Implicit intraday interest rate in the UK unsecured overnight loan market

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23 Feb, 2012

Introduction

- Explicit intraday money market does not exist but overnight loans may be used to smooth intraday imbalances of payment flows
- A bank facing a temporary liquidity squeeze early in the day can borrow overnight and enter an offsetting position later in the day
- This way a bank can effectively obtain liquidity for an arbitrary period of time intraday with no exposure overnight
- Alternatively, a bank can borrow intraday from the central bank against high-quality collateral
- Which of the two options banks choose depends on the relative costs
- In this paper, we estimate the cost of obtaining liquidity intraday through the overnight money market

Motivation

- Smooth operation of the payment systems is one of the main concerns of central banks
- (Very) low price of intraday liquidity is necessary to ensure that banks settle payments in a timely fashion (Bech and Garratt, 2003)
- Delaying payments increases the risks associated with operational outages later in the day as it may force the recipient banks to incur unnecessary costs by borrowing in the overnight money market
- Zero cost of intraday liquidity is also desirable on efficiency grounds (Martin, 2004)
- So what is the cost of intraday liquidity in the UK and what are its determinants?

Related literature: theory

- Martin (2004) and Martin and McAndrews (2010) argue that to achieve socially efficient outcome, central banks should provide intraday liquidity free of charge as it costs nothing to temporarily expand the CB's balance sheet intraday
- Moral hazard can be prevented by collateral requirements
- Gu, Guzman and Haslag (2011) show that under some conditions it may be socially optimal to have a positive intraday interest rate
- This occurs if afternoon production technology is more efficient and some agents have preference for morning consumption: positive capital gains on holding private debt during the day are necessary to induce production in the morning

Related literature: empirical evidence

- Angelini (2000) finds no evidence of a positive price of intraday liquidity
- Furfine (2001) estimates the hourly intraday interest rate at 0.9bps on overnight loans settled through the U.S. Fedwire in Q1-1998; Bartolini, Gudell, Hilton and Schwarz (2005) report similar results for Feb-Sep 2004
- Baglioni and Monticini (2008) document a positive but economically small intraday interest rate in the Italian e-MID interbank market 2003-2004; however, during the recent financial crisis the intraday interest rate experienced a ten-fold jump (Baglioni and Monticini, 2010)
- Kraenzlin and Nellen (2011) study the Swiss overnight loan market 1999-2008 and estimate the hourly intraday interest rate at 0.43bps

