likely to be reversed once the inventory balance is restored.[25] It is important to note, however, that with the recent development of a newer class of inventory risk models, such a distinction may no longer be so clear cut. For example, in the model developed by Vayanos and Vila (2009), the buying/selling pressures from

[25] For a more detailed elaboration of this mechanism, see Hasbrouck and Sofianos (1993).

preferred habitat investors – which are akin to foreign investors in our context – can have a *permanent* impact on bond yields if the net-demand pressure results in a significant long-lasting change in the duration risk that the market as a whole needs to bear.[26] Viewed in this light, one may need to rely on other conceptual frameworks to distinguish between the two mechanisms.

As a preliminary attempt to differentiate between the two sources of friction, this paper relies on two separate identification strategies. Firstly, we utilize our prior knowledge of the yield component that investors' order flow is expected to affect under the two friction paradigms. Specifically, under the information paradigm, order flow affects both the policy rate expectation and the risk premium components, depending on the specific information that it (is perceived to) conveys in a particular instance. On the other hand, order flow should only affect the risk premium component under the inventory paradigm. After all, it is inventory risk consideration that gives rise to the explanatory power of order flow in this case.

With these assumptions, we can distinguish between the two paradigms by re-estimating the medium- and long-term specifications of Equation 2 after replacing the dependent variable with a measure of risk premium. With this replacement, if one finds that the coefficient on foreign order flow is no longer significant, one may have reasonable evidence in support of the information paradigm. As a rough measure of the risk premium component of the Thai 3-year and 10-year yields, a spread between these yields and 2-year yield is used.[27]

Our second identification strategy explores the idea that if the detected foreign influence is really due to their sheer size, if one is able to find another investor group whose distribution of transaction size is on par with that of foreign investors, ond should also expect this investor group to significantly affect yield movements. On the other hand, if the coefficient on the order flow of this investor group turns out to be insignificant, then perhaps there must be something special about foreign investors over and above their large transaction size, such as (perceived) informational superiority.

Examining ThaiBMA's dataset further, it is found that within the local investor category, there is a certain group of investors (henceforth referred to as "control investors"[28]) whose overall trading size appears remarkably similar to

[26] For example, a significant purchase of long-term bonds by foreign investors may have the effect of significantly reducing the amount of duration risk that the rest of the market needs to bear in the aggregate, leading to a permanent reduction in the risk premium component of bond yields.
[27] This measure would provide a reasonable approximation if one is to assume that the 3- and 10-year ahead expected policy rates do not differ too significantly from the 2-year one, such that the spread captures mainly the term-premium component of the 3- and 10-year yields.
[28] Due to a confidentiality issue, the identity of the investor type is not disclosed. However, it can be argued that this investor type does have substantial presence in both the medium- and long-

that of foreign investors, for both the medium-term and long-term segments. This can be clearly seen in Figures 5 and 6, which compare the distribution of trading size between foreign investors and control investors. Given this satisfactory comparison, we re-estimate Equation 2 after replacing local order flow with the order flow of the control investors. As with the original specification, the modified specification is estimated under the GMM framework, with each of the order flow variables instrumented for by its own first lag.

Figure 5: Distribution of Trading Size by Investor Type (medium-term)

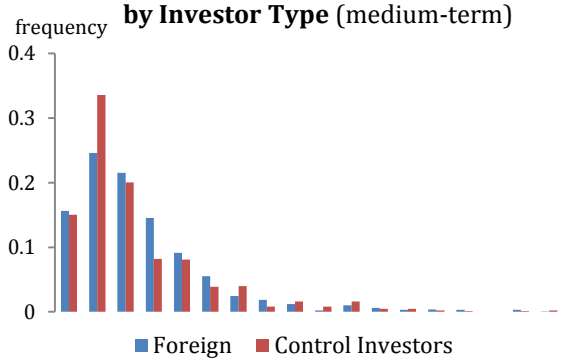
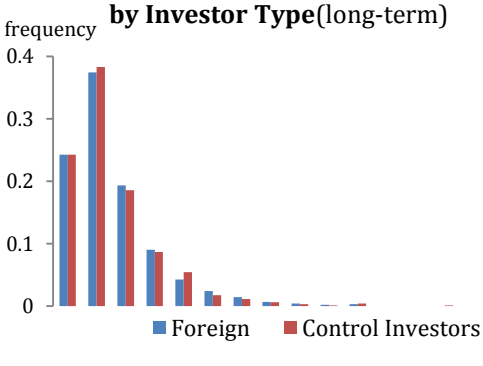


