Intraday Liquidity Around the World

Presented by
James Chapman

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Authors

Biliana Alexandrova Kabadjova (Bank of Mexico), Anton Badev (Federal Reserve Boad of Governors) , Mario Rubem do Coutto Bastos (Bank of Brazil), Saulo Benchimol Bastos (Bank of Brazil), Evangelos Benos (University of Nottingham), Freddy Cepeda-López (Bank of Columbia), James Chapman (Bank of Canada), Martin Diehl (Deutsch Bundesbank), Ioana Duca-Radu (European Central Bank), Rodney Garratt (UC - Santa Barbara) , Ronald Heijmans (De Nerderlandsche Bank), Anneke Kosse (Bank of Canada), Antoine Martin (Federal Reserve Bank of New York), Thomas Nellen (Swiss National Bank), Thomas Nilsson (Bank of International Settlements), Jan Paulick (Deutsche Bundesbank), Andrei Pustelnikov (Bank of England), Francisco Rivadeneyra (Bank of Canada), Sara Testi (European Central Bank)

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Background

- Large-Value Payment Systems (LVPS) underpin all electronic payments in a country.
- Most LVPSs are *liquidity intensive* as their transactions settle on a gross basis. This gives rise to demand for **intraday liquidity (IDL)**.
- LVPS participants can use their own liquidity to meet their payment obligations or borrow intraday (including from the central bank) or recycle incoming payments.
- Payment recycling can give rise to *strategic interactions* between LVPS participants.
- The outcomes of these interactions alongside LVPS institutional features and CB policies (e.g. supply of reserves) will affect the ultimate amount of intraday liquidity used.

Research Questions

- How much intraday liquidity do LVPS participants collectively use in order to meet their payment obligations?
- How does intraday liquidity usage depend on LVPS participant behavior?
- Importantly, how does participant behavior and intraday liquidity usage vary with institutional features? (e.g. incentives for early payments, Reserves balances, CB intraday credit regime, LSM design features)

→ This is the first study to conduct a cross-system analysis of intraday liquidity usage. Allowing for institutional variation.

Relevance

- **Financial Stability**: Intraday liquidity played an important role during the financial crisis of 2008-09. For example, most of Lehman's liquid assets as of Sep 12, 2008 had been pledged as collateral for the purpose of covering intraday liquidity needs, thus causing it to default when faced with unexpected cash outflows on Sep 15, 2008.
- **LVPS design**: Several jurisdictions around the world have recently updated or are re-designing their LVPSs. Maybe some useful lessons can be learned by assessing some of the existing LVPS design features.

(Brief) Literature review

This study is related to two strands of the payment economic literature.

- Bech and Garratt (2003), Martin and McAndrews (2008), Ashcraft et al. (2011) and others study the economic incentives of payment participants. This literature shows that the type of price structure on liquidity affects equilibrium behavior and also that LSMs can lead to higher welfare due to the increased netting opportunities.
- The empirical literature (e.g. McAndrews and Rajan (2002), Bech et. al. (2010), Denbee et al. (2014), Nellen et al. (2018)) studies how individual participants behave in a given system.

$\rightarrow$ Until now models of LVPS behavior are either theoretical and or are empirical analysis on a single system. Silent on the key question of how institutional features effect empirically behavior.

Intraday Liquidity Used & Liquidity Efficiency

- Aggregate daily **value of payments made**:

$$P_s \equiv \sum_{i,j,t} x_s^{i,j}(t)$$

- Aggregate intraday **liquidity used**:

$$N_s^i(t) \equiv \sum_{k=1}^{t} \sum_{i \neq j} x_s^{i,j}(k) - x_s^{j,i}(k)$$

$$L_s \equiv \sum_i \max_t \{N_s^i(t), 0\}$$

- Intraday **liquidity efficiency** (Benos et al, 2014): The amount of payments settled per dollar of IDL used:

$$Q_s \equiv \frac{P_s}{L_s}$$

Payment Timing & Coordination

We attempt to capture key decision variables of LVPS participants: when to make their payments and whether to coordinate them with other participants.

