Liquidity supply by broker-dealers and real activity

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Abstract

- Using data on their trading positions in Treasury bonds and Teasury noise, this paper develops a novel measure of liquidity supply by broker-dealers.
- By using sign restriction method, he measures changes in dealers' liquidity supply by studying noise jointly with dealer gross positions.
- The shift is informative about liquidity in other asset classes, including corporate bonds and equities. A decline in liquidity supply predicts reduced debt issuance and investment by nonfinancial firms and reduced aggregate economic activity. The results suggest that securities intermediaries are important for understanding liquidity commonality, corporate financing, and real activity.

1.Introduction

- When intermediaries' inventory capacity is strained, assets can trade at prices away from their fundamental values.
- Noise in prices, reflect the expected return for providing liquidity. A rise in noise and a contraction in intermediary balance sheets are therefore key symptoms of a deterioration in intermediaries' provision of liquidity.

1 市场冲击

2 银行、证券等公司资金受损；价格波动

3 减少交易并减少手中的头寸

4 市场流动性下降

5 市场中融资风险大，融资困难

6 流动性供给减少

- **Garcia (2012) and Hu et al. (2013)** develop a theory of measuring liquidity supply, which study Treasury noise—the deviations of individual US Treasury yields from a fitted yield curve.
- **Noise could also be driven by liquidity demand by investors**.To address this concern, the author extends their analysis using data on the **trading positions of primary dealers**. Primary dealers are active across asset classes and are at the center of the Treasury market.

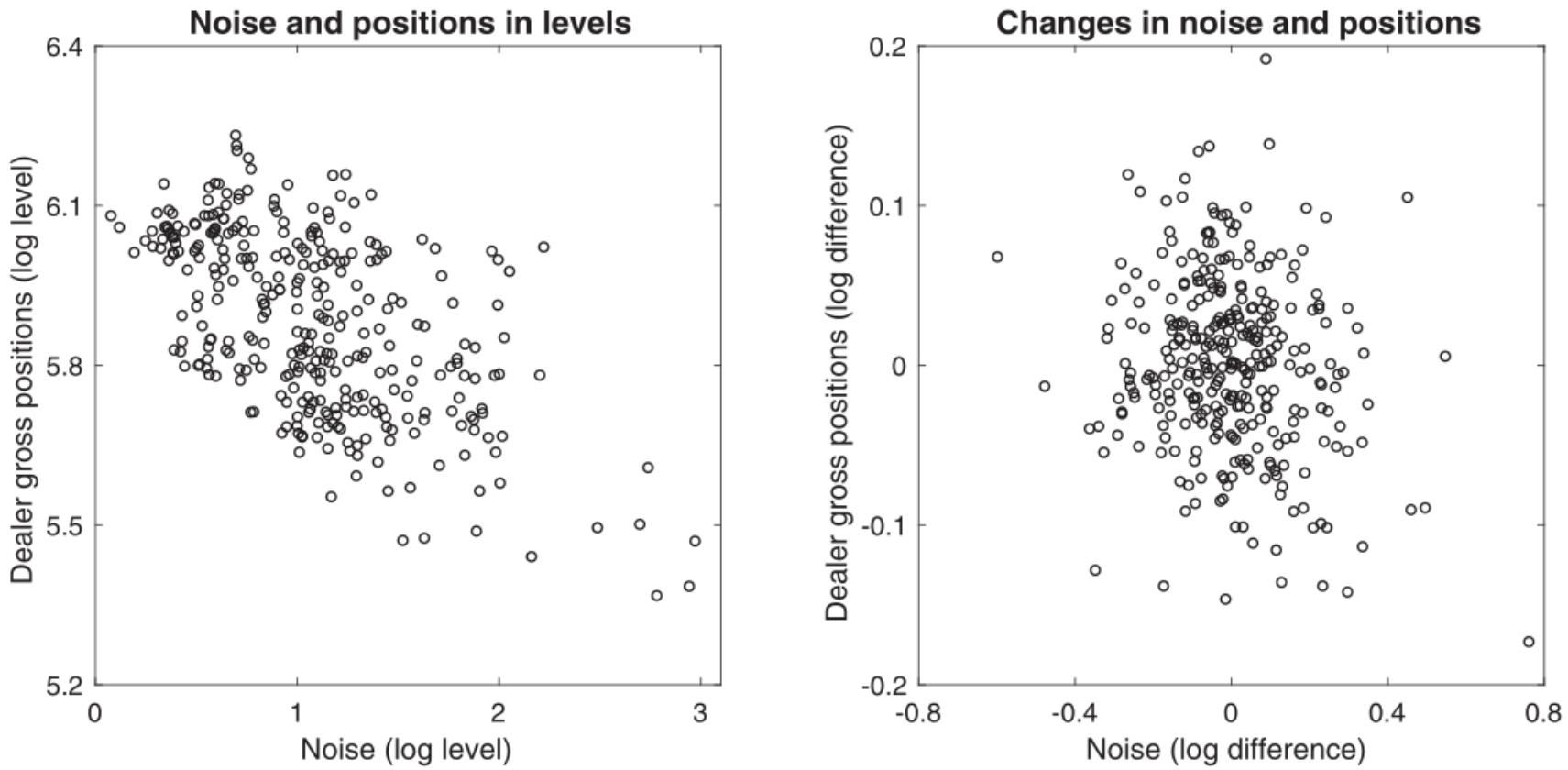

Noise and positions in levels
Dealer gross positions (log level)
Noise (log level)
6.4
6.1
5.8
5.5
5.2
0
1
2
3
Changes in noise and positions
Dealer gross positions (log difference)
Noise (log difference)
0.2
0.1
0
-0.1
-0.2
-0.8
-0.4
0
0.4
0.8

Fig. 1

- The price of liquidity is the deviation of individual Treasury yields from a fitted yield curve: **noise**. The quantity of liquidity is **dealer gross positions in Treasury bonds**. An inward shift in the dealers' supply curve is associated with a rise in noise and a decline in dealer gross positions. An outward shift in the liquidity demand curve is associated with a rise in both noise and dealer gross positions.
- Motivated by this evidence, he measure changes in dealers' liquidity supply by studying noise jointly with dealer gross positions.

