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A Preliminary Assessment of Drivers of Philippine FX Market Liquidity

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Abstract

This study provides a preliminary analysis of liquidity in the Philippine FX market using the FX market illiquidity indicator proposed by Karnaukh et al. (2015). Using an event-study approach, the impact of specific domestic, regional and global developments and shocks on Philippine FX market liquidity were observed. Meanwhile, using econometric analysis, the fundamental factors affecting FX market liquidity were examined. Results revealed that apart from financial market conditions, demand- and supply-side factors likewise influenced Philippine FX market liquidity. These have important policy implications. First, increased global distress can have important ramifications for Philippine financial markets, making continuous monitoring of financial market conditions essential. Second, the BSP has a significant role in mitigating FX market illiquidity, through the implementation of appropriate regulations and support of financial market deepening. Third, developments in the real economy can have important implications for financial markets.

JEL classification: E4, F3, G1
Keywords: foreign exchange market, drivers, liquidity, illiquidity, Philippines
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A Preliminary Assessment of Drivers of Philippine FX Market Liquidity*

Ramon Moreno, Hazel Parcon-Santos, and
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1. Introduction

Market liquidity refers to the combination of the degree of ease with which an asset can be sold or bought in a timely manner and the level of costs associated with that sale, either in terms of transactions costs or the acceptance of a lower price in order to find a buyer in a reasonable time (Elliott, 2015). Thus, a market is said to be liquid if an investor can execute a desired transaction in that market at or near the prevailing market price relatively quickly and with no material price impact (BIS, 2017a). Market liquidity is an important feature of all financial markets as it facilitates the efficient allocation of economic resources through the productive allocation of capital and risk.[1]

The foreign exchange (FX) is the market in which currencies are traded. Understanding liquidity in this market is particularly important since it is the world's largest financial market. According to the Bank for International Settlements' (BIS) 2019 Triennial Central Bank Survey of FX and over-the-counter (OTC) derivatives markets, daily turnover in FX markets average US$6.6 trillion.

The FX market is a vital component of international trade and cross-border investment. It is a critical support to trade activities of firms that want to gain access to international resources and global demand. Without the ability to trade in different currencies, firms' prospects would be limited. Furthermore, investors who seek international diversification benefits need to trade currencies to buy and sell foreign assets and securities. Thus, the FX market is crucial in guaranteeing efficiency and arbitrage conditions in other financial markets, including bonds, stocks and derivatives. For some investors, currencies are viewed as an asset class; thus, they trade currencies to generate returns.

For central banks, FX market liquidity is particularly important because it is related to central bank operations and therefore, may affect how monetary policy is transmitted to the broader economy. A central bank may buy or sell a currency in the FX market in order to increase or decrease the value of its nation's currency against an alternative currency or to temper extreme upward or downward pressure on the value of the domestic currency. Thus, it has important implications on an economy's competitiveness and financial stability.

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[1] PwC (2015)

FX market liquidity could be affected by broad market conditions as well as demand-side and supply side-side factors (Karnaukh, Ranaldo, and Soderlind, 2015). Market conditions may be reflected in returns and volatilities in different financial markets. Demand-side factors primarily reflect changes in demand for FX due to international portfolio reallocation. Meanwhile, supply-side factors reflect financial intermediaries', central bank's and private entities' provision of FX in the market, as well as regulations, infrastructure, and technology that could affect the FX market.

This study provides a preliminary analysis of liquidity in the Philippine FX market using the FX market illiquidity indicator, proposed by Karnaukh et al. (2015) (henceforth referred to as KRS indicator or measure). First, the impact of specific domestic, regional and global developments and shocks on Philippine FX market liquidity are examined using an event-study approach, i.e., by simply observing the changes in the KRS indicator during specific events and shocks. Next, the impact of market conditions, as well as demand-side and supply-side factors on Philippine FX market liquidity are examined using econometric analysis. This allows for examination of fundamental factors affecting FX market liquidity. This study, to the best of the authors' knowledge, is the first one to look at the fundamental factors affecting FX market liquidity in the Philippines, particularly using the KRS measure.

Section 2 briefly surveys the literature on measures of FX market liquidity and the determinants of FX market liquidity. Section 3 discusses the impact of different events on Philippine FX market liquidity for the period 2013-2016. Section 4 presents an empirical exercise on the determinants of FX market liquidity in the Philippines. Section 5 concludes, provides policy implications, and suggests possible areas of future research following the limitations and results of this study.

2. Review of Related Literature

A number of measures has been put forth to measure FX market liquidity. Some measures of FX market liquidity are based on the quantity or volume of trading activity. An example is market turnover, where turnover is defined as the gross value of all new deals entered into during a given period relative to the share of the amount of trades outstanding. While turnover is easy to measure since data are readily available, it is an imperfect metric, particularly over shorter time periods (BIS, 2017a). For instance, turnover volumes may overstate true liquidity with "churn" trades done on an intraday basis.[2] It may also be due to "hot potato trading" rather than an increase in market liquidity, similar to what was documented by Melvin and Taylor (2009) during the global financial crisis (GFC). Thus, greater trading activity than average for a given currency cannot be readily associated with higher liquidity.

Another set of FX liquidity measures uses the cost or price of executing a trade – the effective cost (EC) – which increases as FX market liquidity falls. EC is derived from transaction prices with the quotes prevailing at the time of execution. It is constructed using high-frequency (HF) or second-by-second data. Karnaukh et al. (2015) shows that the EC can be

[2] Churn trades refer to excessive buying/selling by a broker in a client's account for the purpose of generating commissions or reflecting robust market activity.

estimated by low-frequency (LF) or daily indicators. Among the LF indicators, they show that the daily bid-ask (BA) quotes and the Corwin and Schultz (2012) estimator[3] from daily high-low prices have the highest correlation with the HF indicator.[4] From the average of these two estimators, Karnaukh et al. (2015) proposes the KRS indicator. Averaging the two LF measures addresses the issue that bid-ask spreads or high-low prices may vary notably across different platforms and venues.[5]

An alternative is to use cost-quantity measures of FX market liquidity, which combine transaction-based metrics that relate the quantity of liquidity sought to the price at which it can be obtained. An example is market depth where the bids and offers submitted by participants are consolidated in order of price by the central limit order book. Another example is liquidity density which measures the average amount of order book volume per basis point for a given market. Cost-quantity metrics can be particularly useful when analyzing the state of liquidity at a specific moment in time. However, their calculation requires large amounts of data and do not directly show liquidity dynamics over time (BIS, 2017a).

Meanwhile, the literature suggests that drivers of FX market liquidity can be broadly classified into three factors: market conditions, demand-side and supply-side factors.