- System-wide value-weighted **average settlement time**:

$$T_s \equiv \frac{\sum_{t=1}^{T} tP_s(t)}{\sum_{t=1}^{T} P_s(t)}$$

- System-wide **payment dispersion**:

$$D_s(d) \equiv \arg\min_k \frac{\sum_{t=1}^{k} P_s(t)}{\sum_{t=1}^{T} P_s(t)} - d \geq 0$$

$$Tdiff_s \equiv \frac{1}{2}[D_s(0.7) + D_s(0.8) - D_s(0.2) - D_s(0.3)]$$

Summary of variables

1. **Payments** sent by participants in the system,
2. **Intraday Liquidity used** is the maximum net debit position of LVPS participants;
3. **Liquidity efficiency**, is the ratio of payments made per unit of liquidity used.
4. **Payment timing** is the value-weighted average settlement time of payments in a system.
5. **Payment dispersion** is the difference between the upper and lower deciles of payment timing,

Data

- **Raw data**: Individual payments between LVPS participants, including information on: amount, date, settlement time, payer and payee identities.
- **Jurisdictions**: Brazil, Canada, Colombia, Denmark, the Eurozone, Mexico, Switzerland, the United Kingdom and the United States.
  - Respective LVPSs underpin almost 50% of global GDP.
- **Time period**: 2006 to 2020 (with sub-periods of varying length for each system)
- **Aggregation**: The payments data is aggregated at a system level and on a daily basis to produce a total of around 26K daily observations.
- **Limitations**: a) Only observe settlement times, not submission times (adds noise to our activity variables) b) Do not observe CB overdrafts (IDL used includes liquidity obtained from the CB)

Data (cont.)

System name	Jurisdiction	N	First date	Last date	Currency
CHAPS	United Kingdom	3148	2006-01-03	2018-06-18	GBP
CUD	Colombia	2444	2008-07-01	2018-06-29	COP
Fedwire	United States	2523	2008-06-02	2018-06-26	USD
Kronos	Denmark	3120	2006-01-03	2018-06-29	DKK
LVTS	Canada	3170	2006-01-03	2018-07-31	CAD
SIC	Switzerland	2568	2008-06-03	2018-07-30	CHF
SPEI	Mexico	1967	2008-06-02	2016-06-29	MXN
STR	Brazil	4650	2003-01-02	2020-12-31	BRL
TARGET2	Eurosystem	2604	2008-06-02	2018-07-31	EUR