To understand the information content of the resulting measure of dealers' **liquidity supply** in the Treasury market, he study its relation to other liquidity measures, the corporate financing mix, investment, and real activity. **The relationship is followed:**

- An inward shift in liquidity supply in the Treasury market is associated with persistent **declines** in liquidity in corporate bonds and other asset classes;
- A decline in liquidity supply in securities markets is expected to lead to a shift away from corporate debt, toward equity,and **reduced** investment;
- A deterioration in liquidity supply by dealers predicts an economically and statistically significant **reduction** in aggregate real activity.

liquidity demand shifts are not associated with changes in securities issuance, investment, or aggregate activity.

2.Why does author use Treasury market?

- The Treasury market is typically well functioning and has among the highest credit quality, implying that illiquidity in Treasury bonds, if it arises, is likely indicative of liquidity problems in the over all market.
- The Treasury yield curve provides a reliable benchmark to measure price deviations. Treasury yields are typically well approximated by a small number of interest rate factors that can be easily obtained empirically.

3.Liquidity measure

A. Sample Construction

This paper uses Federal Reserve data for Treasury bond prices (Price Quote System) and dealer positions (WeeklyReport of Dealer Positions). The sample runs from July 1990 through May 2017.

B. Dealer gross positions

- Dealer gross positions is the aggregate value of gross long and gross short positions of primary dealers in nominal Treasury coupon securities.
- From the Weekly Report of Dealer Positions.
- Aggregate to a monthly measure by taking the average across all reporting days in a given month.

C. Noise

a. definition:the deviations of individual US Treasury yields from a fitted yield curve

- b. method: use the Svensson (1994)model of the term structure of interest rates,In this model, instantaneous forward rates are given by

$$f(n) = \zeta_0 + \zeta_1 \exp(-n/\nu_1) + \zeta_2 (n/\nu_1) \exp(-n/\nu_1) + \zeta_3 (n/\nu_2) \exp(-n/\nu_2),$$

- n is the time to maturity;
- parameters to be estimated $\theta = (\zeta 0 , \zeta 1 , \zeta 2 , \zeta 3 , \nu 1 , \nu 2)$;
- $\zeta 2$ and $\zeta 3$ control the magnitude and direction of the humps
- $\nu 1$ and $\nu 2$ control the locations of the humps

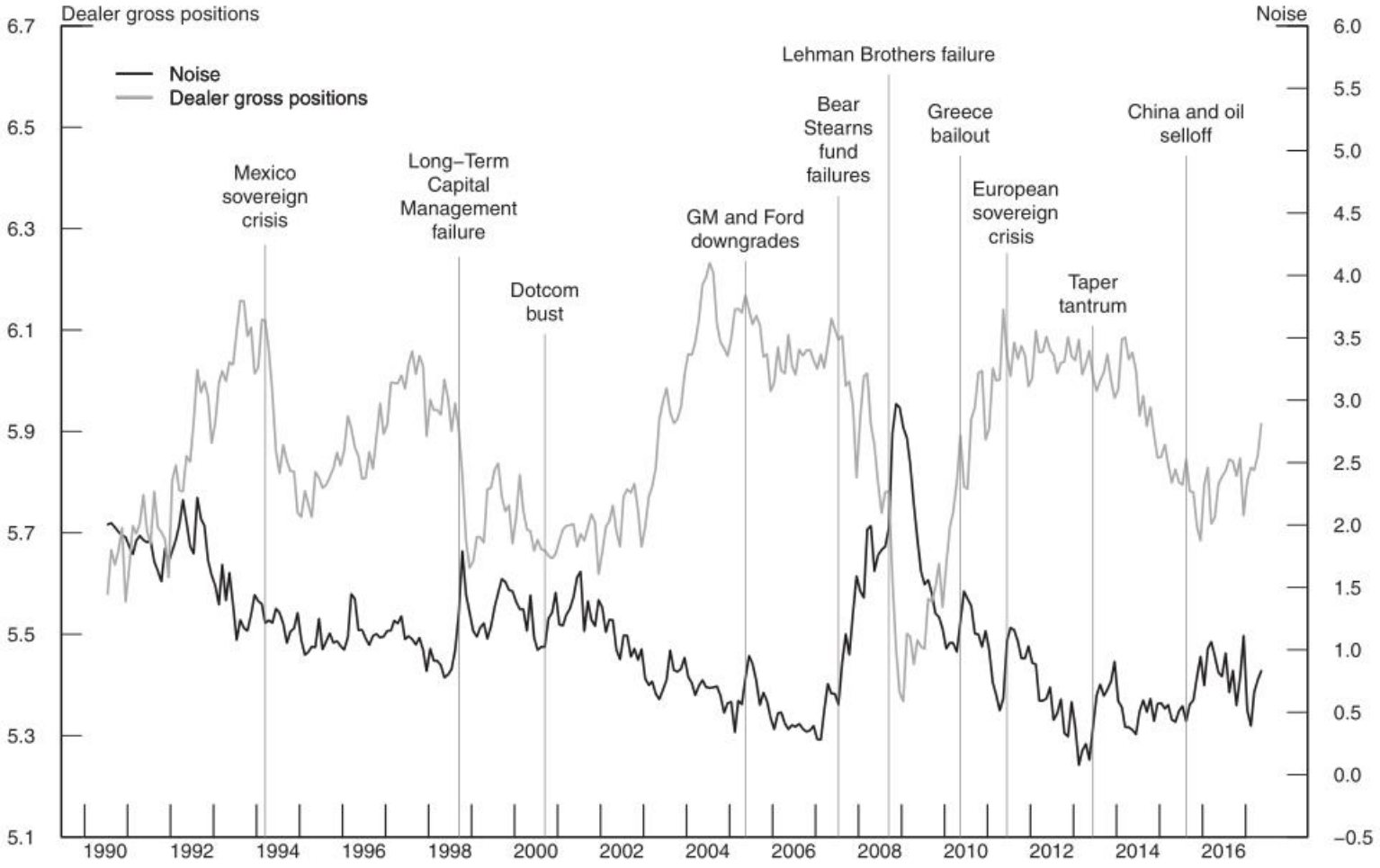
By this way, The parameters θd are estimated by