Market conditions and shocks affect returns and volatility in different markets, and will tend to be reflected in the FX market as assets are reallocated across markets and countries. Pavlova and Rigobon (2007) argue that the FX market acts as a channel that propagates shocks across different financial markets. Meanwhile, Mancini-Griffoli and Ranaldo (2010) highlighted that distressed market conditions cause market volatility, thus market makers require higher compensation for providing liquidity due to the additional risk incurred. Therefore, if market volatility is high, liquidity tends to be lower. This became apparent during the GFC, when FX market illiquidity increased.

Demand-side factors point to conditions that lead to international portfolio reallocations, which, in turn, change the demand for FX. Hau and Rey (2006) provide micro-foundations of the portfolio balance theory relating currency appreciations to capital flows. Flight to quality during financial crises (Maggiori, 2012), search for hedge (Hassan, 2013), and changes in institutional characteristics such as the sovereign credit risk (Barberis, Shleifer, and Wurgler, 2005) may likewise lead to international portfolio reallocations and therefore may have an impact on FX market liquidity. Karnaukh et al. (2015) approximate demand-side dynamics with aggregate measures of capital flows and trade, investors' sentiment, demand for U.S. safe assets, and depreciations of local currencies with respect to reserve currencies.

Supply-side factors reflect the propensity of financial intermediaries and other economic agents to provide liquidity, which may be affected by funding constraints, regulations, technology, and financial market infrastructure. Banti and Phylaktis (2012) found

[3] Corwin and Schultz (2012) developed a bid-ask spread estimator from daily high and low prices, with the assumption that daily high (low) prices are almost always buy (sell) trades (Henceforth, this measure is referred to as CS measure.). Corwin and Schultz show that the high–low spread estimator outperforms alternative low frequency (LF) spread estimators.

[4] 0.44 and 0.53, respectively.

[5] The daily BA spread is obtained from Bloomberg, while data used to calculate the Corwin and Schultz (2012) estimator is from Thomson Reuters.

that a decrease in the cost of funding of financial intermediaries is associated with a decline in transaction costs that results in an increase in liquidity in the FX market. Karnaukh et al. (2015) use money market rates, the TED spread[6] (i.e. the difference between the short-term U.S. government debt and interest rate on interbank loans) and monetary aggregates to account for supply-side factors. Based on a panel of 30 developed and emerging market economies, Karnaukh et al. (2015) find that FX liquidity is mainly influenced by funding constraints, global risk dynamics and supply-side factors.

The current study attempts to examine which among the three factors are important for the Philippine case.

3. Recent Trends in FX market liquidity in the Philippines

Trends in FX market liquidity in the Philippines are analyzed using the KRS measure (Appendix 1 shows the step-by-step calculation). An increase in the measure implies an increase in FX market illiquidity. The KRS indicator recently received significant attention (BIS, 2017a) because of its relative high correlation with effective cost or high frequency measure of FX market liquidity, consideration of different trading platforms, and relative ease of calculation.[7]

To get an idea what factors or events influence FX market liquidity in the Philippines, external and domestic factors are considered for the period 2013-2016.[8] The events were identified from both global and domestic economic and business news, scholarly articles, and events commonly recognized by central bankers and market participants to have possibly affected FX markets. These events may have affected financial markets, in general, by influencing global risk dynamics, sentiments and expectations, as well as funding constraints. Table 1 lists the external factors, while Table 2 lists the domestic factors.

Of the seventeen external events, seven emanated from the Asian region (either Japan or China) and ten originated from either the US or Europe. Of the eleven domestic events, seven are policy changes by the BSP, two are political events, one is a change in investment grade rating, and another is a change in a policy operational framework.

[6] TED is an acronym formed from *T-Bill* and *ED*, the ticker symbol for the Eurodollar futures contract as represented by the London Interbank Offered Rate (LIBOR).
[7] The more interested and technical reader is invited to read Karnaukh et al. (2015) and Corwin and Schultz (2012).
[8] Apart from the global financial crisis years 2008-2009, the period 2013-2016 appears to be particularly interesting as it encompasses diverse external (global and regional) and domestic events that provide rich analysis and discussion.

Table 1. External Events/Shocks

	External Event	Date
(1e)	BoJ's announcement of QQE program	4 April 2013
(2e)	US Fed's announcement of QE tapering	22 May 2013
(3e)	US Fed's start of QE tapering program	1 January 2014
(4e)	US Fed's end of QE program	31 October 2014
(5e)	BoJ's announcement of expanded QQE program	31 October 2014
(6e)	Swiss franc (CHF) float	15 January 2015
(7e)	US FOMC meeting	28 January 2015
(8e)	US FOMC meeting	18 March 2015
(9e)	Chinese stock market peak	12 June 2015
(10e)	Chinese stock market fall	27 July 2015
(11e)	RMB devaluation (by 1.9 percent)	11 August 2015
(12e)	China's "Black Monday"	23 August 2015
(13e)	Fed Funds rate increase	16 December 2015
(14e)	Halt of Chinese stock market trading	4 January 2016
(15e)	UK's EU referendum	24 June 2016
(16e)	Sterling flash event	7 October 2016
(17e)	US elections	8 November 2016

Notes: "e" denotes external event or shock, i.e., event or shock emanating from outside of the Philippines, BoJ – Bank of Japan, QQE – Quantitative and Qualitative Easing, QE – Quantitative Easing, FOMC – Federal Open Market Committee, EU – European Union