Figure 6: Distribution of Trading Size by Investor Type(long-term)



Source: Author's calculation based on ThaiBMA's data (some extreme values are not included to allow for a clearer depiction of the distribution)

Table 6 provides the estimation results of the modified model based on the first identification strategy. It is worth noting that the policy rate expectation variable is no longer statistically and economically significant, which suggests that the spreads are a reasonable approximation of the risk-premium component of the 3-year and 10-year yields.[29] Turning to the coefficient on foreign order flow, it can be seen that, for the long-term specification, the variable remains strongly statistically and economically significant. With this result, whether the influence of foreign activity in this market segment is due to information or inventory risk considerations remains inconclusive. On the other hand, the foreign order flow variable becomes statistically insignificant for the medium-term specification. This result thus provides us with our first piece evidence that perhaps the influence of foreign investors over Thai bond yield movements is through the information channel, at least in the medium-term segment.

We now turn to the results of the second identification strategy, which are reported in Table 7. It is interesting to see that the coefficient on the control investor group's order flow is not significant for both the medium- and long-term specifications. Consistent with the results found using the first identification

term segments of the Thai bond market, which also makes them similar to foreign investors above and beyond their similar trading size.

[29] At the same time, however, changes in implied volatility also become insignificant. This is somewhat surprising given that we would expect exchange rate uncertainty, which is significant in the previous section, to affect the yields through the risk-premium component. Nevertheless, the variable is only significant at 10% level in the initial estimation to begin with, at least for the long-term specification.

strategy, this result lends further support to the information hypothesis, which predicts that the order flows of similar magnitude undertaken by different customer types can have a very different impact on asset price if they (are perceived to) convey different information to the dealers. Dropping the foreign order flow variable does not change the qualitative conclusions found in the baseline specification, suggesting that that the results are robust to the potential multicolinearity issue. Through these two empirical findings, we are thus led to conclude at this stage that the influence of foreign players in the Thai market could very well be due to informational superiority.

Table 6: Impact of Foreign Order Flow on Risk Premium

Variable	Medium-term (3-2 spread)	Long-term (10-2 spread)
Constant	-0.0328 (0.49)	0.2955* (0.06)
Policy Rate Expectation (bps. Δ)	-0.0376 (0.00)	-0.1090** (0.00)
Implied FX Volatility (% Δ)	-0.0011 (0.87)	0.0071 (0.58)
UST Yield (bps. Δ)	0.0384*** (0.00)	0.0909*** (0.00)
Foreign Order Flow	-0.0003 (0.24)	-0.0010*** (0.00)
Observation #	1344	1343
Weak Instrument Rejected at %	10	10

***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively. Only variables that are statistically significant in the baseline specification in Section V are included.

Table 7: Re-estimation with Control Investor Group

Variable	1-5		5-15	
	with foreign	without foreign	with foreign	without foreign
Foreign Order Flow	-0.0007** (0.05)		-0.0018*** (0.00)	
Control Investor Order Flow	0.0001 (0.82)	7.54E-05 (0.59)	-0.0009 (0.56)	0.0014 (0.17)
Observation #	1344	1344	1343	1343
Weak Instrument Rejected at %	10	10	10	10

***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively. Only variables that are statistically significant in the baseline specification in Section V are included.

VII. Concluding Remarks

This paper attempts to provide some preliminary stylized facts about the price formation process in the Thai government bond market. To this end, it examines both the traditional framework, whereby fundamental factors are seen as major drivers of yield movements, as well as the alternative framework, whereby yield

variations may, in the presence of market frictions, also be caused by non-fundamental factors, namely market buying/selling pressures.