$$\theta_d = \arg\min_{\theta} \sum_{j=1}^{J_d} \left[\left(P^j(\theta) - P_d^j \right) \times \frac{1}{D_d^j} \right]^2, \qquad (1)$$

- J d denotes the number of bonds available for curve fitting on day d
- P_{d}^{j} is the market price
- D_{d}^{j} is its Macaulay duration

Noise on day d is defined as the root mean squared error between the model implied yield and the market yield. That is,

$$noise_d = \sqrt{\frac{1}{J_d} \sum_{j=1}^{J_d} \left[yld^j(\theta_d) - yld_d^j \right]^2}, \qquad (2)$$



noise
position

Fig. 2

D. Measure of liquidity supply shifts

a.method: use a vector autoregression (VAR) model of noise and dealer gross positions.

$$Y_t = \mu + \sum_{i=1}^{l} B_i Y_{t-i} + \xi_t, \qquad (3)$$

- Y_t= [noise $_t$ position $_t$] be a 2 × 1 vector in month t
- l is the lag length
- μ is a 2 × 1 vector of constant terms

The residual ξt can be expressed as

$$\begin{bmatrix} \xi_{noise,t} \\ \xi_{positions,t} \end{bmatrix} = A \begin{bmatrix} \delta_t^s \\ \delta_t^d \end{bmatrix}, \tag{4}$$

If A satisfies the following sign restrictions,

$$sign(A) = \begin{pmatrix} + & + \\ - & + \end{pmatrix}, \tag{5}$$

then,

- δ_t^s can be interpreted as an inward shift in liquidity supply
- δ_t^d can be interpreted as an outward shift in liquidity demand

b.interpretation of the VAR

This VAR nests a standard supply-demand model with constant elasticities of supply and demand.

Consider the following system of supply and demand equations:

$$positions_t = b^s noise_t - k^s s_t \tag{6}$$

and

$$positions_t = -b^d noise_t + k^d d_t. \tag{7}$$

➢ 其中，: $b^s > 0$ and $b^d > 0$ $k^s > 0$ and $k^d > 0$

Assume that s_t and d_t follow a vector autoregression, and s_t and d_t are persistent and stochastic.

$$\begin{bmatrix} s_t \\ d_t \end{bmatrix} = \bar{\mu} + \sum_{i=1}^{l} \bar{B}_i \begin{bmatrix} s_{t-i} \\ d_{t-i} \end{bmatrix} + \bar{\delta}_t, \tag{8}$$

To proceed, note that:

$$Y_t = \bar{A}\bar{\mu} + \sum_{i=1}^{l} \bar{A}\bar{B}_i\bar{A}^{-1}Y_{t-i} + \bar{A}\bar{\delta}_t \tag{9}$$

with

$$\bar{A} = \begin{bmatrix} \frac{k^s}{b^s+b^d} & \frac{k^d}{b^s+b^d} \\ -\frac{k^s b^d}{b^s+b^d} & \frac{k^d b^s}{b^s+b^d} \end{bmatrix}. \tag{10}$$

comparing with Eq.(3):

$$Y_t = \mu + \sum_{i=1}^{l} B_i Y_{t-i} + \xi_t, \tag{3}$$

Eq(2)打字.

由供需方程可得.

$$\begin{cases} S_t = \dfrac{b^s noise_t - position_t}{k^s} \\ d_t = \dfrac{b^d noise_t + position_t}{k^d} \end{cases}$$

代入<8>

可得:

$$\begin{bmatrix} S_t \\ d_t \end{bmatrix} = \begin{bmatrix} \frac{b^s}{k^s} noise_t - \frac{1}{k^s} position_t \\ \frac{b^d}{k^d} noise_t + \frac{1}{k^d} position_t \end{bmatrix} = \underbrace{\begin{pmatrix} \frac{b^s}{k^s} & -\frac{1}{k^s} \\ \frac{b^d}{k^d} & \frac{1}{k^d} \end{pmatrix}}_{N} \underbrace{\begin{pmatrix} noise_t \\ position_t \end{pmatrix}}_{Y_t}$$

