Frictions in the Interbank Market and the Demand for Reserves: Lessons from the Financial Crisis

ECB Workshop: Excess Liquidity and Money Market Functioning

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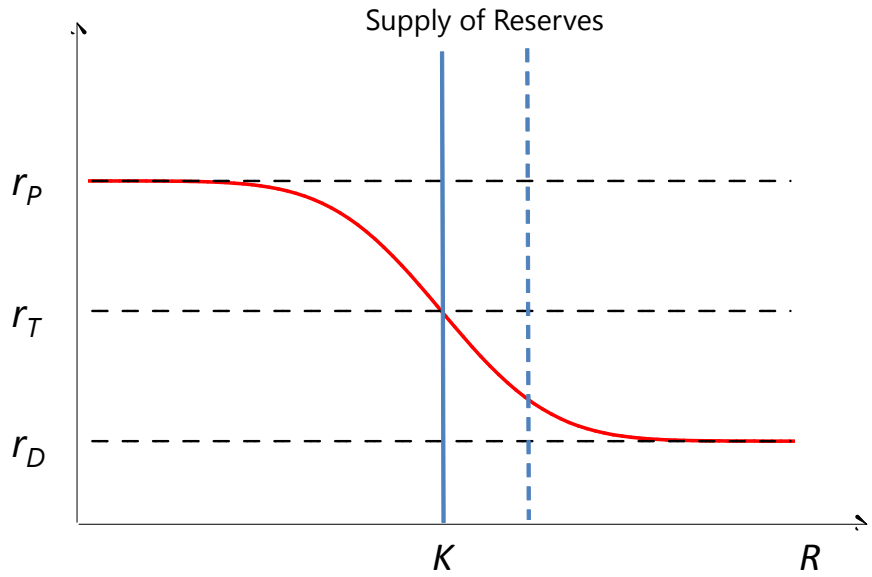
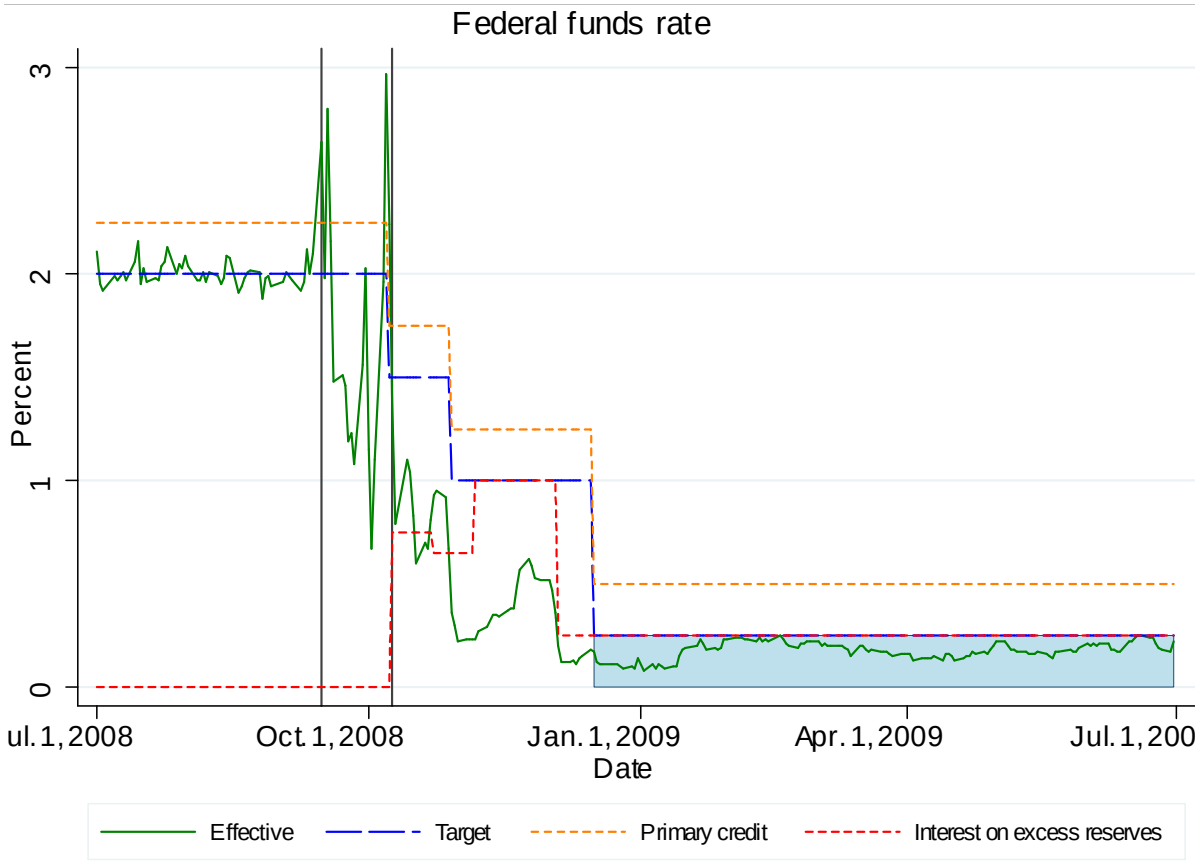
[1]The views expressed in this paper are those of the authors and do not necessarily reflect those of the BIS or FR Board

