The Beneficial Aspect of Asset Price Volatility for Market Liquidity: Evidence from the Thai Foreign Exchange Market

Jakree Koosakul and Ilhyock Shim

PIER Research Exchange

3 November 2016

Introduction

- Negative aspects of market volatility for market liquidity already widely explored
- Positive aspects much less so …
  - Our paper explores the notion that by increasing the scope for profit making, market volatility can foster market liquidity.
- Direct policy implication for central bank FX stabilisation policy

Outline

- Related Literature
- Empirical Methodology
- Baseline Results
- Further Discussion
- Conclusions

Related Literature

1. Impact of market volatility on economic and financial variables
2. Market microstructure on the (non-causal) volatility-liquidity dynamics
3. Drivers of market liquidity

1. Impact of market volatility on economic/financial variables

Large literature on the potential harm of market volatility

- **Real-sector side:**
  - Obstfeld and Rogoff (1998) – volatility reduces welfare by 1) creating fluctuations in domestic income from international trade 2) causing higher price levels as firms incorporate FX risk premiums into price
  - Aghion et al (2009) and Grier and Smallwood (2007) empirically show that FX volatility negatively affects growth and trade performance
- **Financial market side: impact on market liquidity**
  - Market-maker perspective:

    => high volatility leads to high liquidation risk (Demsetz, 1968, Stoll 1978, and Ho and Stoll, 1981)
  - End-investor perspective:

    => high volatility keeps prospective investors out of the market (Pagano, 1989)

    => volatility causes traders' funding constraint to tighten, impairing their ability to provide market liquidity (Brunnermeier and Pedersen, 2009)

1. Impact of market volatility on econ/fin variables (cont.)

Positive aspects much less explored…

From financial market perspective:

- Herrera (2005)'s theoretical model of endogenous market entry:
  - In the presence of entry cost, traders may have little incentive to enter a market unless it is sufficiently volatile, such that there is potential gain from trading.

- **This paper** empirically investigates the potential positive aspect of market volatility

2. Market microstructure on the (non-causal) volatility-liquidity dynamics

- Our hypothesis *not* the first to suggest a positive liquidity-volatility relationship
  - **Clark's mixture of distribution hypothesis (1973)**:

    Volatility and trading volume positively co-move because they are both affected by new information released to the market.
    - Empirical support provided by numerous papers

      - stock market: Karpoff (1987), Canarella and Pollard (2011), Carroll and Kearney (2015).

      - FX market: Galati (2001), Bauwens et al (2006), Rime and Sucarrat (2007).

- **This paper** attempts to control for this channel.
  - Any remaining positive coefficient on market volatility on trading volume therefore evidence in support of **a more casual relationship** between volatility and volume.

3. Determinants of Market Liquidity

Extensive research on determinants of aggregate liquidity

- Cross-sectional determinants: Demsetz (1968), Benston and Hagerman (1974) and Stoll (1978)
- Time-times determinants: Chordia et al (2001), Hameed et al (2010), and Karnaukh et al (2015)
  - Market volatility
  - Investors' risk appetite to trade
  - Market makers' willingness/ability to provide liquidity
  - Monetary conditions
  - Seasonality / asymmetry in down and up markets

- **This paper** explores determinants of **both aggregate and participant-level** liquidity:
  - Interesting/important given segmented/diverse structure of FX market
  - unclear – ex ante – whether aggregate results obtained in previous studies hold at a more granular level.

Empirical Methodology

$$liquidity_t = \beta_0 + \beta_1\, volatility_t + \boldsymbol{X_t\delta} + \epsilon_t$$