$$\Rightarrow \begin{bmatrix} S_t \\ d_t \end{bmatrix} = N Y_t$$

$\because N^{-1} = \bar{A}$

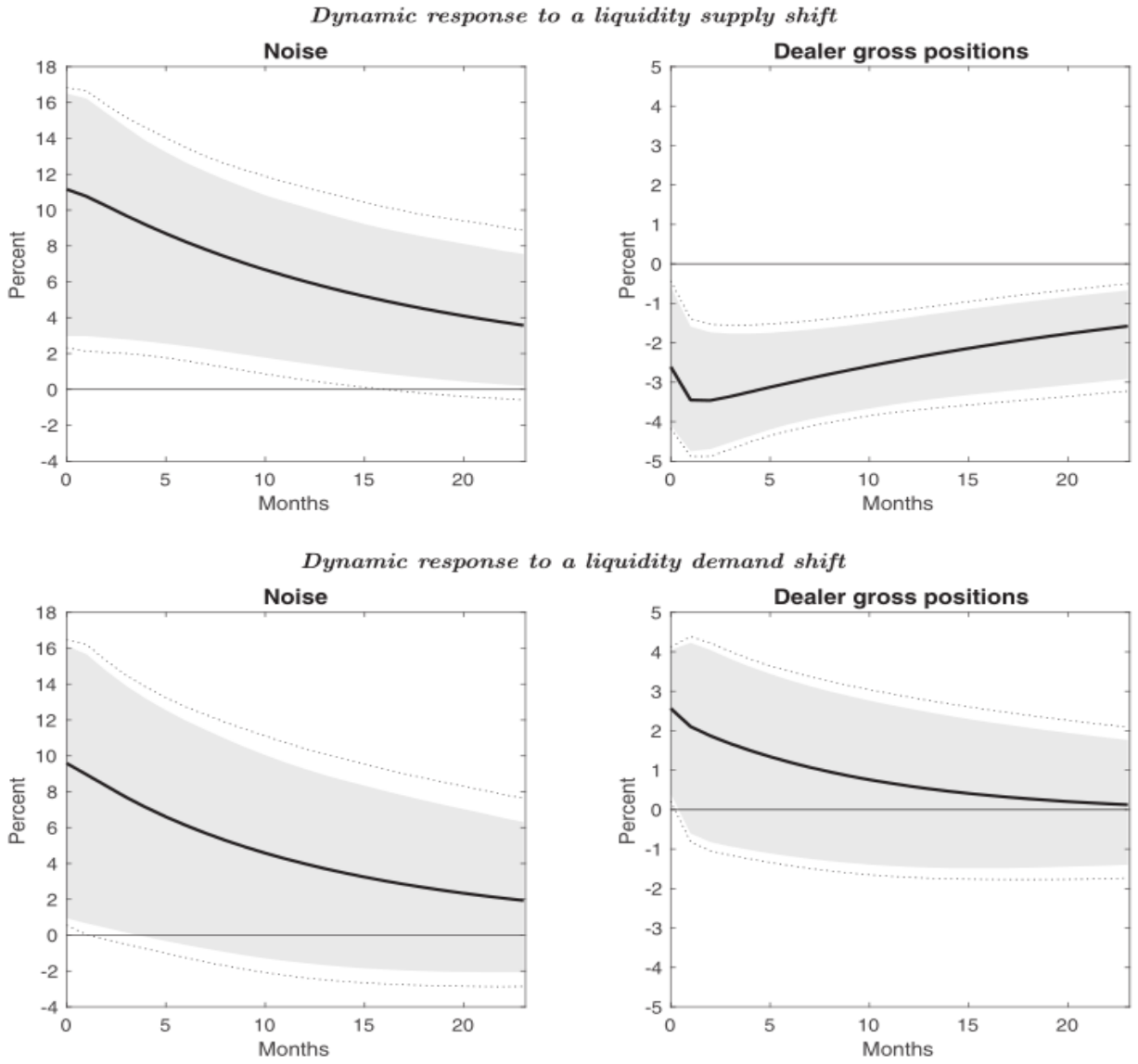
$$\therefore Y_t = \bar{A} \begin{bmatrix} S_t \\ d_t \end{bmatrix} = \bar{A}\bar{M} + \sum_{i=1}^{l} \bar{A}\bar{B}_i\bar{A}^{-1} Y_{t-1} + \bar{A}\bar{\varepsilon}_t$$

c.Estimation of supply and demand shifts

Using Bayesian methods, the author follow the approach of Uhlig (2005), concluding that:

- The proxy for δt is the mean over its posterior distribution
- The liquidity supply and demand shift proxies are normalized to have a standard deviation equal to one.

Fig. 3


Dynamic response to a liquidity supply shift
Noise
Dealer gross positions
Percent
Months
Dynamic response to a liquidity demand shift
Noise
Dealer gross positions
Percent
Months

4.The information content of luquidity supply shift

A.Model specificaton

Do the regressions of the form:

$$\Delta^h y_{t+h} = \alpha^h + \beta_s^h \delta_t^s + \beta_d^h \delta_t^d + \sum_{j=1}^{p} \lambda_j^h \Delta y_{t-j} + \epsilon_{t+h}, \qquad (11)$$

- δ_t^s and δ_t^d are the liquidity supply and demand shift proxies
- β_s^h β_d^h is the response of $\Delta^h y_{t+h}$ at horizon h
- p is lag length
- use Newey and West (1987) 'method to estimate standard errors

B.Illiquidity outside the Treasury market

The three dependent variables:Illiquidity in several asset classes

- For **corporate bonds and equities**, the illiquidity measure is the price impact proxy;
- For **mortgage-backed securities (MBS)**, use the option-adjusted spread

The three explanatory variables:

- the proxy of liquidity supply and demand δ_t^s δ_t^d
- the noise and dealer gross positions innovations