The regression results indicate that both frameworks are relevant in the Thai context. As might be expected, fundamental factors are important drivers of yield movements for every yield tenor considered. At the short-end of the curve, domestic factors, particularly policy rate expectations, appear to be the sole driver of yield movements. At the medium end of the curve onward, the set of statistically significant explanatory variables include both domestic (policy rate expectations, exchange rate uncertainty and country credit risk) and global (global monetary condition and perception of risk) factors. Based on economic significance, however, domestic factors remain dominant drivers of yield movements even for the tenor that is found to be most sensitive to global factors, namely the 10-year tenor.

The detected small influence of global factors on the Thai rates' may be surprising to some, given the globalized nature of today's international capital markets. When the baseline model is extended to include non-fundamental factors, however, it becomes clear that the Thai bond market is not shielded from external factors at all. Specifically, the net-buying pressure of foreign investors is found to significantly dictate the movements of medium- and long-term Thai yields. To the extent that these players' sentiments, and therefore activities, are driven by global developments, the result shows that conditions in the Thai bond market are indeed intricately linked to external conditions.

Apart from highlighting the importance of global factors, the results from the extended model also point to evidence that friction exists in the Thai market. Further empirical investigations provide reasonable, although admittedly preliminary, evidence that the nature of friction is likely to be of the informational kind; foreign players lead price movements because their activity provides price-relevant "private" information to the market, information that is (perceived to be) useful in determining the fair value of Thai yields. Viewed in this light, the Thai bond market's price discovery process may actually have been benefiting from the sizable presence of foreign players.

Looking forward, efforts could perhaps be made to reduce the degree of information asymmetry in the market, by promoting the sophistication/ active-ness of local players. This will in turn serve to ensure that the market's price discovery process is not overly dependent on foreign players (or any specific group of players, for that matter), a feature that may prove problematic in situations where player-specific events may cause certain players to no longer behave rationally or consistently with the underlying fundamentals. This way, the Thai bond market will become more resilient to idiosyncratic shocks that hit specific groups of investors, so long as other investor groups exist to continue facilitating price discovery in the market.

References

Bacchetta, P and E Van Wincoop (2006): "Can Information heterogeneity explain the exchange rate determination puzzle?", *American Economic Review*, vol 96, no 3, pp 552-576.

Bagehot, W (1971): "The Only Game in Town", *Financial Analysts Journal,* vol 27, pp 12-14 & 22.

Bellas, D, M G Papaionnou and I Petrova (2010): "Determinants of emerging market sovereign bond spreads: fundamental vs financial stress", *IMF Working Paper*, 10/281.

Brandt, M W and K A Kavajecz (2004): "Price discovery in the U.S. Treasury market: the impact of orderflow and liquidity on the yield curve", *Journal of Finance*, vol 59, no 6.

Chai-Anant, C and C Ho (2008): "Understanding Asian equity flows, market returns and exchange rates", *BIS Working Paper*, no 245.

Cohen, B H and H S Shin (2003): "Positive feedback trading under stress: Evidence from the US Treasury securities market", *BIS Working Paper*, no 122.

Eichengreen, B and A Mody (2000): What explains changing spreads on emerging market debt?" *NBER Chapters* in: "Capital flows and the emerging economies: theory, evidence, and controversies", pp 107-36, National Bureau of Economic Research.

Engen, E and G Hubard (2004): "Federal government debt and interest rates", *NBER Working Paper*, no 1068.

Evan, M D D and R K Lyons (2002): "Order flow and exchange rate dynamics", *Journal of Public Economy*, vol 110, no 1, pp 170-180.

Fleming, M J and E M Remolona (1997): "What moves the bond market", *Federal Reserve Bank of New York Research Paper*, no 9706.

Faini, R (2006): "Fiscal policy and interest rates in Europe", *Economic Policy*, pp 443-89.