Market activity as a measure of **market trading liquidity**

- **Trading volume**
- Frequency
- Size

Realized volatility

- **high-low volatility**
- within-week SD
- EWMA

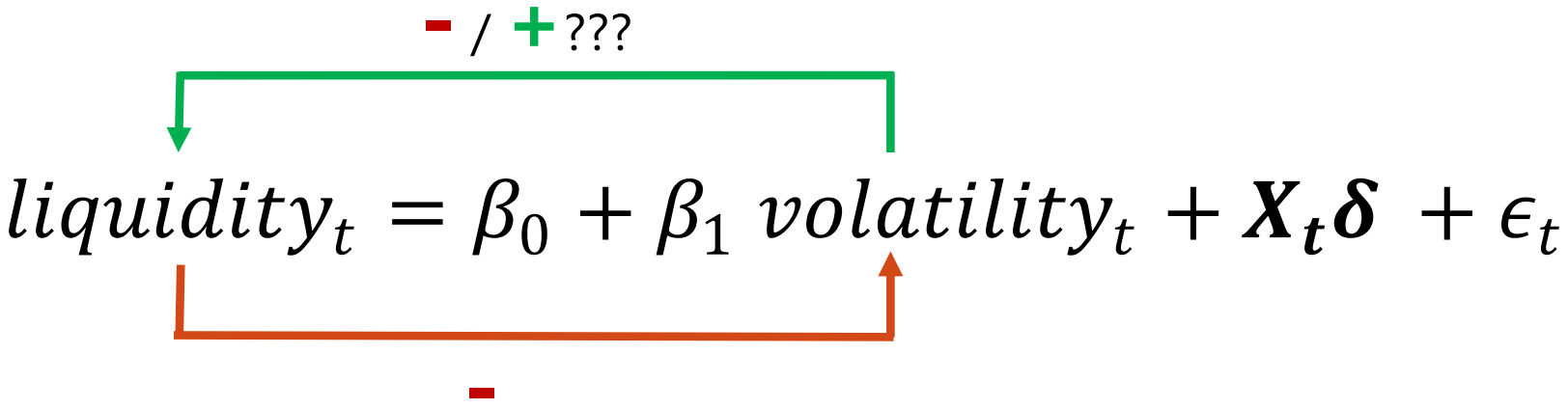
Implied volatility

Other factors

- Investors' risk appetite to trade (VIX)
- Market makers' willingness/ability to provide liquidity (Thai banks' net FX position)
- Monetary conditions (TH policy rate / UST 10Y)
- Seasonality / asymmetry in down and up markets

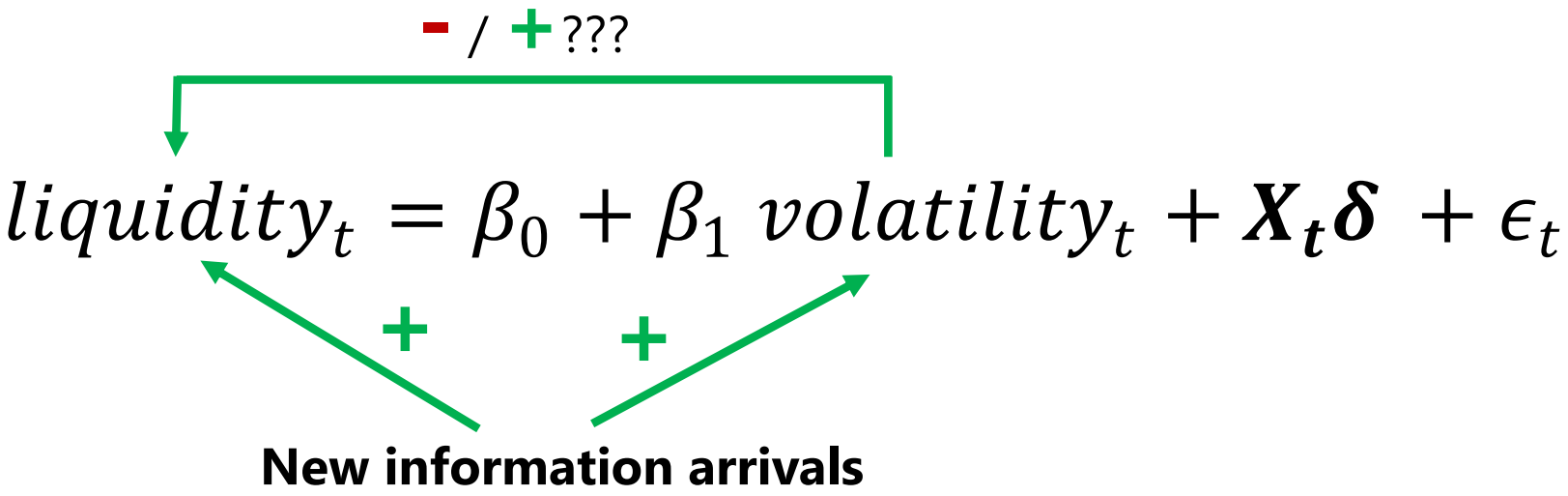
Estimated using OLS, with HAC standard errors. Weekly frequency, utilizing **market activity data from the BOT**. Sample period: 04/01/2010 – 18/03/2016.