Payments and IDL used

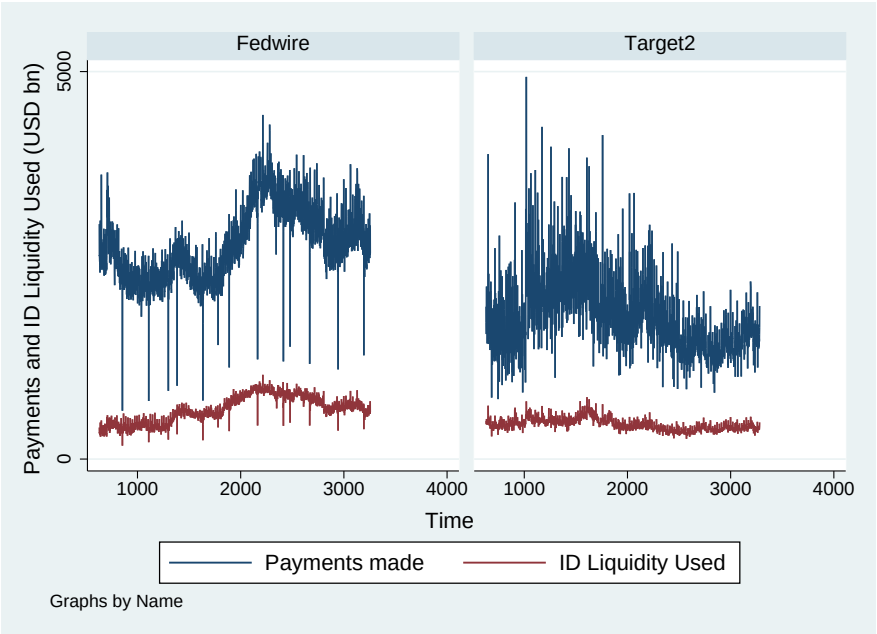
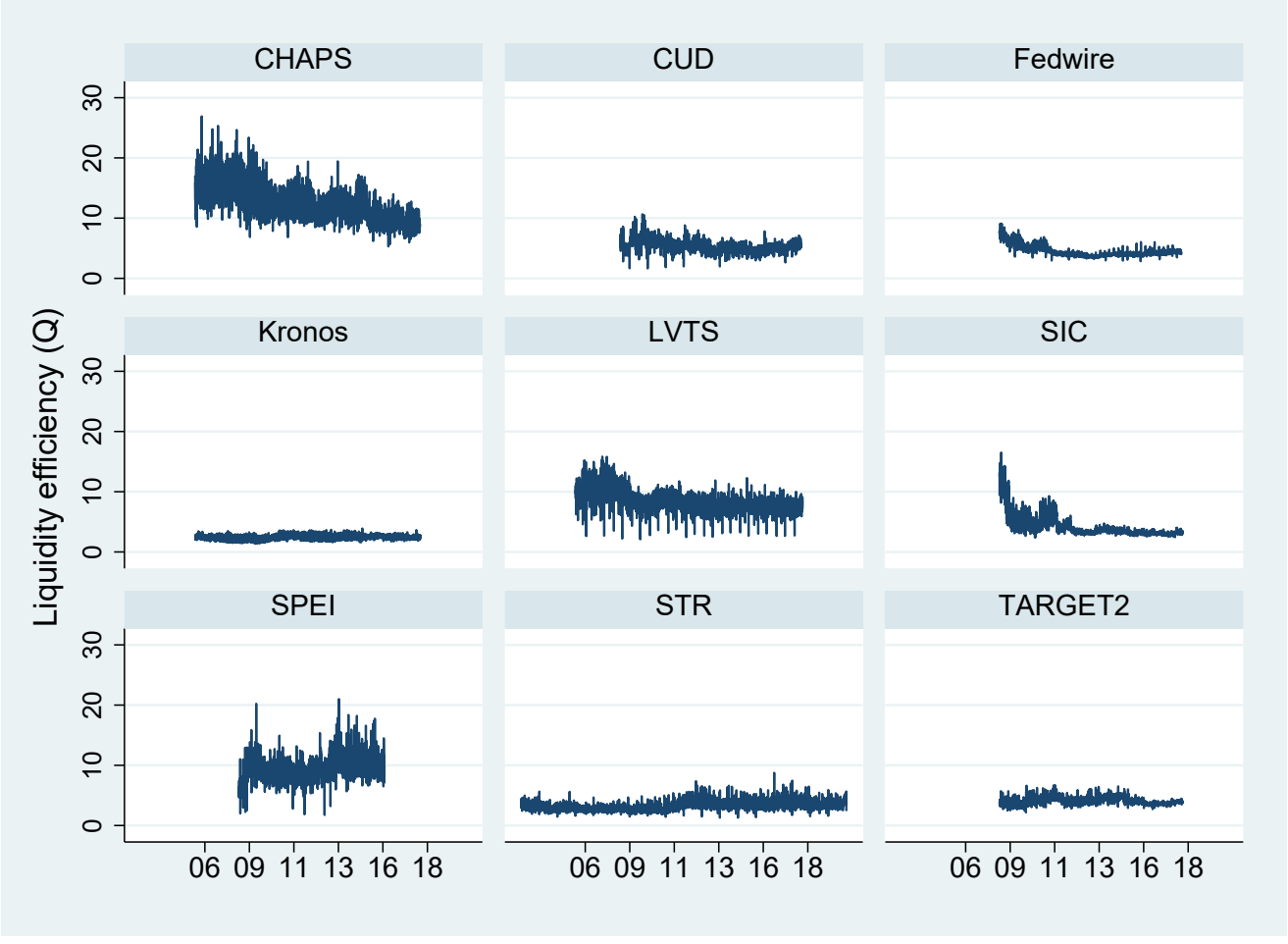


Figure: Daily aggregate values (in USD bn) of payments made (P) and liquidity used (L) in Fedwire and TARGET2.

- Fedwire daily avg: \$630bn, max: \$1tn
- TARGET2 daily avg: \$443bn, max: \$800bn
- IDL used is highly economically significant accounting on average of 15% of payment values or 2.5% of countries' GDP.