Gadanecz, B, K Miyajima and C Shu (2014): "Exchange rate risk and local currency sovereign bond yields in emerging markets", *BIS Working Paper*, no 474.

Garman, M (1976): "Market Microstructure", *Journal of Financial Economics*, vol 3, pp 257-275.

Gereben, A, G Gyomai and Kiss M. N (2006): "Customer order flow, information and liquidity on the Hungarian foreign exchange market, *Bank of Hungary Working Paper*, 2006/8.

Girardi, A and C Impenna (2013): “Price discovery in the Italian sovereign bonds market: the role of order flow”, *Bank of Italy Working Paper*, no 906.

Glosten, L R and P R Milgrom (1985): “Bid, ask, and transaction prices in a specialist market with heterogeneously informed traders”, *Journal of Financial Economics*, vol 14, pp 71-100.

Gonzalez-Rozada, M and E Levy-Yeyati (2008): “Global factors and emerging market spreads”, *the Economic Journal*, no 118.

Green, C (2004): “Economic News and the Impact of Trading on Bond Prices”, *Journal of Finance*, vol 59, pp 1201-1233.

Hartelius, K, K Kashiwase and L E Kodres (2008): “Emerging market spread compression: is it real or it is liquidity?”, *IMF Working Paper*, 08/10.

Hasbrouck, J and G Sofianos (1993): “The trades of market makers: an empirical analysis of NYSE specialists”, *Journal of Finance*, vol 48, no 5, pp 1565-1593.

Ho, T and H R Stoll (1981): "Optimal dealer pricing under transactions and return uncertainty," *Journal of Financial Economics*, Elsevier, vol 9, no 1, pp 47-73.

——— (1983): " The dynamics of dealer markets under competition", *Journal of Finance*, vol 38, no 4, pp 1053-74.

Huang, R D and Stoll H R (1997): “The components of the bid-ask spread: a general approach”, *Review of Financial Studies*, vol 10, no 4, pp 995 – 1034.

Kyle, A S (1985): “Continuous Auctions and Insider Trading”, *Econometrica*, vol 53, no 6, pp1315-1336.

Laubach, T (2009): “New evidence on the interest rate effects of budget deficits and debt”, *Journal of European Economic Association*, vol 7, pp 858-85.

Lyons, R K (1993): “Tests of microstructural hypotheses in the foreign exchange market”, *NBER Working Paper*, no 4471.

Madhavan, A and S Smidt (1993): “An analysis of changes in specialist inventories and quotations”, Journal of Finance, vol 48, pp 1595-1628.

Marsh, I W and C O’Rouke (2005): “Customer order flow and exchange rate movements: is there really information content?”, *Cass Business School Research Paper.*

McGuire, P and M A Schrijvers (2003): “Common factors in emerging market spreads”, *BIS Quarterly Review*, December.

Meese, R and K S Rogoff (1983): “Empirical exchange rate models of the seventies: do they fit out of sample?”, Journal of International Economics, vol 14, pp 3-14

Miyajima, K, M S Mohanty and T Chan (2012): "Emerging market local currency bonds: diversification and stability", BIS Working Paper, no 391

Nelson, C and A F Siegel (1987): "Parsimonious modeling of yield curves", *Journal of Business*, vol 60, pp 473-489.

Park C, R Mercado, J Choi, and H Lim (2015): "Price discovery and foreign participation in the Republic of Korea's government bond cash and futures markets", *ADB Economics Working Paper*, no 427.

Pavabutr, P and H Yan (2014): "Differential impact of foreign portfolio flows on emerging market returns: evidence from Thailand", a paper presented at the 21st Sarttrajan Sangvien Intaravichai Financial Markets Seminar, Thammasat University, Thailand.

Payne, R G (2003): "Informed trade in spot foreign exchange markets: an empirical investigation", *Journal of International Economics*, vol 61, pp 307-329.

Peiris, S J (2010): "Foreign participation in emerging markets' local currency bond markets", *IMF Working Paper*, 10/88.