The UK overnight money market

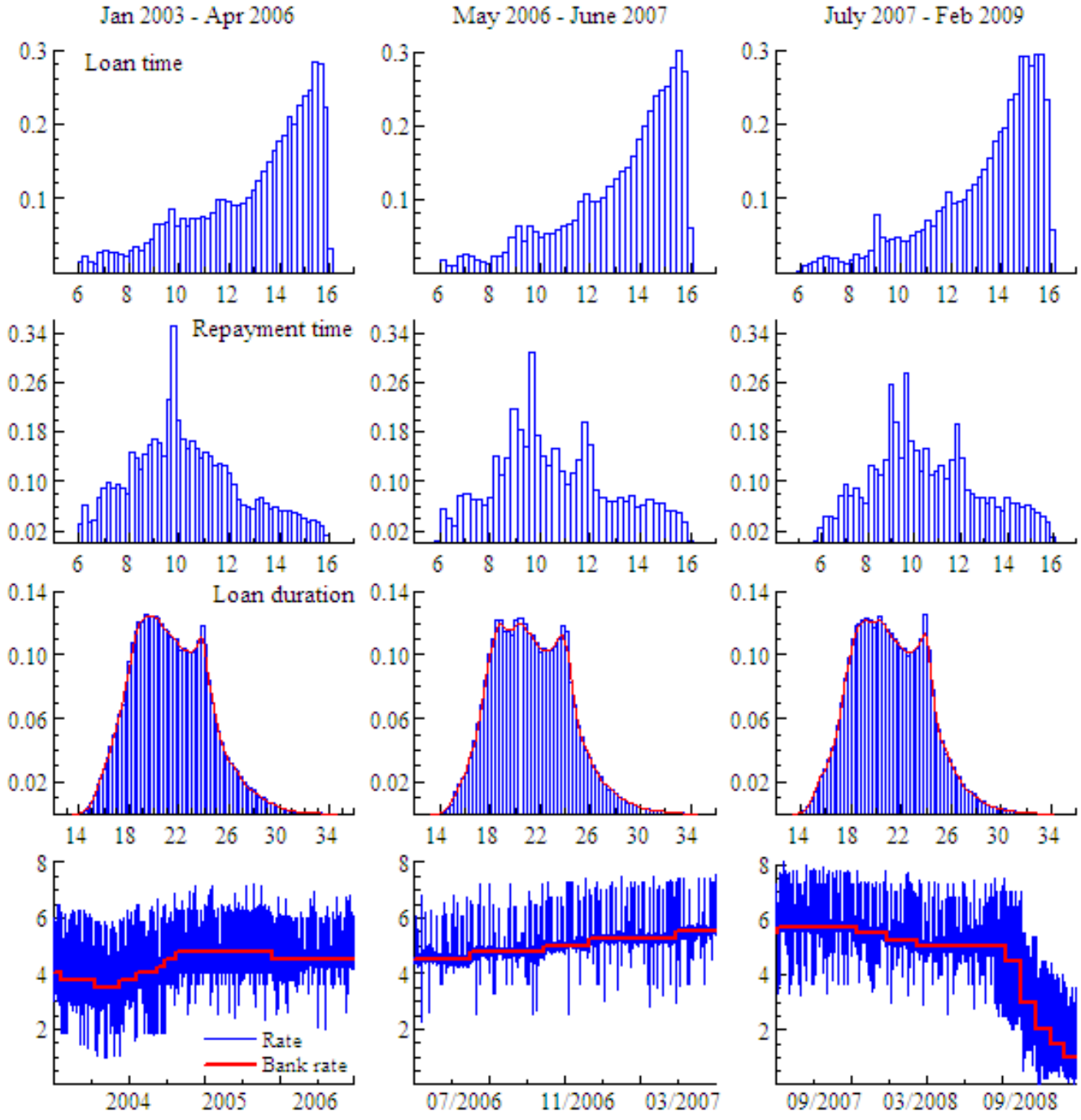
- In 2006, BoE introduced reserve averaging whereby each participant bank is required to achieve a self-imposed average reserve holdings
- Average reserve holding within a narrow range are remunerated at the Bank rate (the main policy rate)
- In response to the financial crisis, the range was widened and subsequently suspended so now all reserves are remunerated
- The market for overnight reserves in the UK is an OTC market where counterparties to each transaction negotiate the terms bilaterally
- Funds are delivered and repaid via CHAPS, the UK's real-time gross settlement system operated by the Bank of England
- While it is clear that funds should be returned the following day, there is no legally binding deadline

Data

- We use data on payments in the UK's large value payment system CHAPS for the period January 2003 - February 2009
- We extract the overnight loan transactions using a version of the algorithm developed by Furfine (1999)
- Caveats: we cannot distinguish between CHAPS member banks and their clients; loans between two clients of the same settlement bank and not included
- In addition to payments data, we use data on intraday reserves account balances held by settlement banks at the BoE
- We construct a measure of aggregate amount of reserves by summing up settlement banks' reserve account balances
- Finally, we use data on reserve targets of the settlement banks

Descriptive statistics

	Jan '03 - April '06	May '06 - Jun '07	Jul '07 - Feb '09
Av. daily volume (£b)	19.3	26.7	30.0
Av. loan amount (£m)	49.2	58.6	64.7
Av. loan duration (hrs)	21.2	21.3	21.4
Av. interest rate (%)	4.28	5.01	4.64
Av. premium (bp)	-3.05	5.19	-5.20
no. settlement banks	12	12	12-13
no. days	839	295	422
no. observations	321,945	125,527	193,047