What do we do?



Why? Standard model wrong or US special?



- "The Mechanics of a Graceful Exit: Interest on Reserves and Segmentation in the Federal Funds Market" Carnegie Rochester 2011

Game plan

- Quick review of standard model of monetary policy implementation
  - Poole (1968), Woodford (2001), Whitesell (2006)
- Our tweaks
  - Transaction cost
  - Credit risk
- Estimate demand curve for reserves for Eurozone
  - Liquidity effect

Standard Model (Poole (1968))

- Risk neutral banks (representative agent)
  - No reserve averaging in model (but in empirics)
  - Reserve requirement zero
- Time line (Bartolini and Pratti, 2003)
  - 9:00 am: Central bank open market operations
  - 10:00 am: A random shock to reserves, v, from the non-bank sector
  - 12:00 pm: The interbank market opens, banks trade at i to get to R
    - R : non-borrowed excess reserves
    - i : overnight rate
  - 3:00 pm: After the market has cleared random payment shock, $\varepsilon \sim F$
- End of day balance: $B = R + \varepsilon$
  - No uncertainty: $R = -\varepsilon$

Whitesell (2006)

- Without knowing ε, the bank chooses R to minimize two types of expected costs:
  - The opportunity cost of holding positive excess reserves with the central bank, relative to lending the funds in the market, and the
  - loss, in the case of deficiencies, on borrowing from the central bank rather than from the market

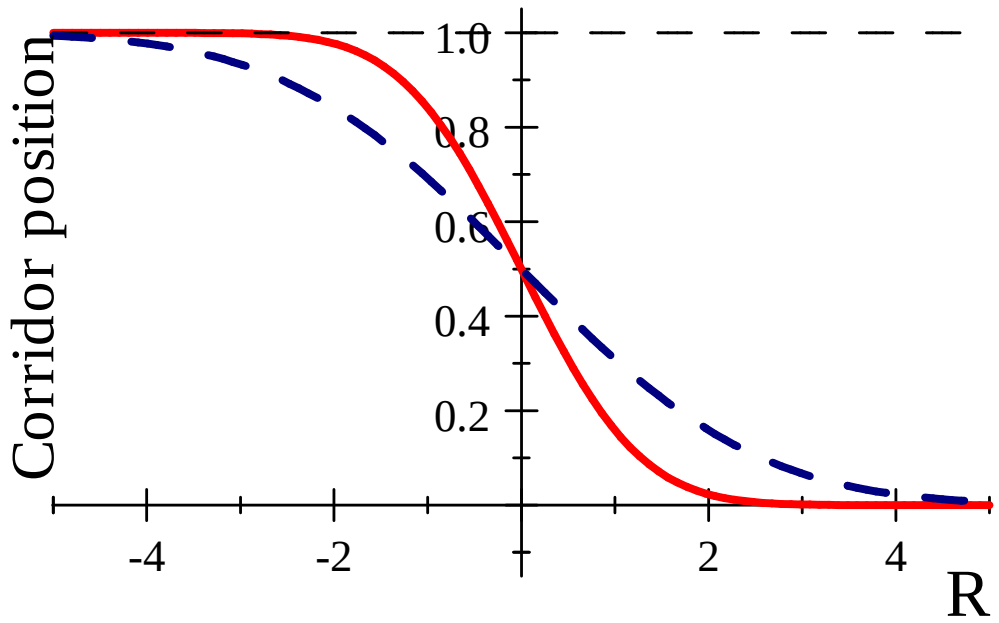
$$\min_R (i - r_{ior}) \int_{-R}^{\infty} (R + \varepsilon) dF(\varepsilon) - (r_{dw} - i) \int_{-\infty}^{-R} (R + \varepsilon) dF(\varepsilon)$$