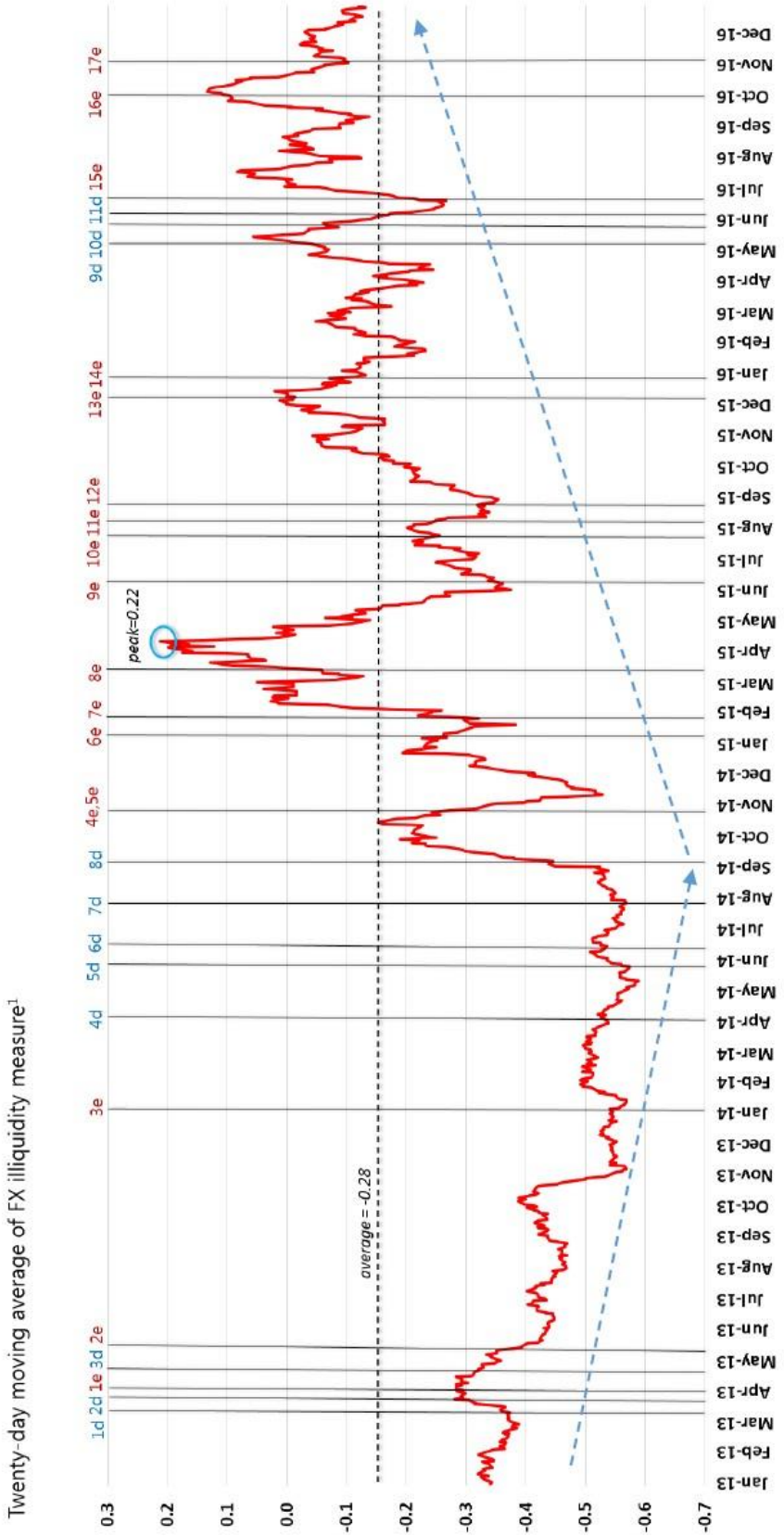
Table 2. Domestic Events/Shocks

	Domestic Event	Date
(1d)	SDA rate reduction by 50 bps	14 March 2013
(2d)	Philippines' 1st investment grade rating	27 March 2013
(3d)	SDA rate reduction by 50 bps	25 April 2013
(4d)	Increase in RR by 1 ppt	4 April 2014
(5d)	Increase in RR by 1 ppt	30 May 2014
(6d)	SDA rate increase by 25 bps	19 June 2014
(7d)	Policy rate increase by 25 bps	31 July 2014
(8d)	Policy rate increase by 25 bps	11 September 2014
(9d)	Philippine general elections	9 May 2016
(10d)	Election results announcement	26 May 2016
(11d)	Implementation of IRC system	3 June 2016

Notes: "d" denotes domestic event or shock, SDA – Special Deposit Account, IRC – Interest Rate Corridor

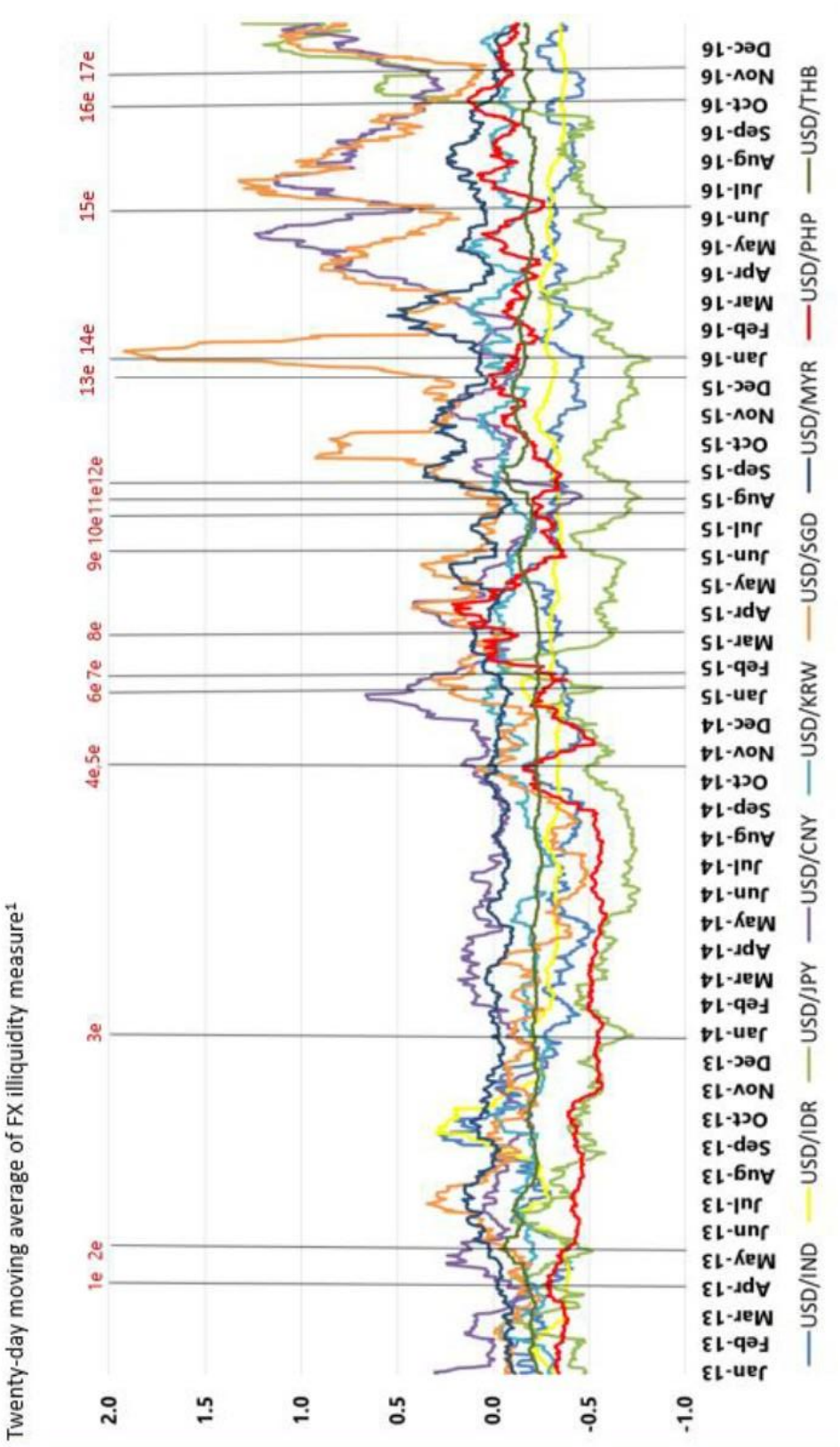
Figure 1 shows external and domestic events and movements in the KRS measure for the Philippines for the period 2013-2016. For said period, the KRS indicator averaged at -0.28. From January 2013 to the 3rd quarter of 2014, the KRS measure for the Philippines remained below the average. Following the consecutive SDA rate reductions in March and April 2013 (1d and 3d), the Philippine investment rating upgrade in March 2013 (2d) and BoJ's QQE program in April 2013 (1e), the KRS measure displayed a downward trend. Even after the announcement of US Fed Chairman Ben Bernanke of QE tapering on 22 May 2013 (2e) and the commencement of US Fed's QE tapering on 1 January 2014 (3e), the downward trend continued and there were no apparent immediate pressures for the KRS measure to increase (although there was a slight increase in January 2014). From June to December 2013, there were no changes in the BSP's key policy rates, SDA rates, and reserve requirement ratios, which could have helped alleviate pressures on FX liquidity. Meanwhile, the BSP's increase in RR on 4 April 2014 (4d) yielded no apparent pressure on the KRS measure to increase.