Jan 2003 - Apr 2006
May 2006 - June 2007
July 2007 - Feb 2009
Loan time
Repayment time
Loan duration
Rate
Bank rate
2004
2005
2006
07/2006
11/2006
03/2007
09/2007
03/2008
09/2008

Methodology

- Let r_τ denote the rate of return on an overnight loan advanced at time τ let d denote the duration of the loan in hours
- Denote the per-hour intraday interest rate by i_D and overnight interest rate by $i_{O/N}$
- Let $d^{(1)}$ the time elapsed between the advance of the loan and the market closing time, i.e. between τ and 4:00pm
- By $d_{O/N}$ the overnight period in hours (4:00pm - 6:00am)
- And by $d^{(2)}$ the time elapsed between 6:00am on the following day and the actual repayment time of the loan
- Thus

$$d = d^{(1)} + d_{O/N} + d^{(2)}$$

Methodology cont.

- Assuming continuous compounding, the rate of return on the overnight loan can be written as

$$r_\tau = i_D d^{(1)} + i_{O/N} d_{O/N} + i_D d^{(2)}$$

  If intraday liquidity has no value, $i_D = 0$

- A distinguishing feature of the UK overnight money market is that the repayment time and hence $d^{(2)}$ are not known at the time the loan is advanced
- The random nature of the repayment time makes our analysis distinct from the previous empirical work
- We treat the potential endogeneity problem by instrumenting for $d^{(2)}$

Regression models

- Model 1

$$r_\tau - br = c + \sum_{k=1}^{9} \alpha_k D_k^\tau + \delta d^{(2)} + \sum_{l=1}^{n_s-1} \gamma_l D_l^b + \beta' \mathbf{x} + \epsilon$$

- Model 2

$$r_\tau - br = c + \alpha d^{(1)} + \delta d^{(2)} + \sum_{l=1}^{n_s-1} \gamma_l D_l^b + \beta' \mathbf{x} + \epsilon$$

- Model 3

$$r_\tau - br = c + \alpha (d^{(1)} + d^{(2)}) + \sum_{l=1}^{n_s-1} \gamma_l D_l^b + \beta' \mathbf{x} + \epsilon$$

Control variables

- **Dummy variables for borrower** Bank-specific dummy variables to proxy for average credit risk of the settlement bank and its clients
- **Day-of-week dummy variables** We employ day-of-week dummies to control for various calendar effects
- **Loan size** Large-value loans may be presumably more costly to obtain
- **Aggregate reserves** By the simple supply-demand argument, we expect the level of aggregate reserves across all settlement banks to co-vary negatively with the interest rate
- **Distance from reserves target** Separately for lender and borrower, we calculate the difference between the average reserves to date and the target reserves

