FX market illiquidity and funding liquidity constraints

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Motivation

- **Trading volume in FX market is large. Does it translate to a highly liquid FX market? That depends on the definition of liquidity adopted and the proxy used**

- **Recent studies found a time-varying common component in FX market liquidity across currencies (Banti, Phylaktis and Sarno (2012); Mancini, Ranaldo and Wrampelmeyer (2012))**

- **Recent literature on the interaction of market liquidity and funding liquidity emerged to explain the severity of liquidity drop during the latest financial crisis (Brunnermeier and Pedersen (2009); Hameed, Kang and Viswanathan (2010); Acharya and Viswanathan (2011))**

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Research questions

- **What are the determinants of time variation in FX market illiquidity?**

- **Is it affected by changes in investors' funding liquidity constraints?**

- **In particular, does a tightening in the funding liquidity constraints cause an increase in FX market illiquidity?**

- **Are funding liquidity constraints more relevant during market declines and crisis times, when the supply of capital is more tight?**

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Literature Review: determinants of FX market illiquidity

- **Identification of a systematic and time-varying component in FX market liquidity**
  - ➤ **Mancini et al. (2012)**
  - ➤ **Banti et al. (2012)**

- **Negative relationship between the VIX and TED spread measures and FX market liquidity for the most traded currencies during the recent financial crisis**
  - ➤ **Mancini et al. (2012)**

- **Positive relationship between volatility and the bid-ask spreads of some currencies in different frequencies and time periods**
  - ➤ **Bollerslev and Melvin (1994)**
  - ➤ **Bessembinder (1994)**

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Literature Review:
market illiquidity & funding liquidity

- **Traders financial constraints influence the liquidity of financial markets. Funding liquidity constraints affect all their operations creating a systematic source of variation in liquidity across financial assets**

  - ➤ **Shleifer and Vishny (1997)** introduce financially constrained arbitrageurs unable to fully exploit opportunities due to the risk of investors redemption

  - ➤ **Gromb and Vayanos (2002)** model financial constraints, arguing that margins affect arbitrageurs' ability to provide liquidity

  - ➤ **Brunnermeier and Pedersen (2009)** show that when traders are close to hit their funding constraints, changes in funding liquidity affect strongly the liquidity of the assets in which they trade

  - ➤ **Hameed, Kang and Viswanathan (2010)** document empirically that negative market returns decrease stock market liquidity, especially during times of tight funding conditions

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Literature Review: funding liquidity & illiquidity spirals

- **Interaction of financing conditions and market liquidity may lead to illiquidity spirals**
  - ➢ **Brunnermeier and Pedersen (2009)** show that when funding is tight, the interaction between market and funding liquidity leads to illiquidity spirals and finally to liquidity dry-ups
  - ➢ **Acharya and Viswanathan (2011)** document the presence of illiquidity spirals related to moral hazard issues in the rollover of debt

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Literature Review: market liquidity & inventory control

- **At the market level, variations in the determinants of dealers inventory level (Stoll (1978); Ho and Stoll (1981)) may be a source of the observed commonality in liquidity across financial markets:**
  - ➤ **Copeland and Galai (1983)** show a negative relationship between asset volatility and liquidity
  - ➤ **Hameed et al (2010) and Chordia et al (2001**) identify recent market movements as a determinant of stock market liquidity
  - ➤ **Bessembinder (1994)** documents seasonality effects in individual currency liquidity

Contributions

- **Identification of the determinants of changes in the common component of FX market illiquidity based on 20 currencies**
  - ➤ Transaction costs: bid-ask spread
  - ➤ Market depth : Pastor-Stambaugh liquidity measure
- **Investigation of the relationship between FX market illiquidity and changes in investors' funding conditions**
  - ➤ Do funding liquidity constraints impact during declining markets when dealers find it more difficult to adjust inventory?
  - ➤ Are funding liquidity dry-ups worse during the recent crisis when funding became a serious issue as stressed by Brunnermeier and Pedersen (2009)?
  - ➤ Is the impact of funding liquidity constraints stronger for illiquid currencies as a shock to speculator capital would lead to a reduction in market liquidity through a spiral effect that is stronger for illiquid currencies, as again proposed by Brunnermeier and Pedersen (2009)?
  - ➤ Is the impact of funding liquidity constraints much stronger on the liquidity of emerging market currencies, which are on the whole less liquid?