Figure 1. FX illiquidity in the Philippines vis-a-vis domestic and external events



Note: FX illiquidity measure computed following the methodology described by Karnaukh et al (2015): average of standardized BA and CS spreads.
Sources: Bloomberg, Thomson Reuters, authors' calculations

Figure 2. FX illiquidity in selected Asian economies vis-a-vis external events



Note: FX illiquidity measure computed following the methodology described by Karnaukh et al (2015): average of standardized BA and CS spreads.
Sources: Bloomberg, Thomson Reuters, authors' calculations

Following four consecutive monetary policy tightening moves of the BSP particularly from June to September 2014 (5d, 6d, 7d, 8d), the KRS measure appear to have started moving on an upward trend. A steeper increase in the KRS measure is more notable starting in September 2014, a month before the US was about to end its QE program (4e). From the beginning of September 2014 to 16 October 2014, the KRS measure increased by 0.36 unit. The anticipation of the end of the US Fed's QE program, which was scheduled to end on October 2014, appear to have created a structural break, where the KRS measure proceeded on an upward trend thereafter. Nonetheless, there was a temporary decline in the KRS measure, coinciding with the announcement of BoJ's expanded QQE program (5e).

Following the hawkish US FOMC meeting press release on 28 January 2015 (7e) and the moderate tone of the 18 March 2015 press release (8e),[9] the KRS measure increased, with the KRS measure peaking at 0.22 on 13 April 2015. Meanwhile, the full float of the CHF (6e) seem to have no discernable impact on Philippine FX liquidity.

Meanwhile, following the successive Chinese shocks in July and August 2015, namely, the Chinese stock market collapse (10e), the RMB devaluation (11e), and China's "Black Monday" (12e), the KRS measure displayed a steep upward trend.

On 16 December 2015, the federal funds rate (FFR) was increased for the first time after almost a decade of accommodative monetary policy by the US Federal Reserve (13e). The preceding Chinese shocks and the increase in FFR reinforced each other in terms of increasing the KRS measure. Nonetheless, the halt of Chinese stock market trading on 4 January 2016 (14e) appear to have minimal impact on Philippine FX illiquidity.

Meanwhile, the 9 May 2016 Philippine elections (9d) only generated a brief increase in the KRS measure, possibly reflecting temporary uncertainty, such that when the election results were announced (10d), the KRS measure continued to fall.

In June 2016, following the BSP's adoption of the IRC as the monetary operational framework (11d) and the UK's referendum (15e), the KRS measure increased. This could have reflected adjustments of banks to the new operational framework and the policy uncertainty brought by Brexit, respectively. Meanwhile, the sterling flash event (16e)[10] and the US elections (17e) resulted in temporary spikes in the KRS measure.

Based on the foregoing, the improved sentiment caused by the Philippines' 1st investment grade rating as well as the reduction in SDA rates in the first few months of 2013 may have helped ease FX market liquidity pressures in the Philippines in spite of the US Fed's QE tapering announcement. Nonetheless, subsequent external policy shocks and stress

[9] The press release indicated that labor market conditions improved further, household spending rose moderately, business fixed investment advanced, unemployment rate declined, and strong job gains were posted; but economic growth moderated, recovery in the housing sector remained slow, export growth weakened, and inflation declined further below the Committee's longer-run objective.

[10] During the sterling flash event, the sterling depreciated by about 9 percent versus the US dollar in early Asian trading, before quickly retracing much of the move. The BIS (2017b) mentioned a range of factors that may have caused the event, including the time of day, significant demand to sell sterling to hedge options positions, the execution of stop-loss orders as the currency depreciated, the presence of staff with less expertise in the suitability of particular algorithms, and fast electronic markets.

episodes in 2014 and 2015, particularly those originating from the US and China appear to have had significant effects on Philippine FX market illiquidity. Noteworthy is that political events, whether domestic or external, only resulted in temporary increases in FX market illiquidity. This may be due to the short-lived policy uncertainties generated by such events.

Figure 2 shows external events and movements in the KRS measure for selected Asian economies. In comparison with other Asian FX markets, increases in FX illiquidity in the Philippines in identified external episodes appear modest, perhaps owing to the less open or less developed financial system of the country.[11] For instance, following the Chinese stock market trading halt on 4 January 2016 (14e), the KRS measure for USD/PHP reached a high of only 0.10 unit, which is lower relative to the highest reached for USD/SGD at 1.92 unit, and USD/MYR at 0.46.[12]

Meanwhile, for the entire period 2013-2016, the KRS measure for USD/PHP displayed the highest correlation with USD/KRW at 0.68. In specific episodes, correlation of the KRS measure for USD/PHP increased with other Asian currencies. For instance, following the US FOMC meeting press releases in January and March 2014, correlation of KRS measures for USD/PHP and USD/THB was at 0.67. Following the shocks from China in June-August 2015, correlation of KRS measures for USD/PHP and USD/IDR was at 0.65.

The foregoing event-study approach is useful to the extent that the association between domestic FX market liquidity and different external and domestic events can be readily visually identified. However, such approach has important limitations. For one, it does not ascertain the fundamental factors that determine FX market liquidity. Moreover, since several events occur successively, it is difficult to establish the primary driver/s of FX market liquidity. Thus, the link between the events and FX liquidity is at best suggestive. Several transmission channels are possible: identified events may have influenced domestic FX market liquidity through their impact on financial market conditions, demand for FX, and supply of FX.