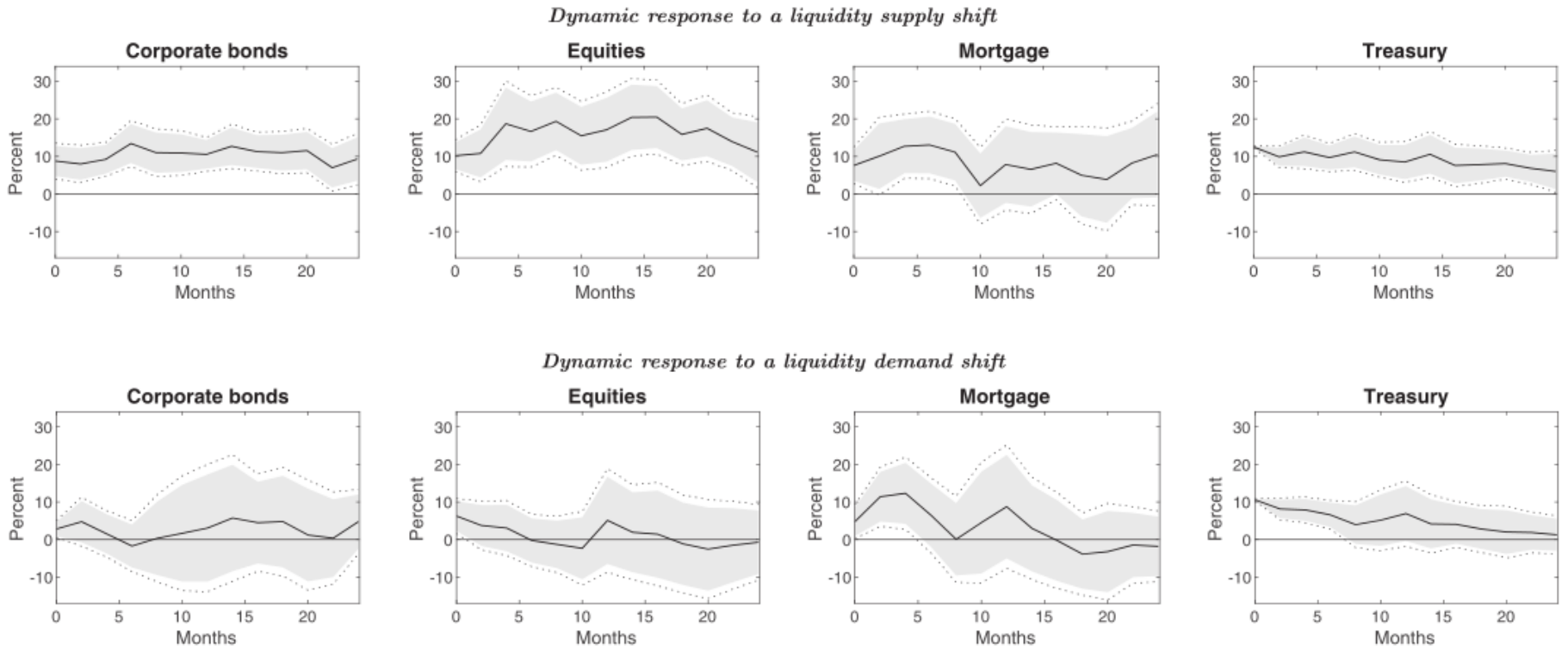

Dynamic response to a liquidity supply shift
Corporate bonds
Equities
Mortgage
Treasury
Percent
Months
Dynamic response to a liquidity demand shift
Corporate bonds
Equities
Mortgage
Treasury
Percent
Months

Fig. 5

	Dependent variable: Change in illiquidity over an h-month horizon ($\Delta^h y_{t+h}$)											
	Corporate bonds			Equities			Mortgage			Treasury		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: contemporaneous change in illiquidity (horizon $h = 0$ months)												
Liquidity supply	8.77***			10.19***			7.61***			12.48***		
	(2.43)			(2.16)			(2.49)			(0.15)		
Liquidity demand	2.83**			6.27***			4.80**			10.60***		
	(1.15)			(2.38)			(2.32)			(0.13)		
Noise		6.11***			8.13***			6.11***			11.22***	
		(1.68)			(1.42)			(1.54)			(0.09)	
Dealer positions			−3.52*			−2.06			−1.41			−1.08
			(1.88)			(1.70)			(1.91)			(0.88)
N	139	139	139	321	321	321	241	241	241	296	296	296
ΔR^2	25.42	22.50	7.31	9.29	9.06	0.66	8.46	8.29	0.48	92.04	92.03	0.87
R^2	36.57	33.65	18.46	17.29	17.06	8.66	20.09	19.92	12.11	98.16	98.15	6.99
Panel B: horizon $h = 6$ months												
Liquidity supply	13.42***			16.65***			13.04***			9.71***		
	(3.14)			(4.84)			(4.58)			(1.92)		
Liquidity demand	−1.70			−0.25			6.53			6.59***		
	(3.46)			(3.55)			(5.10)			(1.96)		
Noise		7.18***			8.89***			9.71***			7.99***	
		(2.20)			(3.40)			(3.50)			(1.35)	
Dealer positions			−7.86***			−8.11***			−3.17			−1.50
			(2.42)			(2.89)			(2.97)			(1.31)
N	122	122	122	321	321	321	232	232	232	290	290	290
ΔR^2	8.41	4.87	5.63	4.69	2.77	2.56	2.83	2.67	0.30	8.00	7.91	0.30
R^2	33.81	30.27	31.03	18.73	16.81	16.60	18.30	18.14	15.77	14.77	14.68	7.07