Pijak, V (2013): "Bond markets co-movements dynamics and macroeconomic factors: evidence from emerging and frontier markets" *Emerging Markets Review*, vol 17, pp 29-43.

Poghosyan, T. (2012): "Long-run determinants of sovereign bond yields in advanced economies", *IMF Working Paper*, 12/271.

Stock, J H, and M Yogo (2005), "Testing for weak instruments in linear IV regression", Chapter 5 in J H Stock and D W K Andrews (eds), "Identification and inference for econometric models: essays in honours of Thomas J. Rothenberg", Cambridge University Press

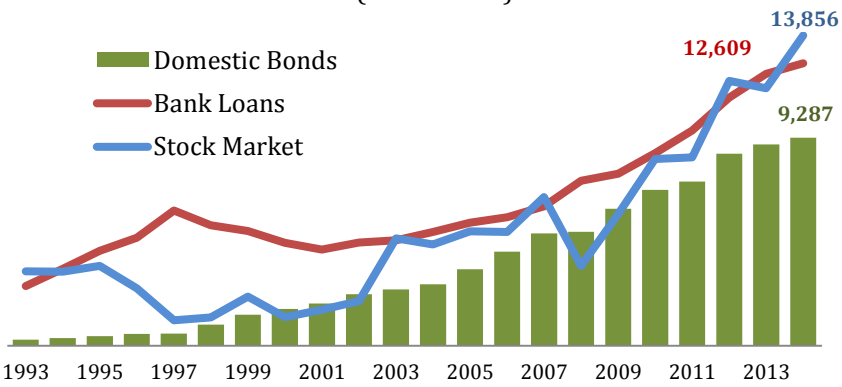
Stoll, H R (1978): "The supply of dealer services in securities markets", *Journal of Finance*, vol 33, no 4, pp 1133-1151.

Valseth, S (2010): "Forecasting short yield changes using order flow: is dealer skill a source of predictability", *UiS Working Paper in Economics and Finance*, 2010/12, University of Stavanger.

Vayanos, D and J Vila (2009): "A preferred-habitat model of the term structure of interest rates", *NBER Working Paper*, no 15487.

Appendix

Figure A: Size of Thailand's Financial Sectors
(billion baht)



Source: ThaiBMA

Table A: Correlations between Independent Variables

	Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Change in Domestic Factors	1) Implied Forward Rate (bps)									
	2) SET Index (%)	-0.02								
	3) 5Y Thai CDS (bps)	-0.04	-0.34							
	4) Implied FX Vol (%)	-0.03	-0.04	0.02						
	5) ST Supply (%)	0.03	0.00	0.01	-0.01					
	6) MT Supply (%)	0.02	0.01	0.00	-0.03					
	7) LT Supply (%)	-0.04	-0.01	-0.02	0.03					
	8) VLT Supply (%)	-0.01	0.03	0.00	0.01					
Change in Global Factors	9) VIX (%)	0.00	-0.25	0.30	0.05	0.01	-0.01	-0.01	0.00	
	10) 6M UST Yield (bps)	0.05	0.03	-0.08	0.00	-0.01	0.00	0.00	-0.05	-0.02
	11) 3Y UST Yield (bps)	-0.01	0.05	-0.11	-0.01	-0.05	0.02	0.00	0.00	-0.28
	12) 10Y UST Yield (bps)	0.00	0.09	-0.20	-0.02	-0.02	0.02	-0.01	0.01	-0.42