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Methodology: measuring FX market illiquidity

- Among the liquidity proxies developed, we measure illiquidity as transaction costs: the percentage bid-ask spreads of the USD against the currencies following the American system.

- We estimate the changes in the common component across currencies by differencing the cross-sectional average:

$$PSPR_t = \frac{1}{N} \sum_{i=1}^{N} PSPR_{i,t}$$

$$\Delta PSPR_t = \log(PSPR_t) - \log(PSPR_{t-1})$$

Methodology: funding liquidity constraints proxy

- Among the proxies for funding liquidity conditions, we employ the interest rate on financial commercial papers, available daily (as in Adrian et al. (2010)).

- Since we are interested in the changes in funding liquidity, we take the first difference of the logs of the FCP rates:

$$\Delta FCP_t = \log(FCP_t) - \log(FCP_{t-1})$$

- So, an increase in FCP interest rates is a proxy for a tightening of funding liquidity constraints.

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Methodology: measures for the other determinants

- Global FX volatility (Menkhoff, Sarno, Schmeling and Schrimpf (2012)):

$$VOL_t = \log(VXY_t) - \log(VXY_{t-1})$$

- FX market returns (Chordia et al. (2001); Hameed et al. (2010)):

$$MKT_t = \sum_{i=1}^{20} \left(\frac{r_{i,t}}{20} \right)$$

- Weekly seasonality (Bessembinder (1994))

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Data

- 20 currencies (10 developed countries and 10 emerging markets) for a time period of 13 years, Jan 1998 to Dec 2010

- Daily foreign exchange bid, ask and mid rates of the USD versus the currencies are obtained from Datastream (WM/Reuters Closing Spot, provided by Reuters at 16 GMT)

- Daily FCP interest rate is available from the U.S. Federal Reserve Board

- Proxies for margin requirements:

  ➢ Federal Funds rate: available from the U.S. Federal Reserve Board

  ➢ TED spread: 3-month LIBOR from Datastream and the 3-month Treasury rate from the U.S. Federal Reserve Board

- Daily VXY is obtained from Bloomberg

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Descriptive statistics of main variables

	Δilliq	ΔFCP
mean	-0.00003	-0.00369
median	0.00071	0
st dev	0.11454	0.09241
min	-0.55196	-2.07944
max	0.58896	1.50408
skew	-0.01154	-4.00308
kurt	2.32023	147.02724
AC(1)	-0.46000	-0.06987

	FCP	FF	TS	Δ FCP	Δ FF	Δ TS
FF	0.9989					
TS	-0.3616	-0.3646				
VOL	-0.3203	-0.3251	0.1260			
Δ FF				0.2686		
Δ TS					-0.0379	-0.0383
Δ VOL				0.0322	0.0794	0.1781