- The first-order condition (marginal cost = marginal benefit):

$$\begin{aligned} i &= r_{ior} + (r_{dw} - r_{ior}) F(-R) \\ &= r_{ior} + (r_{dw} - r_{ior}) P(\text{deficiency}) \end{aligned}$$

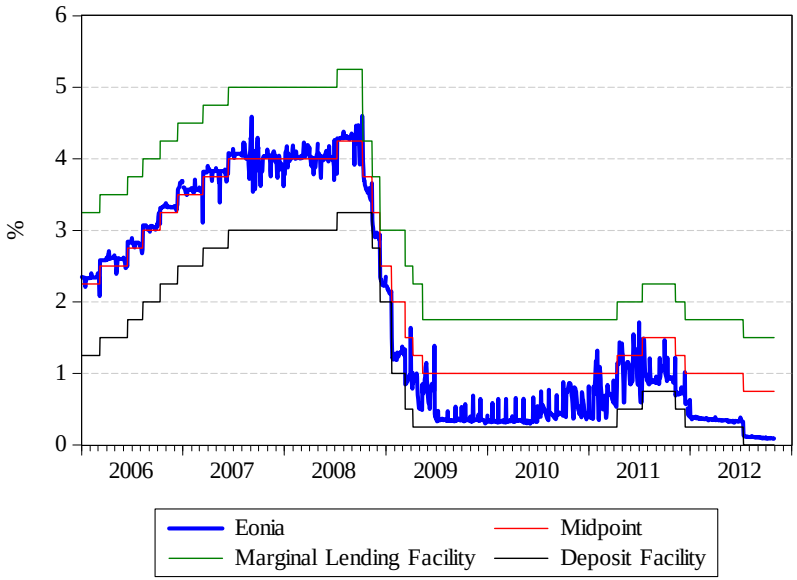
Woodford (2001)

- "T*he demand for [excess reserves is] a function of the location of the overnight rate relative to the [central bank] lending rate and [central bank] deposit rate, but independent of the absolute level of any of these interest rates*".
- Corridor position: $\theta = \frac{i - r_{ior}}{r_{dw} - r_{ior}} = F(-R) = P(\text{deficiency})$

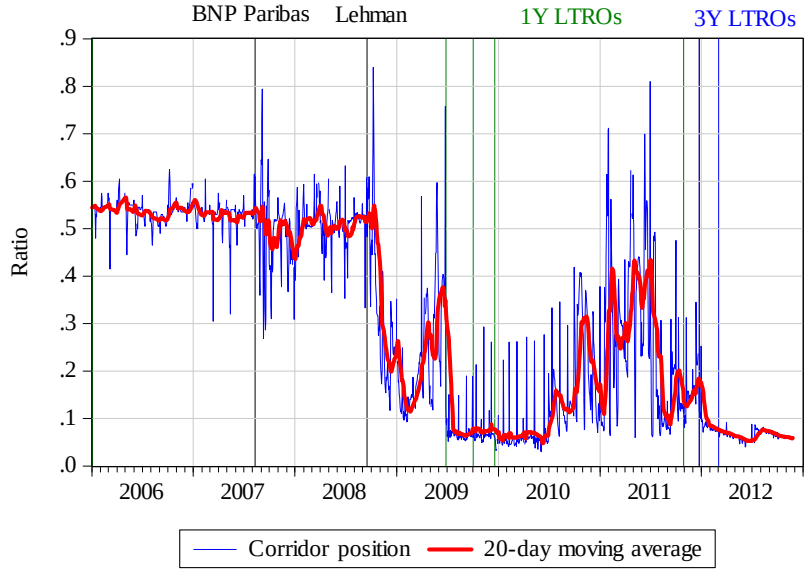


- Modus operandi: To keep i at midpoint - supply zero excess reserves.