Table B: Descriptive Statistics of Dependent and Independent Variables

		Mean	Max	Min	Std. Dev.
Change in Dependent Variable	6M Thai Yield (bps)	0.01	9.12	-26.28	1.64
	3Y Thai Yield (bps)	-0.10	15.14	-18.55	2.47
	10Y Thai Yield (bps)	-0.11	23.26	-22.49	3.44
	15Y Thai Yield (bps)	-0.10	20.92	-20.53	2.69
Change in Domestic Factors	Implied Forward Rate (bps)	0.03	39.00	-24.00	2.75
	SET Index (%)	0.06	5.92	-5.65	1.10
	5Y Thai CDS (bps)	0.00	32.38	-41.47	4.19
	Implied FX Volatility (%)	0.14	69.51	-29.52	5.44
	ST Bond Supply (%)	0.03	24.52	-18.14	1.38
	MT Bond Supply (%)	0.04	29.60	-14.70	1.38
	LT Bond Supply (%)	0.05	6.18	-18.26	0.90
	VLT Bond Supply (%)	0.13	8.71	-20.56	1.14
Change in Global Factors	VIX (%)	-0.01	40.55	-35.06	7.15
	6M UST yield (bps)	-0.01	6.00	-6.00	0.91
	3Y UST yield (bps)	-0.04	16.00	-16.00	3.81
	10Y UST yield (bps)	-0.11	24.00	-24.00	5.67

Table C: Descriptive Statistics of Investor-Specific Order Flows

	Mean (mil baht)	Std. Dev.
ST Local	22,446	18,369
ST Foreign	1,346	4,400
MT Local	43	902
MT Foreign	50	1,331
LT Local	326	1,075
LT Foreign	346	1,223
VLT Local	143	621
VLT Foreign	37	275

Table D: Robustness Check: SET Index Dropped

Variable	0-1	1-5	5-15	15+
Constant	0.00E+00**	0.00E+00	0.00E+00	0.00E+00
	(0.03)	(0.71)	(0.70)	(0.66)
Policy Rate Expectation (bps. Δ)	0.8106***	0.5874***	0.4948***	0.4174***
	(0.00)	(0.00)	(0.00)	(0.00)
Bond Supply (% Δ)	0.0297**	-0.0284	0.0795	0.0367
	(0.05)	(0.42)	(0.22)	(0.46)
CDS Spread (bps. Δ)	0.0032	-0.0031	0.0516**	0.0392**
	(0.67)	(0.87)	(0.03)	(0.04)
Implied FX Volatility (% Δ)	0.0034	0.0205	0.0341**	0.0268**
	(0.47)	(0.12)	(0.03)	(0.04)
UST Yield (bps. Δ)	-0.0547	0.1126***	0.1982***	0.1481***
	(0.14)	(0.00)	(0.00)	(0.00)
VIX (% Δ)	-0.0047	-0.0015	0.0384**	0.0270**
	(0.54)	(0.91)	(0.01)	(0.03)
Adjusted R-Squares	0.43	0.12	0.12	0.12
Observation #	1344	1344	1343	1344

***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively.

Table E: Robustness Check: VIX Dropped

Variable	0-1	1-5	5-15	15+
Constant	0.00E+00**	0.00E+00	0.00E+00	0.00E+00
	(0.04)	(0.68)	(0.74)	(0.68)
Policy Rate Expectation (bps. Δ)	0.8118***	0.5896***	0.4911***	0.4155***
	(0.00)	(0.00)	(0.00)	(0.00)
SET Index (% Δ)	0.0344	0.0642	-0.1414	-0.0801
	(0.32)	(0.50)	(0.31)	(0.42)
Bond Supply (% Δ)	0.0294**	-0.0291	0.0728	0.0397
	(0.05)	(0.41)	(0.26)	(0.41)
CDS Spread (bps. Δ)	0.0039	0.0019	0.0542**	0.0427**
	(0.66)	(0.91)	(0.02)	(0.04)
Implied FX Volatility (% Δ)	0.0034	0.0208	0.0353**	0.0277**
	(0.48)	(0.10)	(0.03)	(0.04)
UST Yield (bps. Δ)	-0.0552	0.1131***	0.1807***	0.1357***
	(0.14)	(0.00)	(0.00)	(0.00)
Adjusted R-Squares	0.43	0.13	0.12	0.12
Observation #	1344	1344	1343	1344