FX market illiquidity
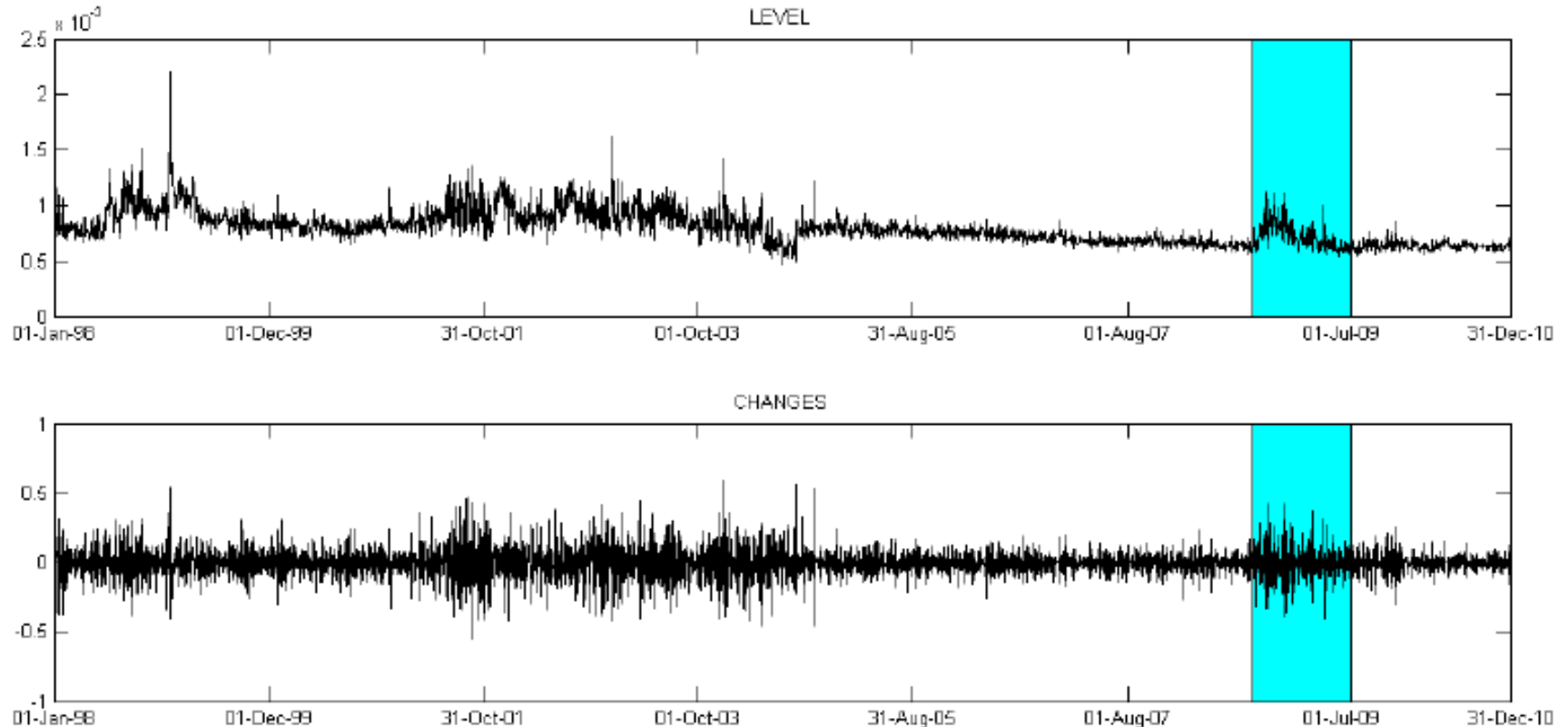
FCP interest rates
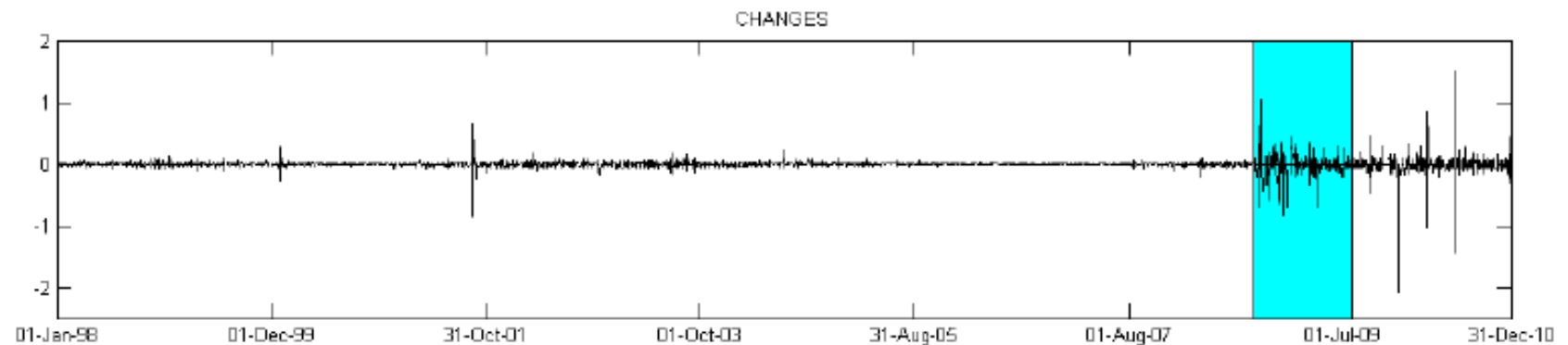