Table. 2

	Dependent variable: Contemporaneous change in illiquidity (Δy_t)											
	Corporate bonds			Equities			Mortgage			Treasury		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Liquidity supply			6.59***			5.80**			3.52*			12.47***
			(1.47)			(2.44)			(1.83)			(0.16)
Liquidity demand			1.06			2.58			2.12			10.61***
			(1.23)			(2.45)			(2.18)			(0.14)
VIX	7.44***		4.50***	16.33***		11.22***	9.80***		2.43	5.65***		−0.17
	(2.23)		(1.48)	(2.31)		(3.09)	(1.91)		(2.40)	(1.19)		(0.16)
Baa spread		6.93***	1.09		14.98***	5.65*		13.24***	10.06***		6.93***	0.16
		(2.48)	(1.38)		(2.52)	(3.09)		(1.97)	(2.52)		(1.13)	(0.21)
N	139	139	139	321	321	321	241	241	241	296	296	296
ΔR^2	20.25	17.02	33.20	17.26	13.15	21.72	11.23	18.73	20.88	11.06	15.61	92.04
R^2	31.40	28.17	44.35	25.26	21.15	29.72	22.86	30.36	32.51	17.18	21.73	98.16

Table. 3

C.Issuance

a. Theory: A decline in liquidity supply is expected to lead firms to shift away from corporate debt issuance and toward equity issuance,for two reasons.

- First, secondary markets for corporate bonds are much less liquid than those for equities.
- Second, dealers are more important as marginal investors for corporate debt than for equity (He et al., 2017; Haddad and Muir, 2018).

b. The three dependent variables: use quarterly aggregate data on net issuance

- net corporate debt issuance
- net equity issuance,net mortgage issuance

c.The three explanatory variables:

- the proxy of liquidity supply and demand δ_t^s δ_t^d
- the noise and dealer gross positions innovations

Dependent variable: Change in net issuance over a four-quarter horizon ($\Delta^h y_{t+h}$, $h = 4$)									
	Corporate debt			Equity			Mortgage		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Liquidity supply	−0.47***			0.33***			−0.05		
	(0.13)			(0.10)			(0.05)		
Liquidity demand	−0.05			0.02			0.01		
	(0.15)			(0.09)			(0.05)		
Noise		−0.27**			0.16**			−0.02	
		(0.13)			(0.08)			(0.04)	
Dealer positions			0.19***			−0.12**			0.02
			(0.07)			(0.05)			(0.02)
N	108	108	108	108	108	108	108	108	108
ΔR^2	11.74	7.96	4.62	8.75	4.70	3.75	0.65	0.20	0.49
R^2	23.70	19.92	16.58	20.42	16.37	15.42	23.99	23.54	23.83

Table. 4

C.Investment

The three dependent variables:change in an investment measure

- capital expenditure
- job posting rate
- construction spending

The three explanatory variables:

- the proxy of liquidity supply and demand δ_t^s δ_t^d
- the noise and dealer gross positions innovations