***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively.

Table F: Robustness Check: CDS Dropped

Variable	0-1	1-5	5-15	15+
Constant	0.00E+00**	0.00E+00	0.00E+00	0.00E+00
	(0.04)	(0.69)	(0.76)	(0.70)
Policy Rate Expectation (bps. Δ)	0.8111***	0.5894***	0.4868***	0.4121***
	(0.00)	(0.00)	(0.00)	(0.00)
SET Index (% Δ)	0.0242	0.0624	-0.1517	-0.0917
	(0.45)	(0.52)	(0.25)	(0.35)
Bond Supply (% Δ)	0.0297**	-0.0291	0.0727	0.0402
	(0.05)	(0.41)	(0.25)	(0.41)
Implied FX Volatility (% Δ)	0.0036	0.0208	0.0334**	0.0263**
	(0.45)	(0.10)	(0.04)	(0.05)
UST Yield (bps. Δ)	-0.0566	0.1131***	0.1946***	0.1454***
	(0.13)	(0.00)	(0.00)	(0.00)
VIX (% Δ)	-0.0032	0.0004	0.0405***	0.0294**
	(0.68)	(0.97)	(0.01)	(0.01)
Adjusted R-Squares	0.43	0.13	0.12	0.12
Observation #	1344	1344	1343	1344

***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively.

Table G: Impact of Investor-specific Order Flow on Thai Bond Yields (full results)

Variable	0-1	1-5	5-15	15+
Constant	0.0800	0.0399	0.2859	-0.0684
	(0.85)	(0.72)	(0.58)	(0.49)
Policy Rate Expectation (bps. Δ)	0.8120***	0.6808***	0.5746***	0.4200***
	(0.00)	(0.00)	(0.00)	(0.00)
SET Index (% Δ)	0.0283	0.0774	-0.0519	-0.0505
	(0.37)	(0.43)	(0.70)	(0.60)
Bond Supply (% Δ)	0.0293**	-0.0032	-0.1245	0.0410
	(0.05)	(0.93)	(0.51)	(0.41)
CDS Spread (bps. Δ)	0.0057	-6.56E-05	0.0214	0.0354**
	(0.47)	(1.00)	(0.37)	(0.05)
Implied FX Volatility (% Δ)	0.0037	0.0252**	0.0263*	0.0266**
	(0.44)	(0.05)	(0.09)	(0.05)
UST Yield (bps. Δ)	-0.0526	0.1099***	0.1607***	0.1467***
	(0.42)	(0.00)	(0.00)	(0.00)
VIX (% Δ)	-0.0038	-0.0134	0.0250	0.0249**
	(0.60)	(0.45)	(0.14)	(0.04)
Foreign Order Flow	7.01E-06	-0.0010*	-0.0014***	-0.0002
	(0.74)	(0.08)	(0.01)	(0.73)
Local Order Flow	1.08E-07	-0.0004	0.0005	0.0002*
	(1.00)	(0.50)	(0.61)	(0.10)
Observation #	1344	1344	1343	1344
Weak Instrument Rejected at %	0.15	0.15	0.25	N/A

***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively.

Table H: Examining the Role of Market Liquidity (full results)

Variable	1-5	5-15
Constant	0.0865	1.0450***
	(0.43)	(0.00)
Policy Rate Expectation (bps. Δ)	0.0400***	-0.0130***
	(0.00)	(0.00)
SET Index (% Δ)	0.0812	-0.0075
	(0.42)	(0.96)
Bond Supply (% Δ)	0.0111	-0.4004
	(0.80)	(0.24)
CDS Spread (bps. Δ)	-0.0109	0.0132
	(0.59)	(0.69)
Implied FX Volatility (% Δ)	0.0219*	0.0168
	(0.09)	(0.40)
UST Yield (bps. Δ)	0.1016***	0.1278***
	(0.00)	(0.00)
VIX (% Δ)	-0.0112	0.0073
	(0.54)	(0.74)
Foreign Order Flow	-0.0019**	-0.0039***
	(0.02)	(0.00)
Foreign Order Flow * Trading Volume	1.03E-07*	1.49E-07**
	(0.09)	(0.01)
Observation #	1344	1343
Weak Instrument Rejected at %	15	25

***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively.

t