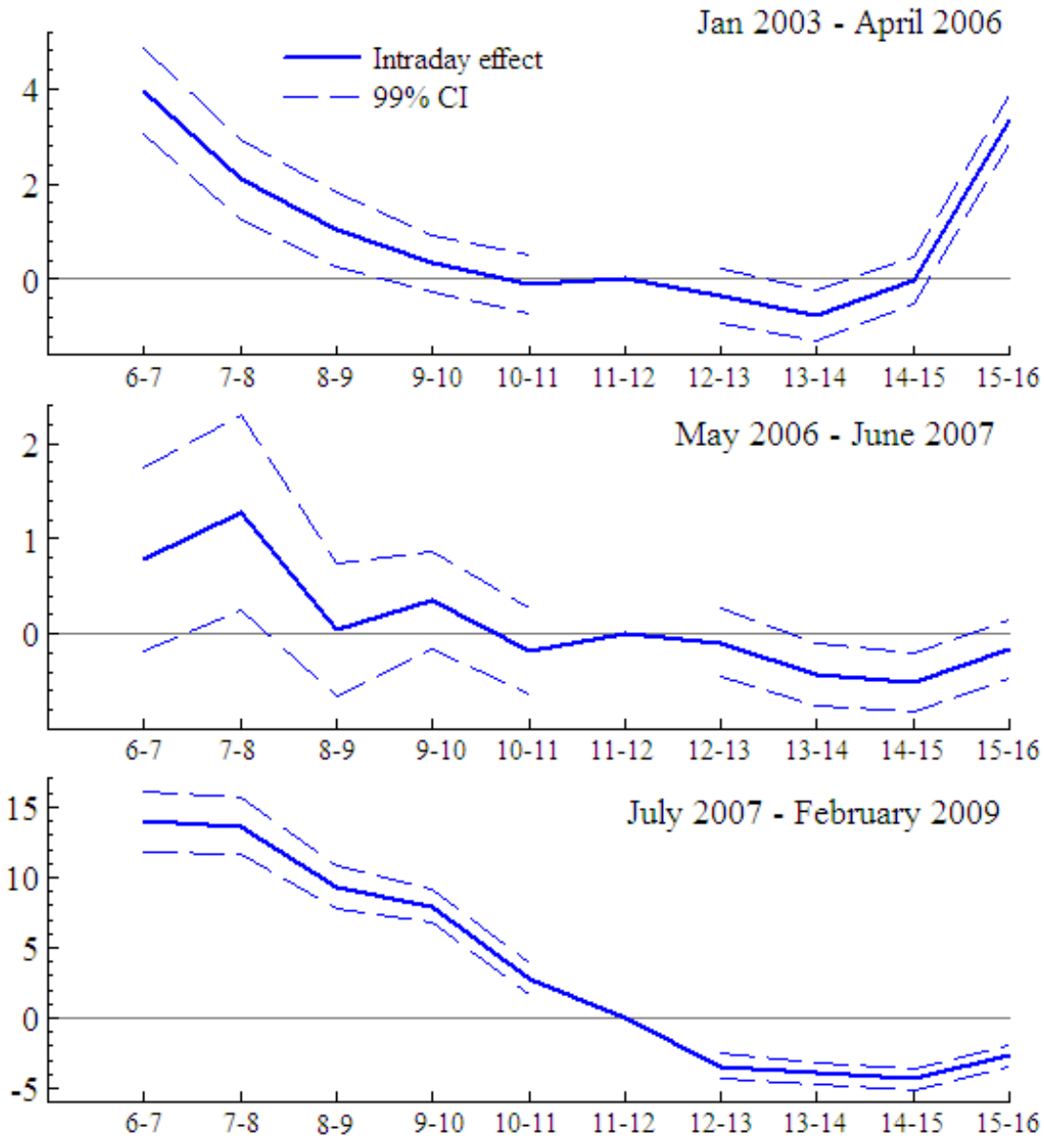
Empirical results

	Jan '03 - Apr '06			May '06 - Jun '07			Jul '07 - Feb '09		
A. Time-of-day effects									
6-7	3.460			.787			13.98		
	(9.88)			(2.11)			(16.98)		
7-8	1.825			1.272			13.64		
	(5.54)			(3.23)			(17.55)		
8-9	.955			.038			9.31		
	(3.21)			(0.14)			(15.55)		
9-10	.299			.357			7.94		
	(1.26)			(1.80)			(17.83)		
10-11	−.032			−.182			2.82		
	(−0.14)			(−1.05)			(6.63)		
12-13	−.389			−.097			−3.40		
	(−1.77)			(−0.70)			(−9.94)		
13-14	−.835			−.433			−3.94		
	(−4.07)			(−3.43)			(−12.44)		
14-15	−.127			−.511			−4.32		
	(−0.65)			(−4.27)			(−14.47)		
15-16	3.046			−.159			−2.67		
	(15.2)			(−1.32)			(−9.09)		
$d^{(1)}$		−.262	−.391		.092	.105		1.563	1.246
		(−9.88)	(−17.3)		(4.30)	(5.62)		(33.92)	(32.2)
$d^{(2)}$	1.963	1.079		−.004	−.055		5.211	4.325	
	(13.65)	(7.90)		(−0.04)	(−0.60)		(24.05)	(21.47)	

Empirical results cont.