4. Empirical Exercise

Following Karnaukh et al. (2015), an empirical analysis of the fundamental factors affecting FX illiquidity in the Philippines from 2005 to 2017 was conducted. Again, an increase in the indicator signifies an increase in illiquidity. During the entire sample period, the KRS averaged at -0.17, reaching a maximum of 0.74 in April 2008, during the height of the GFC, and a minimum of -0.70 in July 2014.[13]

As mentioned, different market conditions, demand-side and supply-side factors may influence domestic FX market liquidity. Accordingly, the following equation is estimated:

$$illiquidity_t = \alpha_t MC_{t,} + \beta_t DF_t + \gamma_t SF_t + X_t \delta + \varepsilon_t \quad (1)$$

[11] The following Asian currencies were considered: Indonesian rupiah (IDR), Japanese yen (JPY), Chinese Yuan (CNY), Korean won (KRW), Singapore dollar (SGD), Malaysian ringgit (MYR), and Thai baht (THB).

[12] Determined by obtaining the maximum FX illiquidity measure within 30 days after the said event.

[13] These numbers are based on monthly averages, in contrast to numbers in Figures 1 and 2, which are based on 20-day moving averages.

where *illiquidity* is the KRS indicator; *MC* is a vector containing financial market condition variables; *DF* is a vector containing demand-side factors; *SF* is a vector containing supply-side factors; and *X* is a vector containing other potential determinants of FX liquidity. Equation (1) is estimated for the period 2005-2017 with monthly frequency using Generalized Method of Moments (GMM) to address possible endogeneity issues.[14]

The following variables were considered as explanatory variables:

i. *market conditions*: domestic FX market volatility, global FX market volatility, Global Financial Crisis years (GFC) period of 2008-2009 (*dummy_GFC* = 1 for 2008-2009; = 0, otherwise), global and domestic equity market volatility;[15]

ii. *demand-side factors*: imports, residents' investments abroad, FX debt obligations;

iii. *supply-side factors*: exports, BSP reverse repurchase policy (RRP) rate and Federal funds rate (FFR) as proxy for funding constraints faced by financial intermediaries, non-residents' investments in the Philippines, overseas Filipino (OF) remittances, financial market depth, termination of US QE program (*dummy_US end QE* = 1 for September 2014 onwards; = 0, otherwise);[16] and

iv. *other factors:* e.g., regulations.

Appendix 2 lists the variables used, their description, and sources.

Benchmark Results

Table (3) displays the benchmark results. The coefficient of domestic FX market volatility is positive and statistically significant, implying that greater domestic FX market volatility increases domestic FX market illiquidity. The coefficient of global FX market liquidity appears with the expected sign (positive), but is statistically insignificant. The coefficient of the dummy variable for GFC is positive and statistically significant, suggesting that the GFC has increased illiquidity in the Philippine FX market. This is consistent with the fact that the KRS indicator reached its peak in April 2008 during the GFC.

[14] GMM is often used to deal with endogeneity issues, possibly arising from simultaneous causality, omission of variables, and errors-in-variables (Wooldridge, 2002). For instance, FX market liquidity may influence domestic FX market volatility or may prompt policy changes (e.g., changes in the RRP) leading to simultaneous causality. GMM allows for the possibility that past realizations of FX market liquidity influence the explanatory variables. Others have also used GMM, see for instance Banti and Phylaktis (2012) and Mancini et al. (2010).

[15] Among the variables for market conditions, global FX volatility has the highest correlation with the KRS measure, followed by domestic FX volatility, VIX, and domestic stock market volatility (Appendix 3).

[16] Dummy on termination of US QE program = 1 started on September 2014, instead of the actual announced termination on October 2014. As suggested by Figure 1, FX market participants appear to have anticipated the end of the QE program.

Table 3. Benchmark Results

Dependent Variable: **KRS FX illiquidity measure**		
Domestic FX market volatility	0.04	***
	(3.57)	
Global FX market volatility	0.01	
	(1.01)	
Dummy_GFC	0.29	***
	(2.62)	
Imports (annual growth)	0.23	**
	(1.95)	
RRP	0.04	***
	(2.66)	
Exports (annual growth)	-0.44	***
	(-2.50)	
Financial Market Depth (M3-to-GDP, annual change)	-3.43	***
	(-4.81)	
Dummy_US end QE	0.15	***
	(2.74)	
R-squared	0.69	
Adjusted R-squared	0.67	
Durbin-Watson	2.04	
J-statistic	5.00	

Notes: All variables used in the estimation are stationary. Estimation was done using GMM with robust standard errors. An AR(1) term and a constant were included. ***, ** and * indicate 1%, 5%, and 10% level of significance, respectively. Figures in *( )* represent the t-statistic. J-statistic accepts the null hypothesis that the instruments (lagged explanatory and dependent variables) are valid.

The coefficient of annual growth in imports is positive and statistically significant, implying that greater demand for FX increases FX market illiquidity. The coefficient of the RRP rate is likewise positive and statistically significant, implying that greater funding constraints increase FX market illiquidity. This finding supports the observation in Figure 1 that the consecutive monetary policy tightening of the BSP in 2014 may have contributed to tighter FX market liquidity in that period.

Meanwhile, the coefficient of the annual growth in exports[17] is negative and statistically significant, suggesting that higher export earnings increase supply of FX, thereby lowering FX market illiquidity. Similarly, the annual change in M3-to-GDP ratio is negative and statistically significant. This implies that greater financial market depth decreases FX market illiquidity. As argued by Levine (1997), a deeper financial system facilitates trading of financial instruments, and timing and settlement of such trades; hence, it is expected that FX illiquidity will decrease as financial market depth increases.[18]

[17] Lagged one period

[18] A positive change in M3-to-GDP implies increasing financial market depth. In the literature, M3-to-GDP is often used as a proxy for financial market depth, inspired by the work of Levine (1997) in which financial depth was defined as the ratio of liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries) to GDP. As such, it reflects the level of liquidity provided to the economy by the financial system. A deep financial market overcomes informational asymmetries, thereby mobilizing savings and facilitates transactions between savers and investors. Other measures of financial market depth (e.g., credit-to-GDP, banking financial assets-to-GDP) are suggested in the literature, but the true measure of financial depth remains an empirical issue.

The coefficient of the dummy variable for the end of the US QE program is positive and statistically significant, suggesting that this event has increased illiquidity in the Philippine FX market. This finding supports the observed structural break in Figure 1.

The foregoing suggests that FX market volatility, demand for FX by importers, funding constraints, export earnings, financial market depth, and global or external developments (such as the GFC and end of the US QE program) have driven FX market liquidity in the Philippines, at least for the period 2005-2017.