Potential Endogeneity (1): Reverse Causality



- Deep markets inhabited by numerous rational speculators should be less volatile than shallower ones (Friedman, 1953)
- In deep markets the uncorrelated demands of investors are so many they should cancel one another out (Pagano, 1989)

Potential Endogeneity (2): Omitted Variable



Mixture of distribution hypothesis (Clark, 1973): daily price changes and trading volume are both positively driven by the same underlying latent "news"-arrival, or information flow, variable.

Potential Endogeneity (2): Omitted Variable (cont.)

$$liquidity_t = \beta_0 + \beta_1\, volatility_t + \boldsymbol{X_t\delta} + \epsilon_t$$

Market activity as a measure of **market trading liquidity**

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Realized volatility
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Information arrival proxies
- **Bond price volatility**
- **Stock price volatility**

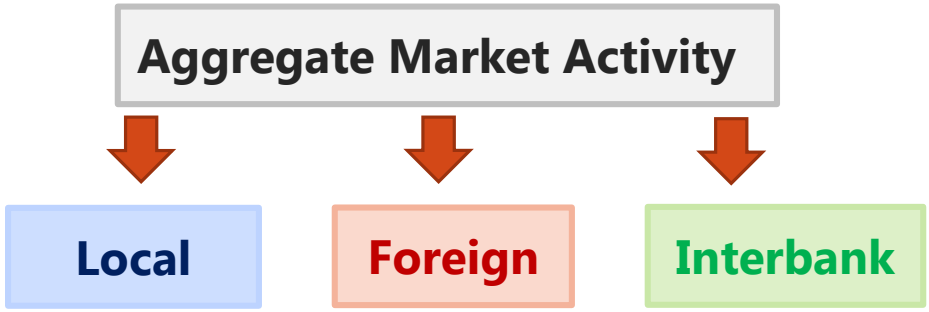
Baseline Results

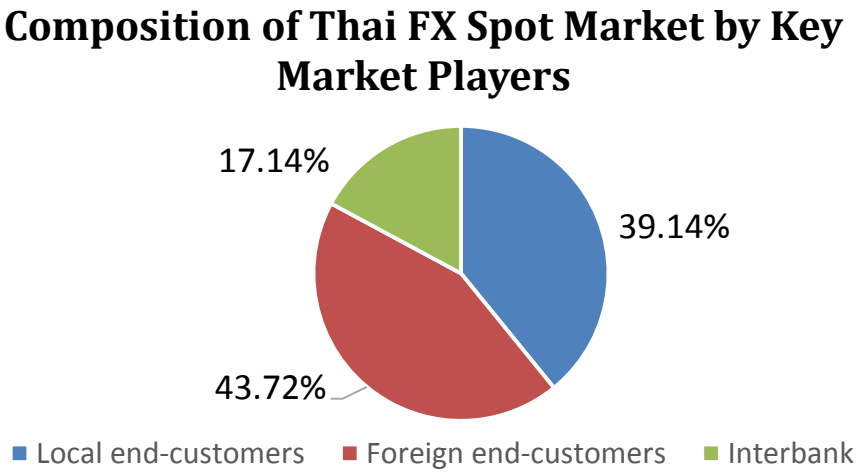
Drivers of Aggregate Liquidity

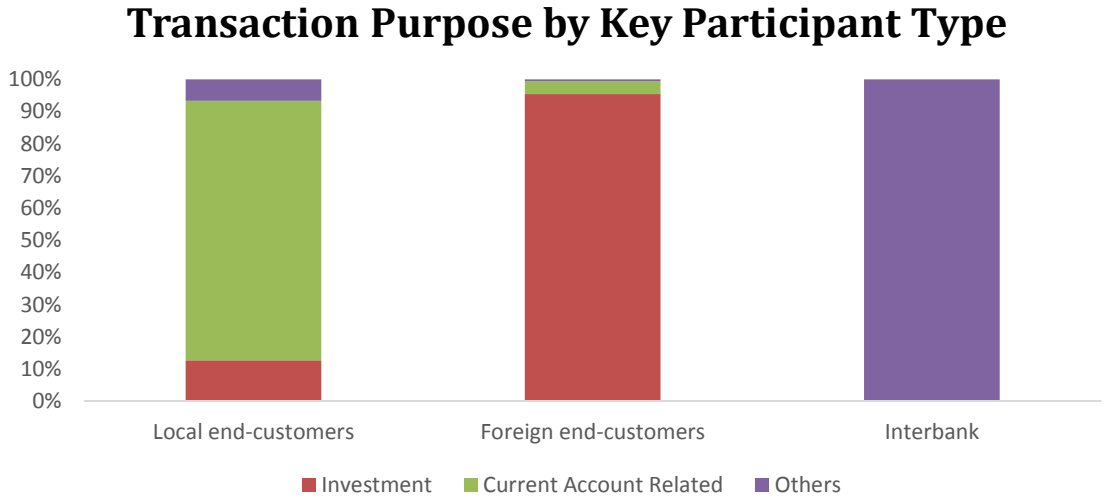
Variable	(1)	(2)	(3)
FX Volatility	**1.36E+03*** **	**1.31E+03*** **	**1.08E+03*** **
FX Return		786.14***	711.52***
Policy Rate*		-38.32***	-36.59***
UST 10Y*		-14.14*	-16.91**
VIX		-27.07**	-40.03***
Bank's Net FX Position		0.43***	0.41***
Stock Volatility			1.72E+03***
Bond Volatility			-408.06
Constant/Monthly Dummies	Yes/No	Yes/Yes	Yes/Yes
Adjusted R-squared	0.07	0.33	0.37
Observation #	324	324	324

Numbers in brackets are p-values. ***, ** and * indicate statistical significance at 1%, 5%, and 10%, respectively. * Modelled as deviations from one-month average to ensure stationarity. Otherwise, all other variables are already stationary in level. Correlation analysis has also been conducted to ensure that the results are not driven by multicollinearity issues.