Eonia and corridor position



Eonia



Eonia corridor position

- Eonia never sits at the floor of corridor (unlike the US)

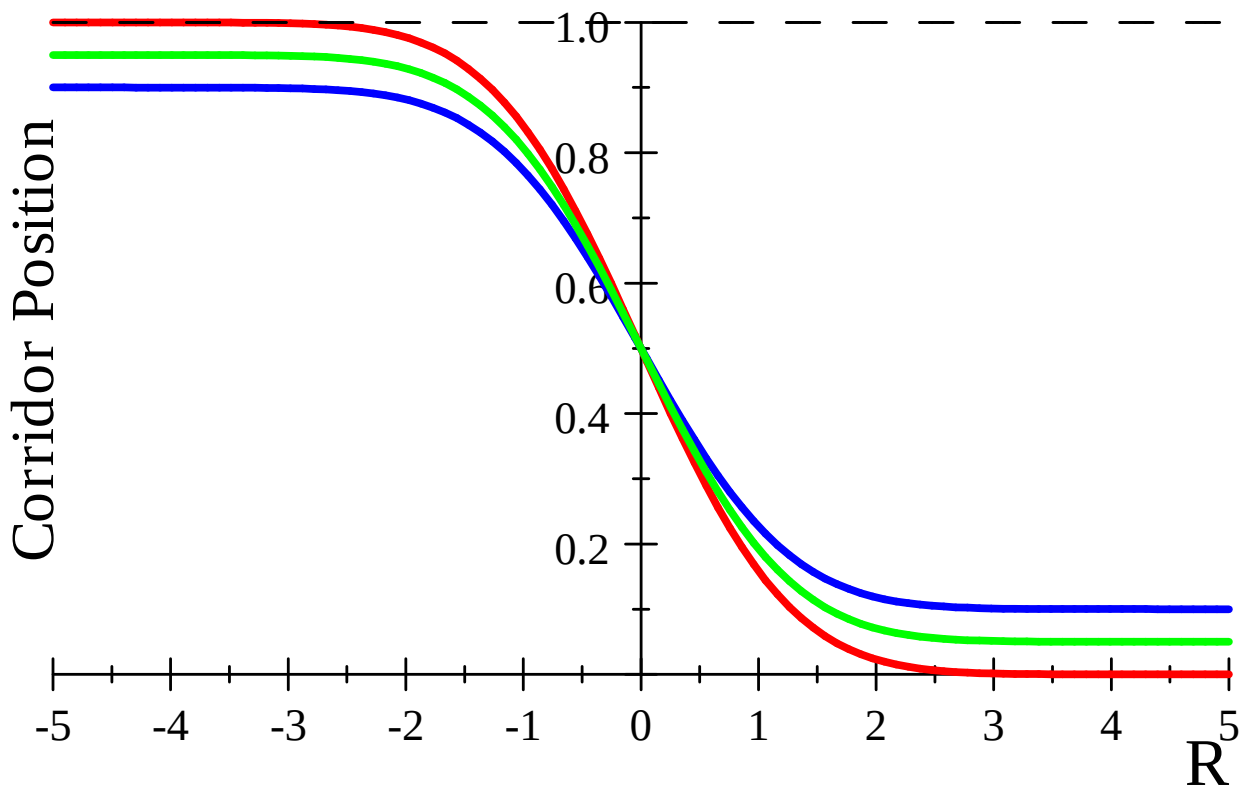
Extended model

- In standard model the effective cost (income) from borrowing (lending) from another bank is equal to i.
- Now the rate at which banks can effectively lend, differs from the rate at which banks can borrow, $i^l \leq i \leq i^b$.
- The bank's problem becomes

$$\min_R (i^l - r_{ior}) \int_{-R}^{\infty} (R + \varepsilon) dF(\varepsilon) - (r_{dw} - i^b) \int_{-\infty}^{-R} (R + \varepsilon) dF(\varepsilon)$$

- Two special cases
  - Transaction cost: $i^l = i - \tau$ and $i^b = i + \tau$, $\tau > 0$
  - Default (credit risk): $i^l = i - \delta$, and $i^b = i$, $\delta > 0$