Robustness Checks

Table 4 displays several robustness checks to verify the benchmark results. For reference, the benchmark results are presented in Specification (1). First, the controls for financial market conditions were altered. Specification (2) considers global equity market volatility proxied by VIX[19,20] as the indicator of market conditions instead of using variables for FX market volatility. VIX is often referred to as the "fear index" and also used as an estimate of global risk aversion. The coefficient of VIX is positive and statistically significant, which implies that global equity market volatility or global risk aversion has a tendency to increase domestic FX market illiquidity. Coefficient signs and statistical significance of the other variables are similar to the benchmark results.

Specification (3) replaces domestic FX market volatility with domestic equity market volatility.[21] The coefficient for this variable is positive and statistically significant.[22] The statistical significance of both global and domestic equity market volatility[23] suggests cross-market effects, i.e., movements or volatility in other financial markets may affect FX market volatility.[24]

Specification (4) uses global FX market volatility, sans control for domestic FX market volatility, as the indicator of market conditions. Its coefficient is positive and now statistically significant, in contrast to Specification (1). This suggests that part of global FX market volatility is already reflected in domestic FX market volatility, which explains why global FX market volatility is statistically insignificant in Specification (1).[25] Nonetheless, it is important to control

[19] VIX is a measure of expected price fluctuations in the S&P 500 Index options over the next 30 days, calculated in real time by the Chicago Board Options Exchange (CBOE) (Source: Bloomberg).

[20] Karnaukh et al. (2015) used VIX as a demand-side factor since it is commonly used as an investors' sentiment proxy (e.g., as used by Brunnermeier, Nagel, and Pedersen (2009)). However, as a volatility indicator it could also fall into the broad category of financial market conditions. In this paper, VIX was used an indicator of financial market conditions.

[21] Measured by the 30-day historical volatility of the Philippine Stock Market Composite Index (PSEi).

[22] Domestic FX market volatility and domestic stock market volatility were not included in the same specification since their correlation coefficient is 0.63. Doing so makes the coefficient of domestic stock market volatility insignificant, implying that part of domestic stock market volatility is being captured by domestic FX market volatility.

[23] Albeit at lower statistical significance

[24] Additional estimations (not shown, but can be requested from the authors) were conducted using global bond market volatility (proxied by the Merrill Lynch Option Volatility Estimate or MOVE Index) and domestic bond market volatility (proxied by the 30-day historical volatility of the 3-month Philippine Treasury bill). The coefficients of these variables are statistically insignificant.

[25] Correlation between FX global volatility and FX domestic volatility is at 0.50.

for global FX market volatility as domestic FX market volatility may fail to capture other relevant global factors. Thus, specifications (5)-(10) revert to controlling for both domestic and global FX market volatility similar to the benchmark specification.

Specification (5) includes resident portfolio investments as an additional demand-side factor. When residents invest abroad, FX illiquidity may increase as residents require foreign exchange when investments are made outside of the country. While the coefficient of resident portfolio investments is positive, it is statistically insignificant, possibly due to the minimal size of Philippine residents' portfolio investments abroad.[26] Even if the imports variable was not included in the specification, the coefficient of residents' portfolio investments remain statistically insignificant.[27]

Specifications (6) and (7) include non-resident investments (sum of foreign portfolio and direct investments) and foreign portfolio investments, respectively, as additional supply-side factors. The coefficients of both variables come with the expected sign (negative, as inflows of foreign investments are expected to reduce FX market illiquidity), however, both are statistically insignificant. This may be due to the still relatively small amounts of foreign investments in the country.[28]

Specification (8) includes changes in OF remittances relative to GDP as a supply-side factor. The coefficient of this variable is negative but statistically insignificant. While OF remittances averaged at 9.3 percent of GDP for the entire sample period, its statistical insignificance may be attributed to the fact that during the entire sample period, changes in the ratio have been relatively small.[29]

Specification (9) uses the FFR, instead of the RRP rate, to capture funding constraints faced by financial intermediaries. The coefficient is positive and statistically significant, similar to the coefficient of RRP, implying that increase in funding constraints faced by financial intermediaries indeed increase FX market illiquidity. More importantly, this implies that the normalization of the US Federal Reserve's monetary policy has an important implication for the Philippines' FX market.

Specification (10) accounts for possible impact of regulations by including a dummy variable for periods when the BSP imposed limits on NDF exposures (i.e., March 2013 onwards). Prior to the imposition of the limit, there was a growing concern that the NDF facility was no longer being used as a hedge but as an investment instrument through currency speculation, which created volatility in the FX market. The coefficient of the NDF dummy is negative and statistically significant, implying that the imposition of the regulation has helped ease FX market illiquidity. It can also be noted that the coefficient of RRP became insignificant in this specification, implying that regulations have a potential to alleviate FX market illiquidity even if there are funding constraints.

[26] For the entire sample period, average residents' portfolio investments relative to GDP stands at 2.0 percent.
[27] Additional estimations (not shown, but can be requested from the authors) were conducted including growth in FX debt obligations as a demand-side factor. However, the coefficient is statistically insignificant.
[28] For the entire sample period, average foreign portfolio investments relative to GDP stands at 1.0 percent of GDP, while average foreign direct investments relative to GDP stands at 1.7 percent.
[29] Standard deviation of OF remittances-to-GDP for the entire sample period is 0.009. The minimal variation on the variable may have led to the low explanatory power.

Based on the estimations, the variables considered help explain about two-thirds of the variations in FX market liquidity, implying that there is scope to improve the model.