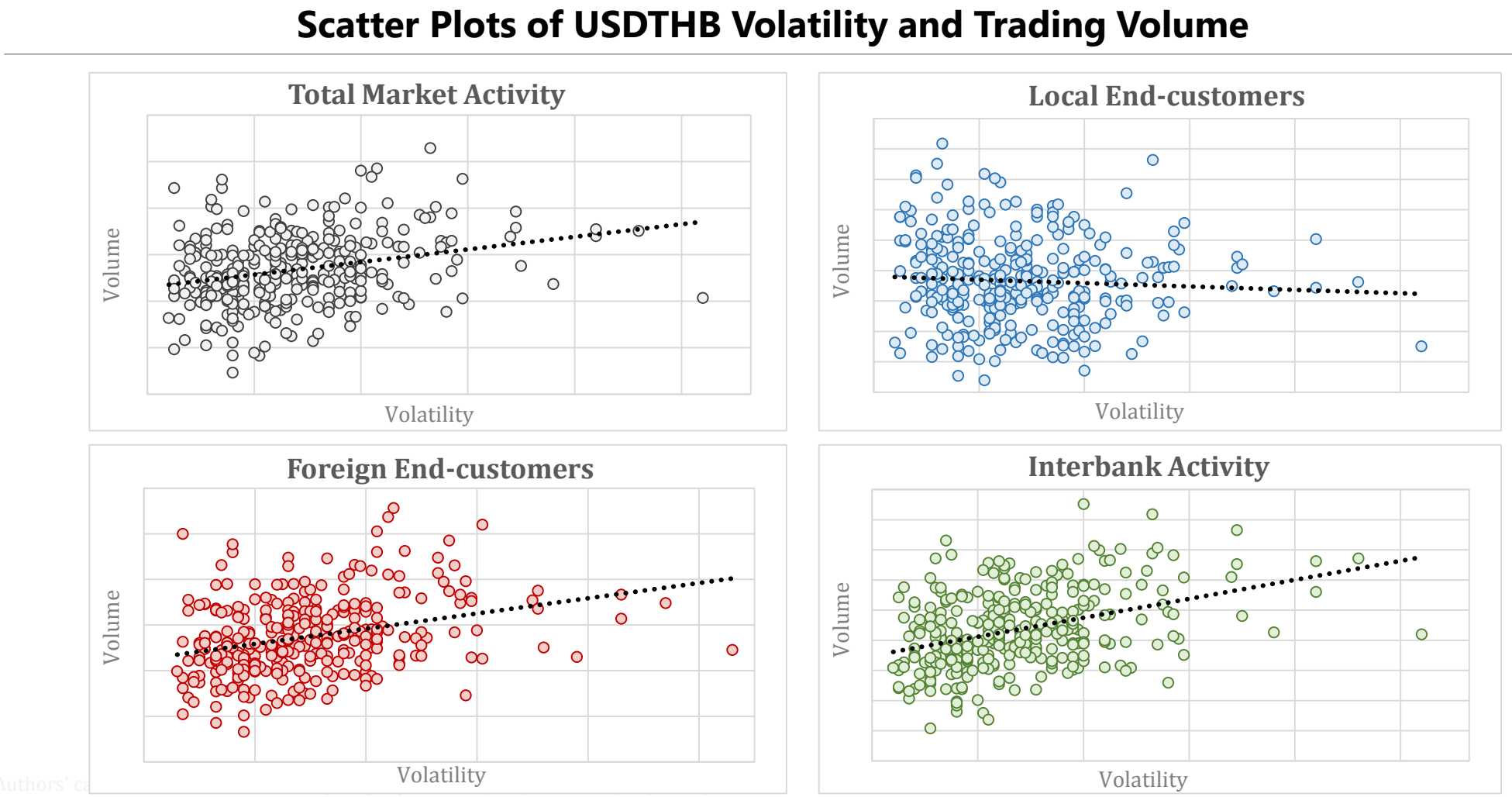
Volatility-liquidity dynamics at a more granular level…







Volatility-liquidity dynamics at a more granular level…



Source: Authors' ca

Volatility-liquidity dynamics at a more granular level…

Drivers of Participant-Level Liquidity

Variable	Local^^	Foreign	Interbank
FX Volatility	**-215.19****	**714.44*****	**479.87*****
FX Return	123.58	207.47	**241.70*****
Policy Rate^	-408.20	-12.41	**-10.51*****
UST 10Y^	-254.42	-4.62	**-5.17****
VIX	4.08	**-14.07****	**-15.40*****
Bank's Net FX Position	-0.15	**0.18*****	**0.11*****
Stock Volatility	239.28	**687.87***	**609.01*****
Bond Volatility	-481.12	1.04E+03	614.21
Constant/Monthly Dummies	Yes/Yes	Yes/Yes	Yes/Yes
Adjusted R-squared	0.05	0.28	0.45
Observation #	324	324	324

Numbers in brackets are p-values. ***, ** and * indicate statistical significance at 1%, 5%, and 10%, respectively. ^ Modelled as deviations from one-month average to ensure stationarity. ^^ To ensure stationarity, local activity is modelled in first differences. Accordingly, explanatory variables for the local specification are also re-modelled in first differences.