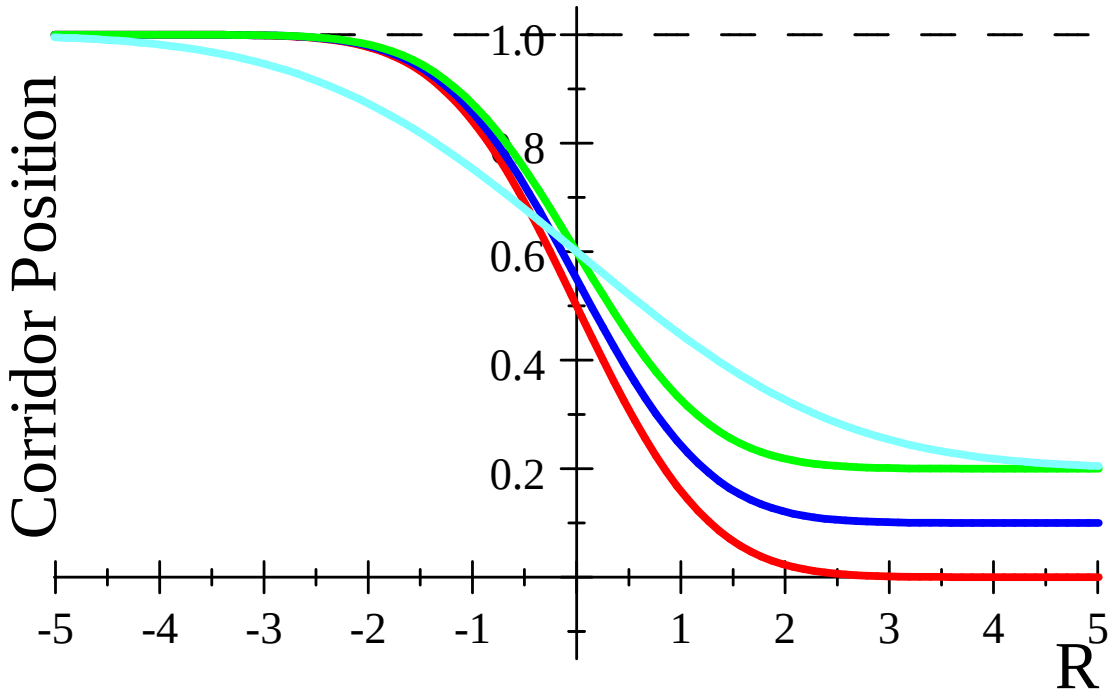
Transaction cost



— $\tau = 0$, — $\tau = .05c$, — $\tau = .1c$,

- $R^{Supply} = 0 \Rightarrow i$ at midpoint. No impact on modus operandi.

Credit risk



— $\delta = 0, \sigma = 1$, — $\delta = .1c, \sigma = 1$,
— $\delta = .2c, \sigma = 1$, — $\delta = .2c, \sigma = 2$.