Table 4. Robustness Checks

Dependent Variable										
KRS FX illiquidity measure	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Domestic FX market volatility	0.04 ***				0.04 ***	0.04 ***	0.04 ***	0.04 ***	0.04 ***	0.04 ***
	(3.57)				*(3.82)*	*(3.56)*	*(3.62)*	*(3.22)*	*(3.27)*	*(4.28)*
Global FX market volatility	0.01		0.01	0.02 **	0.01	0.01	0.01	0.01	0.01	0.01
	(1.01)		*(1.49)*	*(1.97)*	*(0.97)*	*(1.03)*	*(1.11)*	*(1.04)*	*(1.14)*	*(0.82)*
Dummy_GFC	0.29 ***	0.34 ***	0.29 ***	0.31 ***	0.29 ***	0.30 ***	0.29 ***	0.32 ***	0.35 ***	0.29 ***
	(2.62)	*(3.41)*	*(2.80)*	*(2.59)*	*(2.58)*	*(2.97)*	*(2.98)*	*(2.94)*	*(3.22)*	*(2.48)*
Global stock market volatility		0.01 *								
		(1.66)								
Domestic stock market volatility			0.01 *							
			(1.68)							
Imports (annual growth)	0.23 **	0.30 **	0.20	0.22 *	0.21 *	0.23 **	0.22 *	0.20 *	0.23 *	0.24 **
	(1.95)	*(1.66)*	*(1.46)*	*(1.72)*	*(1.88)*	*(1.95)*	*(1.87)*	*(1.68)*	*(1.91)*	*(2.00)*
Resident Portfolio Investments (% GDP)					0.05					
					(0.30)					
RRP	0.04 ***	0.04 ***	0.04 **	0.05 ***	0.04 ***	0.04 ***	0.04 ***	0.05 ***		0.03
	(2.66)	*(2.49)*	*(2.02)*	*(2.73)*	*(2.62)*	*(2.66)*	*(2.62)*	*(2.73)*		*(1.55)*
FFR									0.03 ***	
									(2.68)	
Exports (annual growth)	-0.44 ***	-0.48 ***	-0.43 **	-0.43 ***	-0.43 ***	-0.44 **	-0.40 **	-0.40 **	-0.47 ***	-0.41 ***
	(-2.50)	*(-2.61)*	*(2.30)*	*(-2.50)*	*(-2.49)*	*(-2.35)*	*(-2.20)*	*(-2.33)*	*(-2.65)*	*(-2.41)*
Foreign Portfolio and Direct Investments (% GDP)						-0.08				
						(-0.34)				
Foreign Portfolio Investments (% GDP)							-0.20			
							(-0.72)			
OF remittances-to-GDP (annual change)								-1.56		
								(-0.84)		
Financial Market Depth (M3-to-GDP, annual change)	-3.43 ***	-3.59 ***	-3.35 ***	-3.23 ***	-3.44 ***	-3.48 ***	-3.40 ***	-3.22 ***	-3.63 ***	-2.43 ***
	(-4.81)	*(-5.54)*	*(-4.52)*	*(-4.19)*	*(-4.91)*	*(-5.43)*	*(-5.58)*	*(-4.19)*	*(-5.37)*	*(-3.63)*
Dummy_US end QE	0.15 ***	0.11 *	0.11 *	0.11 *	0.15 ***	0.14 ***	0.14 ***	0.16 ***	0.12 **	0.26 ***
	(2.74)	*(1.81)*	*(1.66)*	*(1.77)*	*(2.75)*	*(2.71)*	*(2.69)*	*(3.24)*	*(2.12)*	*(8.63)*
Dummy_regulation										-0.16 ***
										(-3.41)
R-squared	0.69	0.66	0.67	0.67	0.69	0.69	0.69	0.69	0.69	0.69
Adjusted R-squared	0.67	0.65	0.65	0.65	0.66	0.67	0.67	0.67	0.66	0.67
Durbin-Watson	2.04	2.01	2.02	2.06	2.03	2.04	2.03	2.06	2.04	2.03
J-statistic	5.00	5.63	5.13	5.70	5.36	5.07	5.21	4.63	6.10	3.68

Notes: All variables used in the estimations are stationary. All equations were estimated using GMM with robust standard errors. An AR(1) term and a constant were included. ***, ** and * indicate 1%, 5%, and 10% level of significance, respectively. Figures in *( )* represent the t-statistic. J-statistic accepts the null hypothesis that the instruments (lagged explanatory and dependent variables) are valid.

5. Conclusion and Policy Implications

This study provided an initial assessment of FX market liquidity in the Philippines. A cursory examination of the KRS FX market illiquidity indicator suggests that the improved sentiment caused by the Philippines 1st investment grade rating as well as the reduction in SDA rates in the first few months of 2013 may have helped ease FX market liquidity pressures in the Philippines despite the US Fed's QE tapering announcement. Nonetheless, subsequent external policy shocks and stress episodes in 2014 and 2015, especially those originating from the US and China, and the anticipation of the US Fed's policy rate increase in December 2015 appear to have had significant effects on Philippine FX market illiquidity. Noteworthy is that political events, whether domestic or external, only resulted in temporary increases in FX market illiquidity. This may be due to the short-lived policy uncertainties generated by such events.

Moreover, there is an indication that the end of the US Federal Reserve's quantitative easing program in October 2014 coupled with the BSP's successive monetary policy tightening in prior months were associated with increasing trend in domestic FX market illiquidity.

Meanwhile, relative to other countries, the impact of external policy shocks and stress episodes in Philippine FX market liquidity appear modest, perhaps owing to the less open or less developed financial system of the country. Nonetheless, efforts of the BSP to review the economy's FX regulatory framework on a continuing basis, which is complemented by appropriate prudential regulations and market surveillance (Bayangos et al. (2016)), as well as the country's sustained macroeconomic fundamentals may have played an important role in helping the economy withstand domestic and external shocks that may impact FX market liquidity.

Based on the empirical analysis, apart from financial market conditions, demand- and supply-side factors likewise influence Philippine FX market liquidity. These have important policy implications.

First, findings suggest that increased global distress can have important ramifications for Philippine financial markets. Thus, the BSP must continuously monitor events that impact financial market conditions to ensure financial stability. The results particularly call for continuous monitoring of the US Federal Reserve's monetary policy.

Second, findings suggest that the BSP has a significant role in mitigating FX market illiquidity, specifically during periods of monetary tightening. In particular, regulations can play an important role in easing FX market illiquidity.

Third, findings underscore the importance of deepening the domestic financial market, which has a great potential to mitigate FX market illiquidity.

Finally, findings support the need for continuous upgrading of the country's export capacity to support the economy's steady supply of FX. This suggests that even developments in the real economy can have important implications for financial markets.

This study may be limited by the fact that the analysis primarily took a macroeconomic perspective and symmetric approach. More insights may be obtained using a microeconomic and asymmetric approach. For instance, the behavior of different financial market participants during stress and non-stress episodes may differ depending on their FX needs and vulnerabilities. Likewise, the behavior of the central bank during different periods may be asymmetric depending on whether FX market illiquidity is high or low. These factors, while not considered in the current study, may be subject of future research.

Moreover, analysis were based on a single liquidity measure. The results may be validated by using other FX market liquidity measures. Likewise, given the expanded jurisdiction of the BSP under Republic Act No. 11211, future studies could consider liquidity measures that use data from other entities which were placed under the purview of the BSP (e.g., money service businesses). These may further enrich the analysis.

Other important factors that may be considered in future studies include the role of technology and other BSP regulations. For instance, technological innovations can possibly increase internationalization of client flows and lower the cost of setting up FX trading venues, which, in turn, can facilitate provision of FX liquidity (BIS, 2017a). Future studies can likewise focus on the impact of the different FX market reforms that the BSP has implemented since 2007. Other BSP regulations relevant to the FX market may also be considered such as the Liquidity Coverage Ratio, Net Stable Funding Ratio, FCDU requirements, limits on net open FX position, and Currency Risk Protection Program. The existence of market segmentation (formal and informal market) in the Philippine FX market is also worth considering.