Further Discussion

A. Potential Remaining Endogeneity

B. Alternative Measures of Liquidity and Volatility

C. Non-Linearity

A. Potential Remaining Endogeneity

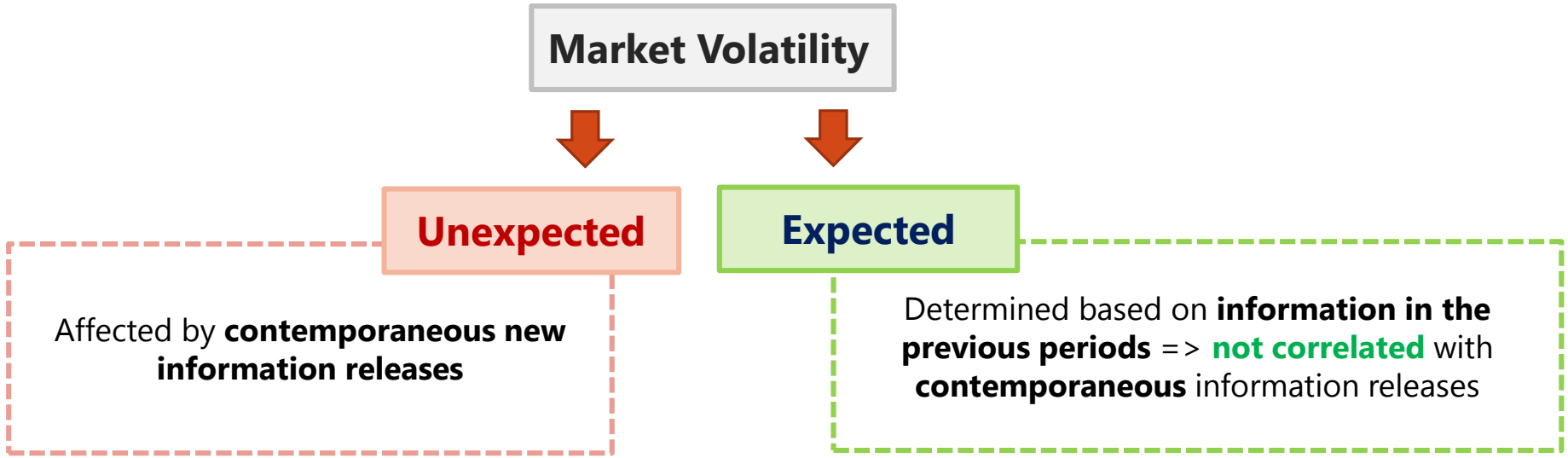
- Stock and bond market volatilities may not be sufficient in capturing new arrivals of all FX-relevant information.
  - Explore additional measures of information arrivals
    1. Citigroup Economic Surprises Indices (CESI) for TH, DM and US.
    2. Order-flow – private information relevant for asset price determination (Bagehot, 1971, Glosten and Milgrom, 1985, Kyle, 1985, and Evan and Lyons, 2002)

Variable	Total		Foreign		Interbank	
FX Volatility	**1.06E+03*** **	**922.49*** **	**699.49*** **	**612.35*** **	**479.27*** **	**447.51*** **
Stock Volatility	1.59E+03**	1.54E+03***	591.03	574.61*	565.87***	573.11***
Bond Volatility	-417.53	-938.26	945.57	702.18	540.09	507.68
CESI for Thailand	-0.16		-0.14		-0.24	
CESI for US	**5.52*** **		**3.11** **		**1.85***	
CESI for Developed Markets^	**8.29** **		**5.97** **		**1.58*** **	
Foreign FX Order-Flow		**2.09*** **		**1.32*** **		**0.42*** **
Constant/Monthly Dummies	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes
Adjusted R-squared	0.36	0.42	0.27	0.36	0.44	0.45
Observation #	324	324	324	324	324	324

Numbers in brackets are p-values. ***, ** and * indicate statistical significance at 1%, 5%, and 10%, respectively. ^ The CESI for developed markets series is first regressed on the CESI for US series, such as the post-transformed series reflects surprises above and beyond those from US news.