Liquidity efficiency (Q)

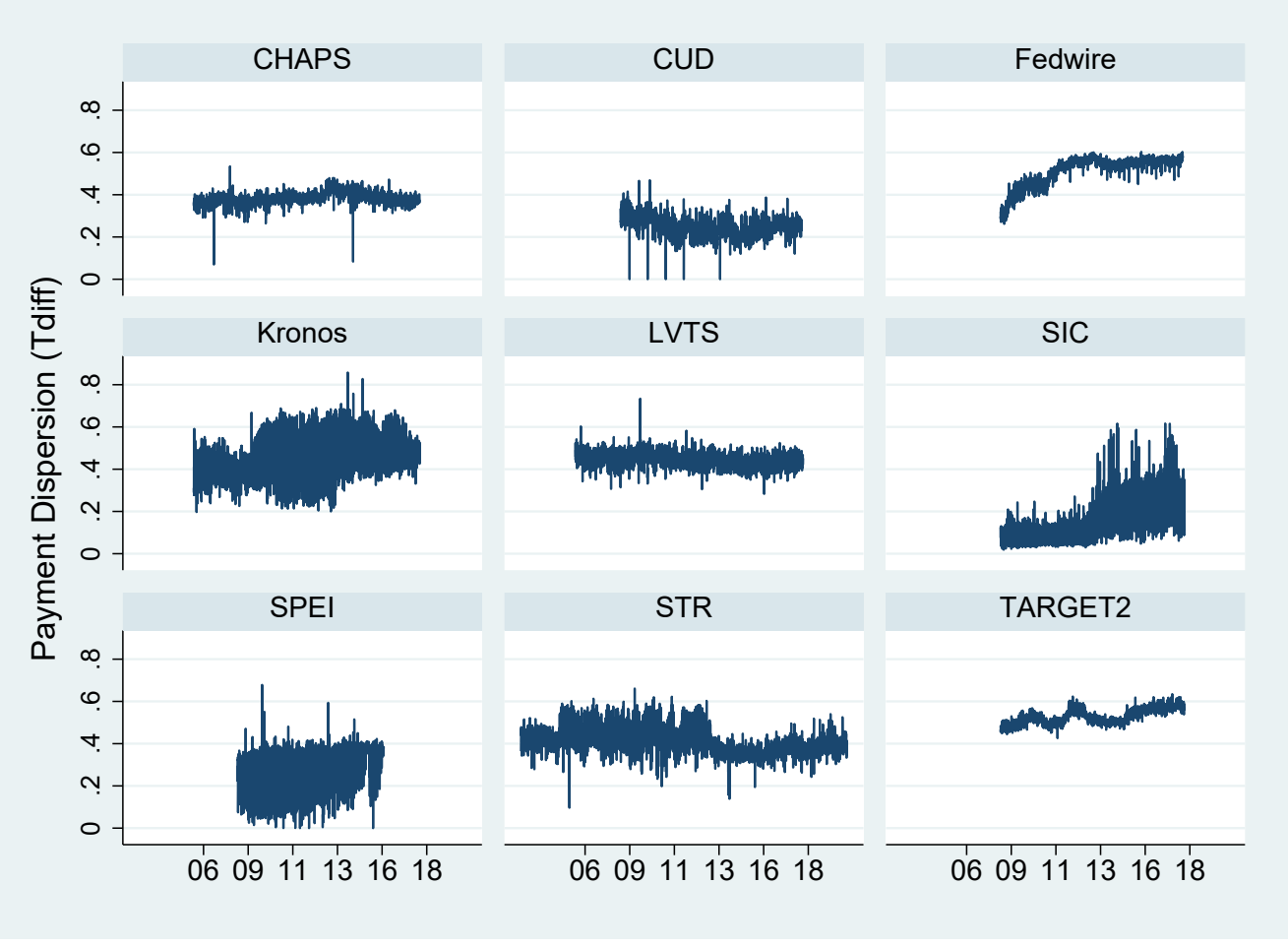


- Substantial time and cross-sectional variation in liquidity efficiency

Payment timing (T)

- Smaller time and cross-sectional variation in payment timing

Payment dispersion (*Tdiff*)



- Larger time and cross-sectional variation in dispersion

Institutional Characteristics and LSMs

How to account for institutional characteristics and LSM design features?