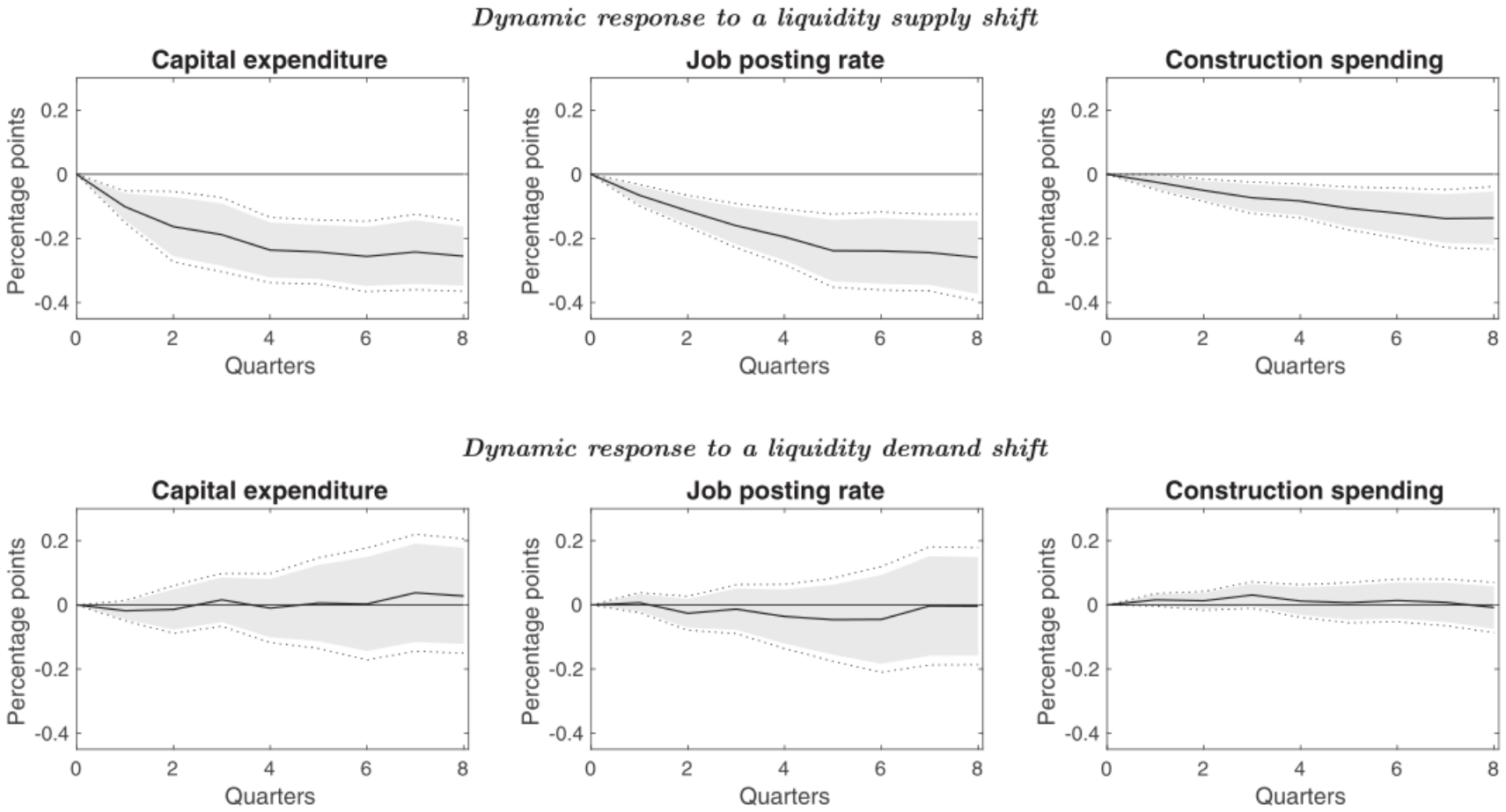

Dynamic response to a liquidity supply shift
Capital expenditure
Job posting rate
Construction spending
Percentage points
0.2
0
-0.2
-0.4
0
2
4
6
8
Quarters
Dynamic response to a liquidity demand shift
Capital expenditure
Job posting rate
Construction spending
Percentage points
Quarters

Fig. 7

Dependent variable: Change in investment over a four-quarter horizon ($\Delta^h y_{t+h}$, $h = 4$)									
	Capital expenditure			Job posting			Construction		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Liquidity supply	−0.24***			−0.19***			−0.08***		
	(0.05)			(0.04)			(0.03)		
Liquidity demand	−0.01			−0.04			0.01		
	(0.06)			(0.05)			(0.03)		
Noise		−0.12**			−0.11***			−0.03	
		(0.05)			(0.04)			(0.02)	
Dealer positions			0.09***			0.06***			0.04**
			(0.03)			(0.02)			(0.02)
N	108	108	108	108	108	108	108	108	108
ΔR^2	12.01	6.60	5.33	6.46	4.38	2.03	3.85	1.31	2.56
R^2	38.08	32.67	31.40	57.43	55.35	53.00	49.49	46.95	48.20

Table. 5

Table.6

Dependent variable: Change in net issuance over a four-quarter horizon ($\Delta^h y_{t+h}$, $h = 4$)									
	Corporate debt			Equity			Mortgage		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Liquidity supply			−0.25*			0.31**			−0.07
			(0.13)			(0.12)			(0.05)
Liquidity demand			0.02			0.01			−0.00
			(0.13)			(0.08)			(0.06)
VIX	−0.30**		0.10	0.08		−0.09	0.01		−0.00
	(0.13)		(0.13)	(0.09)		(0.11)	(0.03)		(0.07)
Baa spread		−0.38***	−0.33***		0.15*	0.08		0.01	0.04
		(0.10)	(0.12)		(0.08)	(0.11)		(0.04)	(0.06)
N	108	108	108	108	108	108	108	108	108
ΔR^2	5.67	14.21	16.84	0.67	3.13	9.27	0.02	0.06	1.17
R^2	17.63	26.17	28.80	12.34	14.80	20.94	23.36	23.40	24.51