	Jan '03 - Apr '06			May '06 - Jun '07			Jul '07 - Feb '09		
B. Day-of-week effects									
Monday	3.233	3.131	3.133	1.391	1.398	1.412	2.889	2.892	2.776
	(20.1)	(19.5)	(19.7)	(23.1)	(23.1)	(23.8)	(13.52)	(13.78)	(13.7)
Tuesday	.914	.930	1.020	1.364	1.354	1.360	2.531	2.479	2.299
	(5.87)	(6.00)	(6.64)	(22.41)	(22.2)	(22.4)	(11.30)	(11.25)	(10.8)
Thursday	.864	.861	.943	1.327	1.332	1.340	1.794	1.817	1.886
	(5.48)	(5.48)	(6.03)	(18.24)	(18.3)	(18.46)	(8.29)	(8.54)	(9.20)
Friday	−4.990	−4.769	−4.420	3.584	3.621	3.603	−.002	.091	.233
	(−31.8)	(−30.6)	(−28.9)	(29.43)	(29.8)	(29.8)	(−0.01)	(0.42)	(1.11)
C. Controls									
Loan size	.005	.010	.019	.006	.006	.005	−.012	−.006	.009
	(4.61)	(9.75)	(30.1)	(10.03)	(11.22)	(18.5)	(−9.05)	(−5.21)	(15.4)
Aggr. res.	−.506	−.388	−.423	−.097	−.080	−.076	−1.173	−1.157	−1.181
	(−36.1)	(−29.2)	(−32.7)	(−10.02)	(−8.77)	(−8.56)	(−122.2)	(−121.6)	(−129.8)
Res. lend.	−.180	−.239	−.199	.085	.077	.079	.682	.622	.457
	(−8.19)	(−10.9)	(−9.31)	(4.64)	(4.28)	(4.45)	(19.8)	(18.5)	(14.8)
Res. borrow.	−.804	−.835	−.791	.203	.191	.186	−2.068	−2.158	−2.072
	(−29.3)	(−30.5)	(−29.3)	(6.43)	(6.04)	(5.94)	(−33.79)	(−35.6)	(−35.1)
no. obs.		321,945			125,527			193,047	