A. Potential Remaining Endogeneity

- Stock and bond market volatilities may not be sufficient in capturing new arrivals of all FX-relevant information.



$$liquidity_t = \theta_0 + \theta_1\, ex\_volatility_t + \theta_2\, unex\_volatility_t + \boldsymbol{X_t\gamma} + \nu_t$$

Further Discussion: Potential Remaining Endogeneity (cont)

Expected and Unexpected Volatilities

Variable	Total	Foreign	Interbank
Expected FX Volatility	**3.62E+03*** **	**2.29E+03*** **	**1.32E+03*** **
Unexpected FX Volatility	626.51**	433.53**	329.23***
FX Return	562.10**	118.03	192.78**
Policy Rate*	-33.16***	-10.26	-9.38***
UST 10Y*	-17.28***	-4.91	-5.32**
VIX	-35.58***	-11.36*	-13.96***
Bank's Net FX Position	0.43***	0.20***	0.11***
Stock Volatility	1.29E+03**	429.04	468.70***
Bond Volatility	291.33	1.39E+03	844.19
Constant/Monthly Dummies	Yes/Yes	Yes/Yes	Yes/Yes
Adjusted R-squared	0.37	0.30	0.47
Observation #	322	322	322

Numbers in brackets are p-values. ***, ** and * indicate statistical significance at 1%, 5%, and 10%, respectively. * Modelled as deviations from one-month average to ensure stationarity.

B. Alternative Measures of Liquidity and Volatility

$$liquidity_t = \beta_0 + \beta_1\, volatility_t + \boldsymbol{X_t\delta} + \epsilon_t$$

Market activity as a measure of **market depth**

-Trading volume
-**Trading Frequency**
-**Trading Size**

Realized volatility
- high-low volatility
- **within-week standard deviation**
- **exponentially weighted moving average (EWMA)**

Implied volatility (options-implied)

Further Discussion: Alternative Measures of Liquidity

Trading Frequency

Variable	Local^^	Foreign	Interbank
FX Volatility	-161.01	**318.14*** **	**306.28*** **
FX Return	679.23	**154.55*** **	**110.45*** **
Policy Rate^	15.78	**-7.97*** **	**-6.85*** **
UST 10Y^	-1.13E+03	**-2.09***	**-2.51****
VIX	15.78	**-7.97*** **	**-6.85*** **
Bank's Net FX Position	-0.38	0.00	-0.01
Stock Volatility	1.16E+03	140.30	89.60
Bond Volatility	-2.17E+03	758.16	553.62
Constant/Monthly Dummies	Yes/Yes	Yes/Yes	Yes/Yes
Adjusted R-squared	-0.03	0.50	0.55
Observation #	324	324	324

Numbers in brackets are p-values. ***, ** and * indicate statistical significance at 1%, 5%, and 10%, respectively. ^ Modelled as deviations from one-month average to ensure stationarity. ^^ To ensure stationarity, local activity is modelled in first differences. Accordingly, explanatory variables for the local specification are also re-modelled in first differences.

Further Discussion: Alternative Measures of Liquidity

Trading Size

Variable	Local^^	Foreign	Interbank
FX Volatility	-3.26E-03	-0.04	**-0.19*** **
FX Return	2.90E-03	-0.03	-0.01
Policy Rate^	-8.22E-04	2.37E-03	2.98E-03
UST 10Y^	7.63E-05	7.98E-04	6.76E-04
VIX	8.91E-04	-1.97E-04	-1.19E-04
Bank's Net FX Position	-1.49E-02	**4.48E-05*** **	**3.86E-05*** **
Stock Volatility	1.13E-06	**0.20***	**0.29** **
Bond Volatility	1.58E-03	-0.13	-0.22
Constant/Monthly Dummies	Yes/Yes	Yes/Yes	Yes/Yes
Adjusted R-squared	0.00	0.15	0.25
Observation #	324	324	324

Numbers in brackets are p-values. ***, ** and * indicate statistical significance at 1%, 5%, and 10%, respectively. ^ Modelled as deviations from one-month average to ensure stationarity. ^^ To ensure stationarity, local activity is modelled in first differences. Accordingly, explanatory variables for the local specification are also re-modelled in first differences.