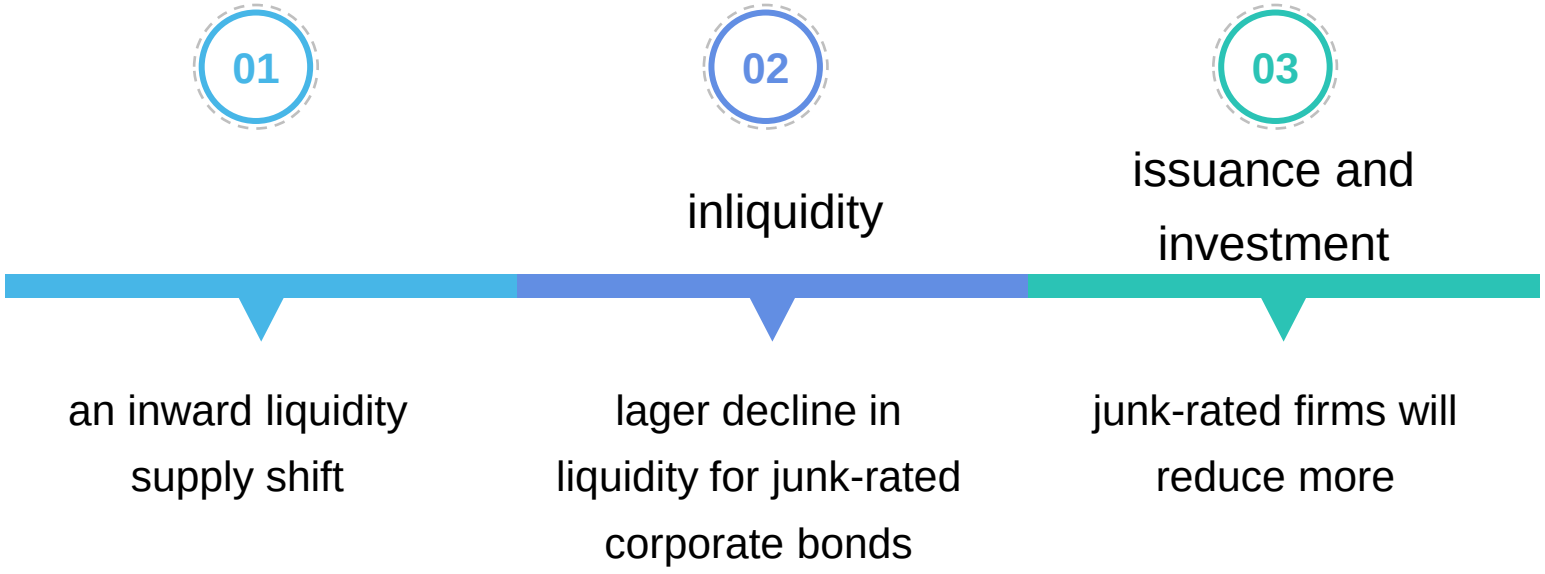
Table. 7

Dependent variable: Change in investment over a four-quarterhorizon ($\Delta^h y_{t+h}$, $h = 4$)									
	Capital expenditure			Job posting			Construction		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Liquidity supply			−0.11**			−0.13**			−0.08**
			(0.05)			(0.05)			(0.04)
Liquidity demand			0.04			−0.00			0.01
			(0.05)			(0.05)			(0.03)
VIX	−0.14**		0.08	−0.16***		−0.06	−0.05**		−0.03
	(0.06)		(0.08)	(0.04)		(0.06)	(0.02)		(0.03)
Baa spread		−0.19***	−0.20***		−0.14***	−0.05		−0.03	0.02
		(0.03)	(0.06)		(0.04)	(0.04)		(0.02)	(0.02)
N	108	108	108	108	108	108	108	108	108
ΔR^2	5.23	15.80	19.09	5.11	6.05	8.52	1.38	0.81	4.21
R^2	31.30	41.87	45.16	56.08	57.02	59.49	47.02	46.45	49.85

D.Firm-level outcome

a.data:Quarterly panel data for nonfinancial firms

b.theory:



c.estimation:

- For different firm

$$\begin{aligned}\Delta^h y_{i,t+h} = {} & (\beta^h_{s,IG}\delta^s_t + \beta^h_{d,IG}\delta^d_t)IG_{i,t-1} \\ & + (\beta^h_{s,HY}\delta^s_t + \beta^h_{d,HY}\delta^d_t)HY_{i,t-1} \\ & + \lambda^h z_{i,t} + u^h_i + \epsilon_{i,t+h}, \end{aligned} \qquad (12)$$

- $IG_{i,t-1}$ is a dummy variable indicating that firm i had a credit rating of BBB- or above in period t − 1
- $HY_{i,t-1}$ is a dummy variable indicating that firm i had a credit rating of BB+ or below in period t − 1
- $z_{i,t}$ included are four lags of sales growth for quarterly data or one lag of sales growth for annual data.

Dependent variable: Change in outcome for firm i over a four-quarter horizon				
	Net issuance		Investment and employment	
	Debt	Equity	Capital expenditure	Employees
	(1)	(2)	(3)	(4)
$\delta_t^s \times IG_{i,t-1}$	−0.11**	0.15***	−0.22**	−1.04
	(0.04)	(0.04)	(0.10)	(2.06)
$\delta_t^s \times HY_{i,t-1}$	−0.34***	0.09***	−0.49***	−6.23**
	(0.07)	(0.03)	(0.10)	(2.44)
$\delta_t^d \times IG_{i,t-1}$	0.07	0.03	0.11	2.49
	(0.06)	(0.04)	(0.11)	(1.67)
$\delta_t^d \times HY_{i,t-1}$	−0.06	0.01	0.13	3.92
	(0.12)	(0.03)	(0.17)	(3.08)
R^2 (within, in %)	0.41	0.23	0.79	0.80

Table. 8

E.real activity

The three dependent variables:changes in real activity

- the unemployment rate
- payroll employment
- capacity utilization
- a monthly real activity index

The three explanatory variables:

- the proxy of liquidity supply and demand δ_t^s δ_t^d
- the noise and dealer gross positions innovations

	Dependent variable: Change in real activity over a 12-month horizon ($\Delta^h y_{t+h}$, $h = 12$ months)											
	Unemployment			Employment			Capacity utilization			Real activity index		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Liquidity supply	0.20**			−0.22**			−0.63***			−0.34***		
	(0.08)			(0.08)			(0.20)			(0.13)		
Liquidity demand	0.05			−0.04			0.07			−0.06		
	(0.06)			(0.08)			(0.17)			(0.13)		
Noise		0.12*			−0.13*			−0.30*			−0.20*	
		(0.06)			(0.08)			(0.17)			(0.12)	
Dealer positions			−0.06**			0.08**			0.32***			0.13**
			(0.03)			(0.03)			(0.09)			(0.05)
N	321	321	321	321	321	321	321	321	321	321	321	321
ΔR^2	3.45	2.76	0.87	1.48	1.07	0.51	3.91	1.79	2.44	2.45	1.77	0.85
R^2	43.18	42.49	40.60	64.56	64.15	63.59	29.39	27.27	27.92	41.78	41.10	40.18

Table. 10

5.Conclusion

- This paper measures liquidity supply by primary dealers in the Treasury market using data on their gross long and short positions and Treasury noise.
- A deterioration in liquidity supply in the Treasury market is associated with declines in liquidity in other asset classes, including corporate bonds.
- Reduced liquidity supply predicts declines in debt issuance, investment, and employment by nonfinancial firms as well as a shift toward equity issuance.
- Declines in corporate bond liquidity, debt issuance, investment, and employment are especially pronounced for firms with low credit quality.
- Liquidity supply is also informative about aggregate real activity.

谢谢大家！