Intraday interest rate pattern



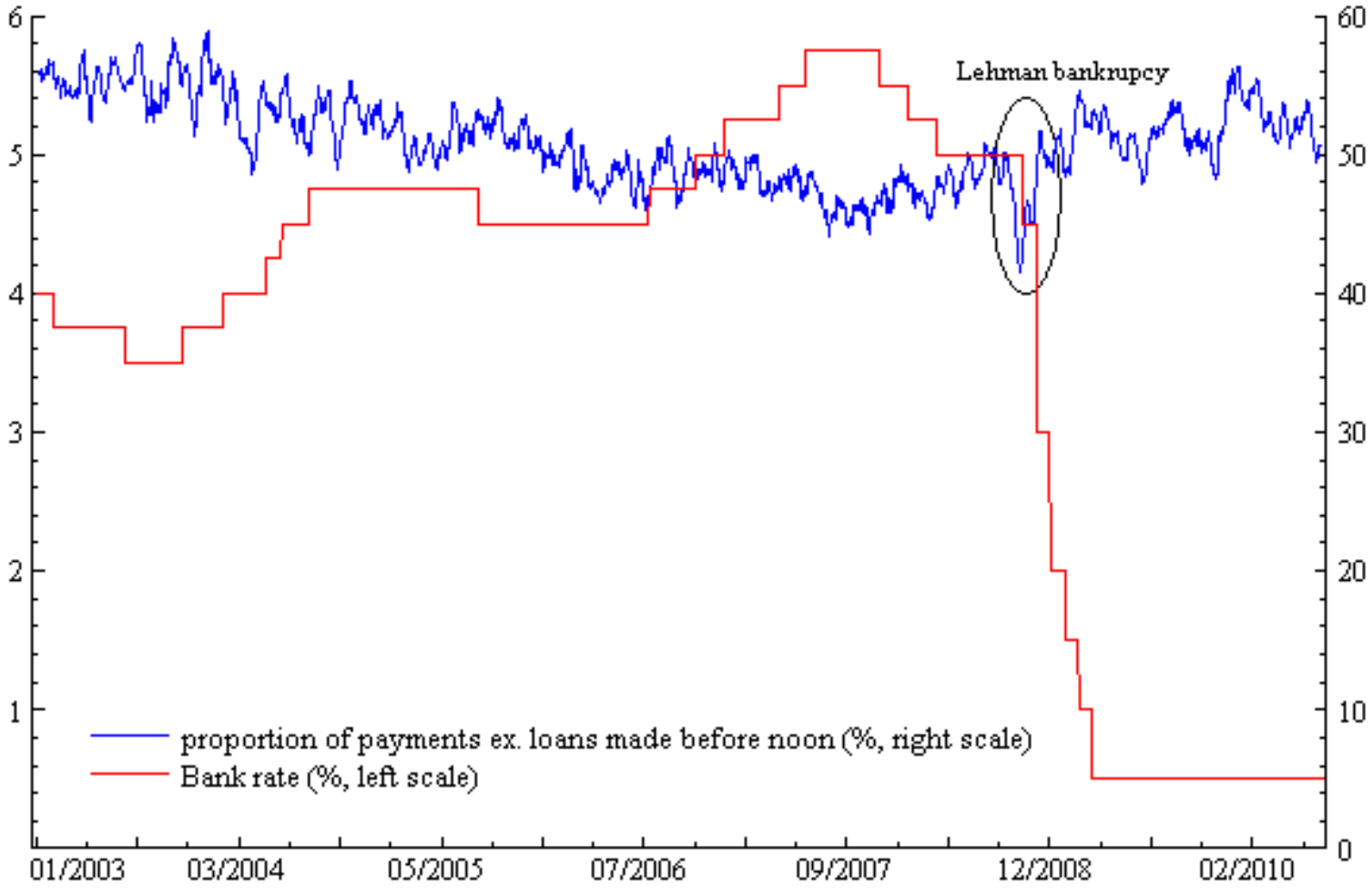
Robustness check with brokers data

- One limitation of the analysis is that it is based on transaction data from CHAPS only
- Since we observe little market activity in the morning it may be that the intraday interest rate may be affected by market (il)liquidity
- To address this concern we collect bid and ask quotes posted by brokers and observed by the BoE in the Sterling overnight money market
- We use bid-ask spread as a measure of liquidity and estimate similar regressions as before
- Some of the other controls employed before cannot be used because they are loan-specific
- Also, we only have the brokers' data for the second and third sub-sample periods

Empirical results based on brokers data

	May '06 - Jun '07		Jul '07 - Feb '09	
7-8	−0.652 (−1.28)		6.131 (4.63)	
8-9	−0.121 (−0.23)		2.911 (1.86)	
9-10	0.399 (0.75)		3.662 (2.27)	
10-11	0.648 (0.96)		2.884 (1.85)	
12-13	−0.615 (−0.97)		−2.380 (−1.67)	
13-14	−0.935 (−1.58)		−3.807 (−2.65)	
14-15	−2.197 (−3.66)		−5.740 (−4.09)	
15-16	−4.229 (−6.76)		−5.015 (−3.74)	
$d^{(1)}$		0.431 (9.55)		1.449 (13.7)
Spread	2.609 (14.0)	2.575 (14.0)	−0.222 (−4.90)	−0.225 (−4.99)
Aggregate reserves	−1.70e-4 (−3.76)	−2.67e-4 (−5.98)	−8.03e-4 (−12.3)	-8.01e-4 (−12.6)
no. obs.	3,718		5,890	

Interest rate and throughput



Conclusion

- Intraday interest rate can be used as an indicator of payment system distress
- Our empirical results show that the intraday cost of liquidity is quite small in normal times but increases substantially during periods of liquidity crises
- The increase in the intraday interest rates coincides with decreased payments throughput
- One possible solution to alleviate the tension in the payments systems is for the central bank to widen the criteria for acceptable collateral