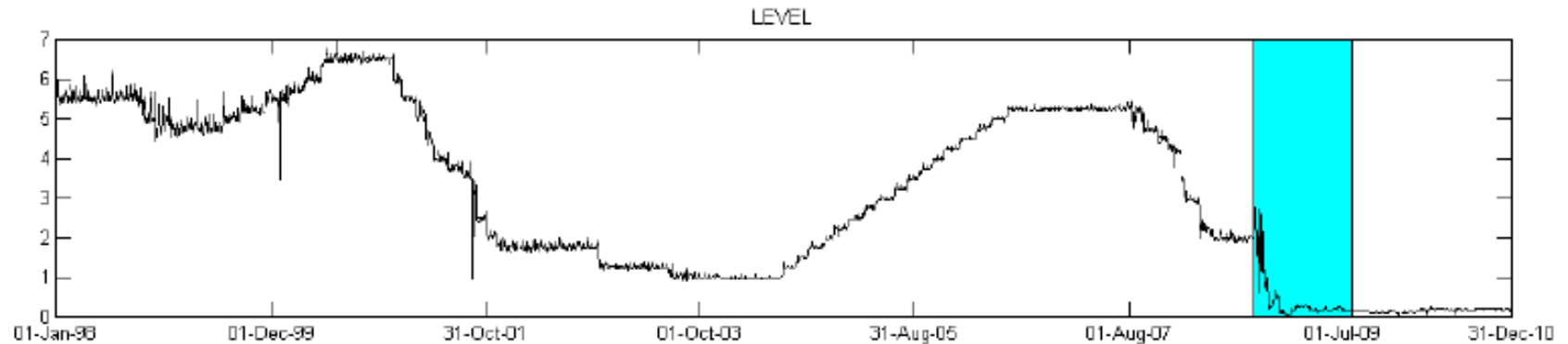
FX market illiquidity and funding liquidity constraints