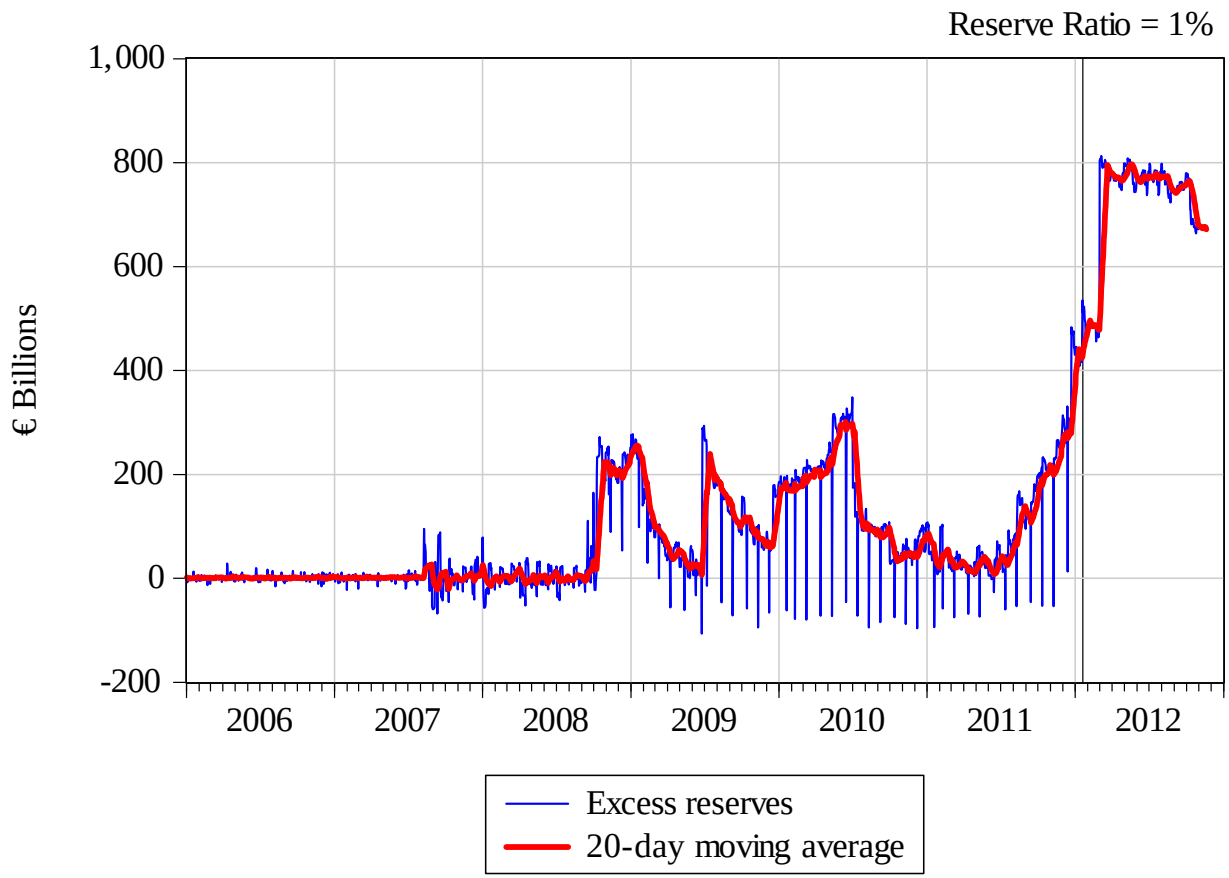
- $R^{Supply} = 0 \Rightarrow i$ above midpoint. Change modus operandi.

Impact of financial crisis - A view from down under

- "Beginning in August 2007, as banks became **less certain of their own funding requirements** and **less confident of the credit profile of their counterparties**, the inter-bank borrowing markets became quite tight. Banks were more inclined to hold onto cash, both because of an increased unwillingness to lend it, but also reflecting a concern about their ability to obtain funding themselves from the market in the future should they require it. This was most evident in term markets, where borrowing rates increased sharply. However, for similar reasons, there was an **increased precautionary demand for [reserves] balances**, reinforced by the fact that [reserves] are a risk-free asset. **The effect was the demand curve for [reserves] shifted out.** Debelle (2008).