Further Discusion: Alternative Measures of Volatility

Sign and Significance of Coefficient on Volatility under Alternative Measures

Measure of Activity	Entity Type	Baseline	Intraweek SD	EWMA	Implied Vol
Volume	Total				
	Local^				
	Foreign				
	Interbank				
Frequency	Local^				
	Foreign				
	Interbank				
Size	Local^				
	Foreign				
	Interbank				

Green (red) coloured boxes denote the specifications where the coefficient on market volatility is statistically significantly positive (negative). Grey coloured boxes denote specifications where the coefficient is not statistically significant. ^ To ensure stationarity, variables in the local specification are modelled in first differences.

C. Non-Linearity in the Volatility-Liquidity Dynamics

- Possible that the observed positive relationship holds only up to a certain level of volatility.

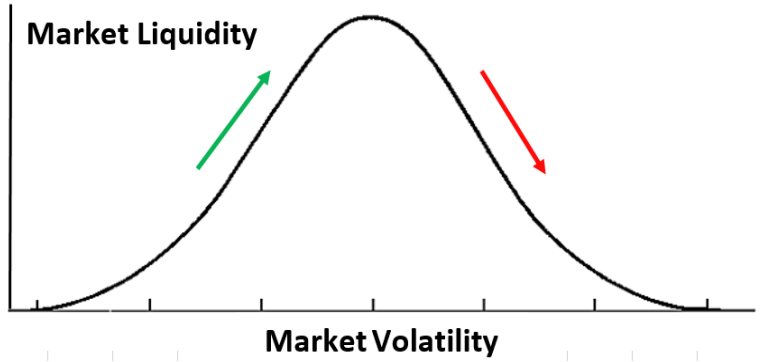
Market Volatility

Normal Level

Enhances market liquidity by increasing the scope for profit making (Herrera, 2005), thereby attracting investors into the market.

High Level

Reduces market liquidity by:
- Keeping prospective investors out of the market (Pagano, 1989)
- Affecting traders' ability to provide liquidity as funding constraints tighten (Brunnermeier and Pedersen, 2009)



$$liquidity_t = \rho_0 + \rho_1 volatility_t + \rho_2 \boldsymbol{volatility_t * D_t} + \boldsymbol{X_t \omega} + \eta_t$$

C. Non-Linearity in the Volatility-Liquidity Dynamics

Variable	Total	Local	Foreign	Interbank
95th percentile				
FX Vol	**1.40E+03*** **	-295.11**	**1.01E+03*** **	**604.83*** **
FX Vol 95 * FX Vol	-436.08	273.65	**-406.95** **	**-171.78** **
Adjusted R-Squared	0.37	0.06	0.29	0.46
99th percentile				
FX Vol	**1.31E+03*** **	-242.79**	**872.63*** **	**533.63*** **
FX Vol 99 * FX Vol	**-822.10** **	198.80	**-568.16*** **	**-193.10** *
Adjusted R-Squared	0.37	0.05	0.29	0.46
Observation #	324	324	324	324

Numbers in brackets are p-values. ***, ** and * indicate statistical significance at 1%, 5%, and 10%, respectively. Again, the local specification is estimated in first differences to ensure stationarity. Because of this, the dummy variable for this specification is also changed to match the first differences model. Specifically, the dummy variable takes the value of one if the change in volatility exceeds the 95th and 99th percentiles of the sample period values.

Summary of Key Findings

- **On average**, market volatility has a significant **positive *causal* effect** on market liquidity, in line with the theoretical prediction offered by Herrera (2005)'s model.
- **At high levels** of volatility, the **beneficial aspect** significantly **diminishes**.
- **Significant participant-level heterogeneity** in the volatility-liquidity dynamics, with real businesses averse to volatility and financial players attracted to it.
- Direct policy **implications for central bank intervention**.
  - Strategy to drive down FX volatility may not be optimal in all cases.
  - Intervention affects not only level of participation, but also composition of players in the market.