The finding that relative to other Asian economies, FX market liquidity in the Philippines is less influenced by external policy shocks and stress episodes likewise encourages research on the possible reasons, including the degree of economic openness and role of regulations.

Notwithstanding the aforementioned limitations, this study can be considered important as an initial assessment of drivers of FX market liquidity in the Philippines, from which future research can build on.

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Appendix 1. Calculation of the KRS Measure of FX Market Illiquidity

The effective cost or the price of executing a trade can be calculated using transactions prices with quotes prevailing at the time of execution. It is constructed using high-frequency (HF) or second-by-second data. Nonetheless, Karnaukh et al. (2015) shows that it can be estimated by low-frequency (LF) or daily indicators. Among the LF indicators, they show that the daily bid-ask (BA) quotes and the Corwin and Schultz (2012) estimator (CS) from daily high-low prices have the highest correlation with the HF indicator. From the average of these two estimators, Karnaukh et al. (2015) proposed the KRS indicator.

Following are the step-by-step procedure in calculating the KRS indicator.

Step 1. Obtain daily prices data, from Bloomberg the bid and ask quotes, and from Thomson Reuters the mid, low, and high quotes

Step 2. Compute two daily measures for the desired FX pair.

(a) Daily relative BA spread = (Ask – Bid) / [(Ask + Bid)/2]

(b) Two-day CS measure = $[2 (e^{\alpha} – 1)] / (1 + e^{\alpha})$,

where $\alpha = \ln [(2+S)/(2-S)]$ and S = spread

Step 3. Compute two monthly measures for the desired FX pair:

(a) Monthly relative BA spread is a simple average across all daily BA estimates

(b) Exclude negative two-day CS estimates from the sample and compute monthly CS measure as a simple average across positive two-day CS estimates

Step 4. Compute monthly FX illiquidity measures for each FX pair

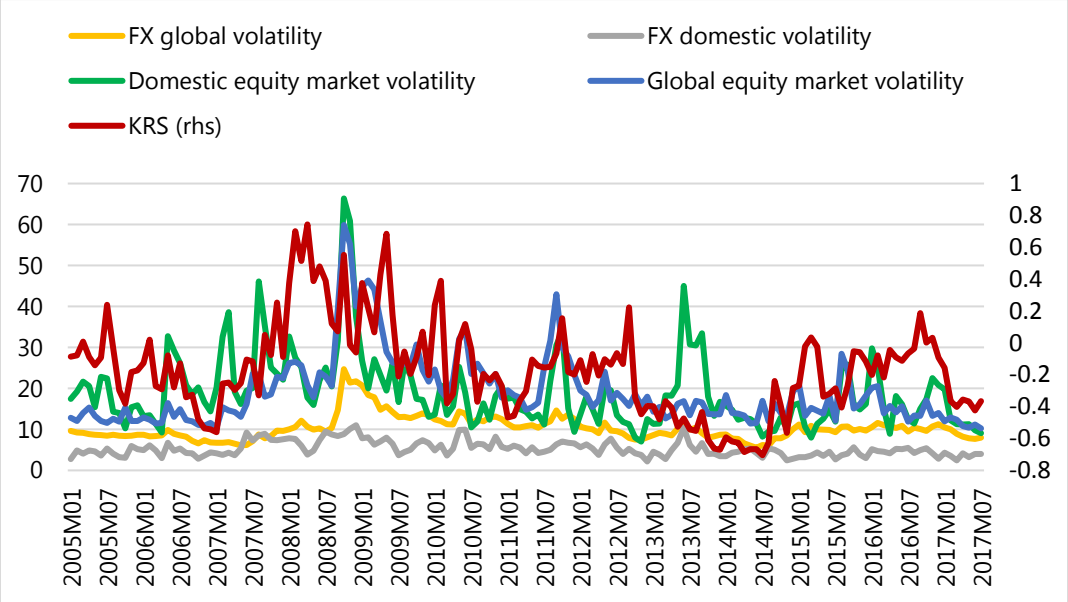
(a) Standardize monthly BA spread and monthly CS estimates (for each series, subtract the mean and divide by the standard deviation)

(b) Take simple average across the two series

Appendix 2. Description and Sources of Variables Used in the Empirical Estimation

Variable	Description	Source
KRS Indicator	Average between the daily bid-ask (BA) quotes and the Corwin and Schultz (2012) estimator from daily high-low prices	Bloomberg and Thomson Reuters
Domestic FX market volatility	30-day historical price volatility of USD/PHP	Bloomberg
Global FX market volatility	Changes in the JP Morgan Global FX volatility index, which tracks implied volatility of three-month at-the-money forward options on major and developed currencies.	Bloomberg
Global equity market volatility	Changes in the Chicago Board Options Exchange Market Volatility (VIX) Index, which measures implied volatility of S&P 500 index options.	Bloomberg
Domestic equity market volatility	30-day historical price volatility of the Philippine Stock Exchange Index	Bloomberg
Imports	Annual growth in merchandise imports	BSP Statistical Database
Exports	Annual growth in merchandise and service exports	BSP Statistical Database
Residents' portfolio investments	Net acquisition of financial assets (portfolio) as a percentage of GDP	Balance of Payments Statistics, BSP
Foreign portfolio investments	Net incurrence of liabilities (portfolio) as a percentage of GDP	Balance of Payments Statistics, BSP
Foreign portfolio and direct investments	Net incurrence of liabilities (portfolio and direct) as a percentage of GDP	Balance of Payments Statistics, BSP
OF remittances	Annual change in OF remittances-to-GDP ratio	BSP Statistical Database
RRP	Reverse repurchase rate, set by the Bangko Sentral ng Pilipinas (BSP) Monetary Board	BSP Statistical Database
FFR	Federal funds rate, set by the US Federal Open Market Committee (FOMC)	BSP Statistical Database
Financial market depth	Annual change in M3-to-GDP ratio	BSP Statistical Database
Dummy for GFC period	Dummy=1, for 2008-2009; =0, otherwise	Authors' calculation
Dummy for end of US QE program	Dummy=1, for September 2014 onwards; =0, otherwise	Staff calculation
Dummy for period of NDF limit imposition	Dummy=1, for March 2013 onwards; =0, otherwise	Staff calculation

Appendix 3. The KRS Indicator vis-à-vis other Measures of Financial Market Conditions



Note: See Appendix 2 for description of variables
Sources: Bloomberg and authors' own calculations

Measures of Financial Market Conditions	Correlation with KRS
FX domestic market volatility	0.44
FX global market volatility	0.50
Domestic equity market volatility	0.30
Global equity market volatility	0.48

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