Run the following regression:

$$\Delta illiq_t = \alpha + \beta \Delta FCP_t + \delta VOL_t + \varphi \Delta TS_t + \varsigma \Delta FF_t + \mu MKT_{t-1} +$$

$$\gamma_1 d_t^{MON} + \gamma_2 d_t^{TUE} + \gamma_3 d_t^{WED} + \gamma_4 d_t^{THUR} + \sum_{i=1}^{4} \theta_i \Delta illiq_{t-i} + \varepsilon_t$$

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Results of the main regression analysis

	1	2
D FCP t	0.03892	0.03752
VOL t		0.1761
MKT t-1		-1.0724
dummy mon	-0.02847	-0.02952
dummy tue	-0.02814	-0.02903
dummy wed	-0.02018	-0.02167
dummy thur	-0.00001	-0.01426
constant	0.01752	0.01848
Rbar	0.35	0.35

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Market illiquidity, market declines and funding liquidity

- **To test if the impact of market returns is symmetric, we interact lagged market returns with a dummy for negative and positive market returns:**

$$\Delta illiq_t = \alpha + \beta \Delta FCP_t + \mu_1 d_{t-1}^+ MKT_{t-1} + \mu_2 d_{t-1}^- MKT_{t-1} + \delta VOL_t +$$

$$\gamma_1 d_t^{MON} + \gamma_2 d_t^{TUE} + \gamma_3 d_t^{WED} + \gamma_4 d_t^{THUR} + \sum_{i=1}^{4} \theta_i \Delta illiq_{t-i} + \varepsilon_t$$

- **To test if the impact of market declines is indicative of capital constraints, we interact market returns with a dummy for lagged positive changes in funding constraints:**

$$\Delta illiq_t = \alpha + \beta \Delta FCP_t + \mu d_{t-1}^{+FUND} MKT_{t-1} + \delta VOL_t +$$

$$\gamma_1 d_t^{MON} + \gamma_2 d_t^{TUE} + \gamma_3 d_t^{WED} + \gamma_4 d_t^{THUR} + \sum_{i=1}^{4} \theta_i \Delta illiq_{t-i} + \varepsilon_t$$

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Market illiquidity, market declines and funding liquidity

	1	2	3	4
D FCP t	**0.03953**	**0.03811**	**0.03737**	**0.03606**
lag dummy pos MKT ret	0.070			
lag dummy neg MKT ret	**-2.224**	**-2.186**		
dummy for pos fund constraints			-2.137	-2.067
VOL t		0.171		0.167
dummy mon	-0.029	-0.029	-0.028	-0.029
dummy tue	-0.028	-0.029	-0.029	-0.029
dummy wed	-0.020	-0.021	-0.019	-0.020
dummy thur	-0.013	-0.014	-0.013	-0.013
constant	0.014	0.015	0.016	0.016
Rbar	0.35	0.35	0.35	0.35

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Crisis episodes and FX market illiquidity

- **In order to test if during crisis periods the changes in funding liquidity constraints have a strong positive impact on FX market illiquidity, we use a dummy, which takes the value of 1 during the period from Lehman Brothers collapse on September 15th, 2008 to July 2009, when the US recession ended and zero otherwise**

- We interact it with our measure of changes in funding constraints in the following regression:

$$\Delta illiq_t = \alpha + \beta(dummy_t * \Delta FCP_t) + \delta VOL_t + \mu MKT_{t-1}$$

$$\gamma_1 d_t^{MON} + \gamma_2 d_t^{TUE} + \gamma_3 d_t^{WED} + \gamma_4 d_t^{THUR} + \sum_{i=1}^{4} \theta_i \Delta illiq_{t-i} + \varepsilon_t$$

- We expect the beta to be positive and statistically significant

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Crisis episodes and FX market illiquidity

dummy t * D FCP t	**0.0759**
VOL t	**0.1735**
MKT t-1	**-1.0401**
dummy mon	**-0.0290**
dummy tue	**-0.0294**
dummy wed	**-0.0219**
dummy thur	**-0.0139**
Constant	**0.0184**
Rbar	0.35

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Robustness tests

- **Repeat estimation using GMM: results are qualitatively the same**

- **Investigate determinants of shocks to FX market illiquidity: determinants are the same as in the main analysis**

- **Use an alternative measure of liquidity, market depth: Pastor-Stambaugh proxy for liquidity**

- **Measure common component of FX market illiquidity differently: weighting currencies according to their transaction flow**

- **Investigate the impact of funding liquidity and volatility across currencies: more volatile currencies suffer the higher impact on illiquidity of changes in funding liquidity constraints**

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Determinants of shocks to FX market illiquidity

D FCP t	**0.0340**
VOL t	**0.1705**
MKT t-1	**-1.0257**
dummy mon	**-0.0306**
dummy tue	**-0.0279**
dummy wed	**-0.0200**
dummy thur	**-0.0131**
constant	**0.0179**
Rbar	0.02

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Pastor-Stambaugh proxy for liquidity