Dummy variable	Definition
Institutional characteristics	
Incentives	Equals 1 if there are in place incentives or requirements for settling payments early
Credit	Equals 1 if the central bank can provide intraday credit on an uncollateralized basis or at a lower collateral cost (e.g. via collateral pooling)
LSM design features	
LSM	Equals 1 if there is an LSM in place
FIFO_bp	Equals 1 if the LSM allows for the FIFO protocol to be bypassed
Offsetting	Equals 1 if the LSM enables multilateral offsetting
Priority	Equals 1 if it is possible to change the priority of payments in the LSM queue
Reservations	Equals 1 if it is possible to reserve liquidity for payments outside the LSM

Institutional Characteristics and LSMs (cont.)

Dummy variable values by jurisdiction

System name	Jurisdiction	*Incentives*	*Credit*	*LSM*	*FIFO_bp*	*Offsetting*	*Priority*	*Reservations*
CHAPS	United Kingdom	1	0	0/1	0/1	0/1	0/1	0/1
CUD	Colombia	1	0	1	1	1	1	0
Fedwire	United States	0	1	0	0	0	0	0
Kronos	Denmark	1	0	1	1	1	1	0
LVTS	Canada	1	1	1	0	1	0	0
SIC	Switzerland	1	0	1	0	0	1	0/1
SPEI	Mexico	0	0	1	0	1	0	0
STR	Brazil	0	0	0/1	0/1	0/1	0/1	0
TARGET2	Eurosystem	0	0	1	1	1	1	1

- In the UK, an LSM was introduced on 22/4/2013.
- In Brazil, an LSM was introduced on 9/1/2012.
- In Switzerland, the ability to reserve liquidity was introduced on 18/6/2016.

Panel Regressions for Timing (T)

	T	T	T	T	T	T	T
$\Delta IBOR$	0.0121***						0.0118**
	(0.009)						(0.019)
Reserves		-0.0001***					-0.0001***
		(0.001)					(0.000)
Incentives			0.0192				-0.0561*
			(0.731)				(0.083)
Credit				0.0636*			0.1933***
				(0.090)			(0.000)
LSM					-0.0059		
					(0.159)		
FIFO_bp						-0.1441**	-0.0759**
						(0.033)	(0.030)
Offsetting						-0.0269	-0.1451***
						(0.617)	(0.000)
Priority						0.1817***	0.1887***
						(0.000)	(0.000)
Reservations						-0.0408*	0.0157
						(0.058)	(0.620)
_cons	0.5282***	0.5520***	0.5159***	0.5146***	0.5332***	0.5170***	0.5760***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.0005	0.0527	0.0014	0.0796	0.0171	0.3394	0.6457
N	25205	26033	26039	26039	26039	26039	25200

Panel Regressions for Timing (T)

Key takeaways:

- **Increases** in the **opportunity cost of reserves** ($\Delta IBOR$) associated with **payment delays** $\rightarrow$ Consistent with LVPS participants hoarding on liquidity in stressful periods.
- **Higher reserves balances associated with earlier payments** $\rightarrow$ Less of an incentive for LVPS participants to delay their payments.
- **LSM liquidity-saving features** (FIFO bypass, multilateral offsetting) associated with **earlier payments**, consistent with theory.

Panel Regressions for Dispersion (*Tdiff*)

	Tdiff	Tdiff	Tdiff
$\Delta IBOR$	0.0356***	0.0369***	0.0372***
	(0.000)	(0.001)	(0.000)
Reserves	0.0001***	0.0000	0.0000**
	(0.005)	(0.539)	(0.040)
Incentives		0.0272	-0.2518***
		(0.684)	(0.000)
Credit		0.1089***	0.4237***
		(0.000)	(0.000)
LSM		-0.0482	
		(0.235)	
FIFO_bp			0.4713***
			(0.000)
Offsetting			-0.3855***
			(0.000)
Priority			-0.1472**
			(0.024)
Reservations			0.0604
			(0.133)
_cons	0.4834**	0.6406***	0.8505***
	(0.043)	(0.000)	(0.000)
R^2	0.1661	0.5215	0.6429
N	25196	25196	25196