- **Temporary price change in terms of expected return reversal accompanying order flow**

$$r_{i,t} = \alpha_i + \beta_i \Delta x_{i,t} + \gamma_i \Delta x_{i,t-1} + \varepsilon_{i,t}$$

$$L_{i,m} = \hat{\gamma}_{i,m}$$

$$\Delta L_m = \alpha + \gamma \Delta REPO_m + \beta \Delta FCP_m + \delta VOL_m +$$

$$+\varphi \Delta TS_m + \varsigma \Delta FF_m + \mu MKT_{m-1} + \theta \Delta L_{m-1} + \varepsilon_m.$$

- **Analysis at a different frequency, monthly**

- **Funding liquidity measured as changes in amount outstanding of REPOs and changes in monthly FCP rates**

- **Volatility is the monthly standard deviation of FX currency returns**

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Pastor-Stambaugh proxy for liquidity

	1	2
REPOS	**0.0089**	**0.0085**
FCP	-0.0003	0.0000
VOLt		**-0.4405**
constant	-0.0001	**0.0016**
Rbar	0.37	0.41

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Impact of funding liquidity and volatility across currencies

- **We investigate whether currencies that exhibit higher volatility also present the largest impact of changes in funding liquidity constraints on illiquidity**

- **We build a measure of changes in illiquidity level of each individual currency:** $\Delta PSPR_{i,t} = PSPR_{i,t} - PSPR_{i,t-1}$

- **We estimate the impact on the changes in individual currency illiquidity of changes in funding liquidity interacted with individual currency volatility (daily absolute currency returns, as in Menkhoff et al. 2012) in a panel with fixed effects:**

$$\Delta PSPR_{i,t} = \alpha + \beta(\Delta FCP_t * VOL_{i,t}) + \gamma_1 d_t^{MON} + \gamma_2 d_t^{TUE} + \gamma_3 d_t^{WED}$$

$$+ \gamma_4 d_t^{THUR} + \sum_{n=1}^{4} \delta_n \Delta PSPR_{i,t-n} + \varepsilon_t$$

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Impact of funding liquidity and volatility across currencies (cont'd)

- **We also investigate whether the impact is stronger:**
  - **for emerging market currencies, which are on the whole less liquid**
  - **during the recent financial crisis**

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Impact of funding liquidity and volatility across currencies

DFCPxVOL	**2.2134**		
D FCPxVOL (emerging)		**3.17207**	
D FCP x VOL (crisis)			**2.46371**
VOL t	**0.2243**	**0.29414**	**0.22434**
MKT t-1	**-1.0795**	**-1.79876**	**-1.07129**
dummy mon	**-0.2200**	**-0.03666**	**-0.02180**
dummy tue	**-0.0239**	**-0.03042**	**-0.02401**
dummy wed	**-0.0167**	**-0.02791**	**-0.01684**
dummy thur	-0.0071	-0.01204	-0.00694
Constant	**0.0134**	**0.02162**	**0.01332**
Rbar	0.36	0.35	0.36

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Conclusions I

➢ **We find a strong impact of the changes in funding liquidity conditions on the time variation of FX market illiquidity, controlling for global FX volatility and market returns**

➢ **We identify a strong weekly seasonality in FX market illiquidity**

➢ **We document an asymmetric effect of market returns on illiquidity in the FX market; inventory accumulation concerns are more important in declining markets, and this relates to periods when the suppliers of liquidity face capital tightness**

➢ **We show that liquidity dry-ups during crisis times have a strong impact on FX market illiquidity**

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Conclusions II

➢ **Funding liquidity together with the other explanatory variables are found to explain shocks to FX market illiquidity as well**

➢ **The relationship between funding liquidity and FX market illiquidity holds true for another liquidity proxy at a lower frequency**

➢ **We confirm that a shock to speculator capital would lead to a reduction in market liquidity through a spiral effect that is stronger for illiquid currencies**

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