Panel Regressions for Dispersion (*Tdiff*)

Key takeaways:

- Increases in the **opportunity cost of reserves** (Δ *IBOR*) associated with increased dispersion $\rightarrow$ Consistent with liquidity hoarding.
- Increased **reserves balances** associated with increased dispersion $\rightarrow$ Ample liquidity reduces incentives for payment coordination.
- **Incentives for early payment** associated with reduced dispersion $\rightarrow$ Consistent with LVPS participants trying to avoid being singled out.
- Lower cost of **CB intraday credit** associated with higher dispersion $\rightarrow$ less of an incentive to economize on liquidity by coordinating payments.
- LVPS participants potentially endogenizing **LSM characteristics**: They coordinate less when the LSM algorithm is capable of offsetting payments submitted at different times and coordinate more when the benefits of doing so are higher (via multilateral offsetting).

Panel Regressions for Liquidity Efficiency (Q)

	Q	Q	Q
T			2.4497
			(0.591)
Tdiff		-12.5865***	-12.1812***
		(0.002)	(0.007)
$\Delta IBOR$		0.4552***	0.4133*
		(0.004)	(0.059)
Reserves		0.0010	0.0012
		(0.397)	(0.293)
Incentives		3.3869*	3.5877**
		(0.072)	(0.043)
Credit		-2.2255	-2.8119
		(0.266)	(0.191)
LSM	-0.6718		
	(0.631)		
FIFO_bp		-0.4172	-0.4015
		(0.922)	(0.925)
Offsetting		3.3422	3.8002
		(0.393)	(0.328)
Priority		-7.3624*	-7.7391*
		(0.080)	(0.066)
Reservations		5.1767***	5.1186***
		(0.005)	(0.005)
_cons	6.5580***	9.4304**	7.7919
	(0.001)	(0.035)	(0.154)
R^2	0.1352	0.4351	0.4363
N	25226	25196	25196

Panel Regressions for Liquidity Efficiency (Q)

Key takeaways:

- **Liquidity efficiency highly negatively correlated with dispersion** $\rightarrow$ The more (less) coordinated payments are, the higher (lower) the amount of recycling and the higher (lower) the degree of liquidity efficiency.
- **The effects of several explanatory variables on liquidity efficiency manifest via dispersion** (e.g. Reserves balances, CB intraday credit regime, several LSM features)
- **The presence of an LSM not correlated with liquidity efficiency** $\rightarrow$ Possibly because of limited usage due to an abundance of reserves in several jurisdictions and/or because of offsetting effects of specific LSM features (e.g. FIFO bypass versus Multilateral Offsetting)

Preliminary analysis of LSM determinants

Lots of interesting LSM results

- Liquidity saving features of LSMs associated with earlier payments
- FIFO bypass/Multilateral offsetting associated w/ reduced/increased payment coordination although no effect on efficiency
- Liquidity reservations lead to higher payment dispersion but increased efficiency
- Priority setting (within LSMs) associated with delays and detrimental to liquidity efficiency

Further thoughts on LSMs

What is driving the LSM results?

- Reverse causality? Maybe systems with low Q are the ones that introduce LSMs
- Sample Selection? Maybe when expanded to other systems the results reverse.
- Change in modeling? Maybe we need to rethink how to model payment coordination beyond a two or three period model.

Some policy-relevant conclusions

- **Financial stability**: Significant amount of IDL used around the world, averaging 15% of daily payment values or 2.5% of countries' GDPs.
- **Funding markets**: Increases in funding costs associated with lower payment coordination and lower liquidity efficiency.
- **QE**: Higher reserves balances result in (a.) payments being processed earlier but (b.) increase payment dispersion which reduces IDL efficiency.
- **LVPS rules**: Early payment incentives not associated with earlier payments but do seem to lead to increased payment coordination and improved liquidity efficiency.
- **LSM design**:Specific LSM design features may be reducing efficiency due to endogenous behavioral changes.

Going forward

- Call for more CBs to join
- Explore new areas of interbank/LVPS activity

Thank you!