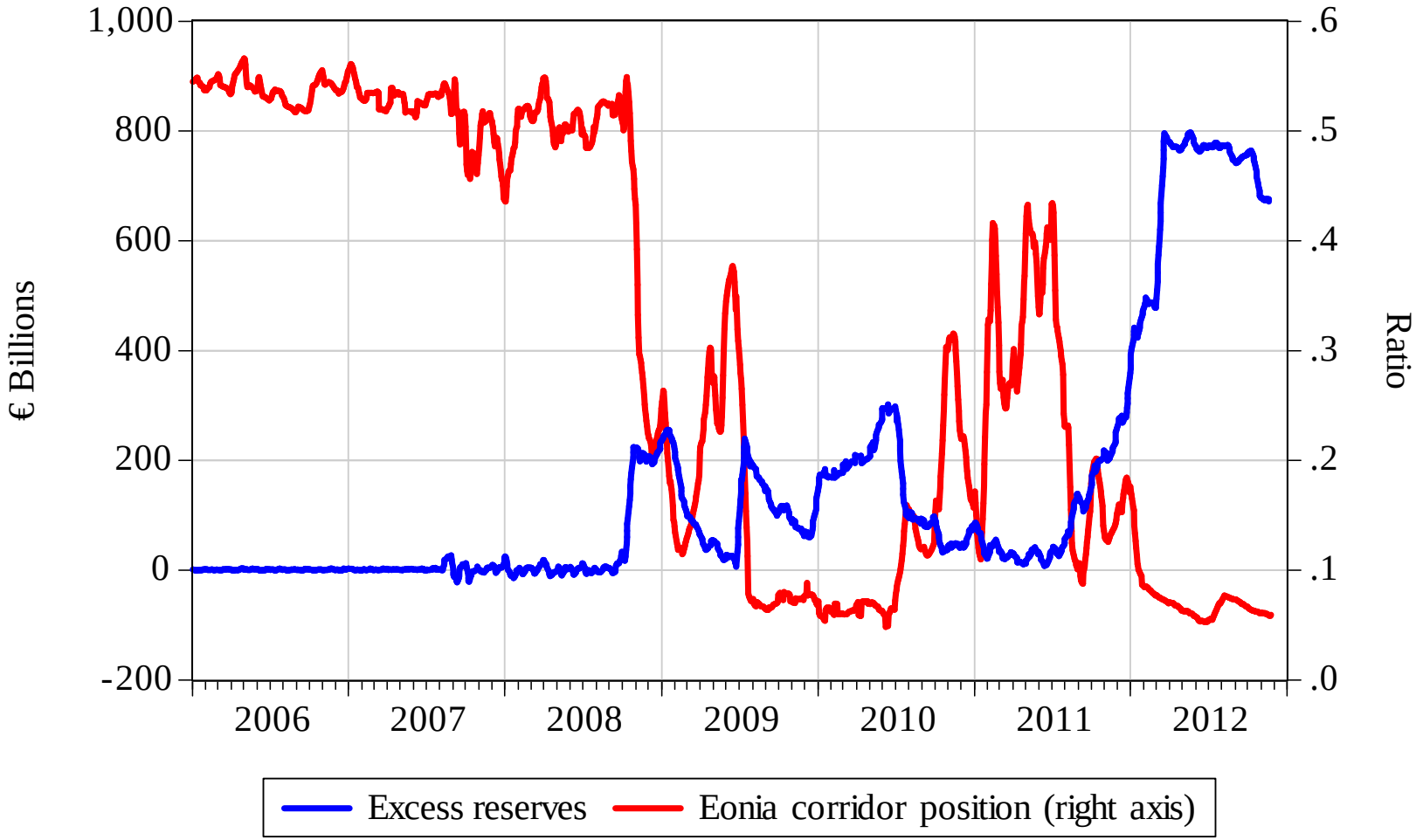
ECB Excess Reserves

- Excess reserves = current accounts + deposit facility - reserve requirement



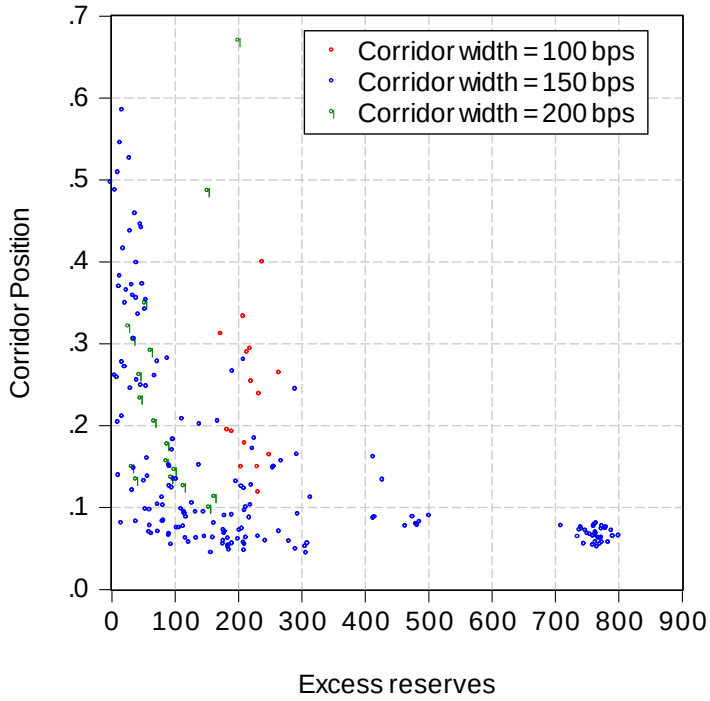
Excess Reserves and corridor position

20 day moving averages

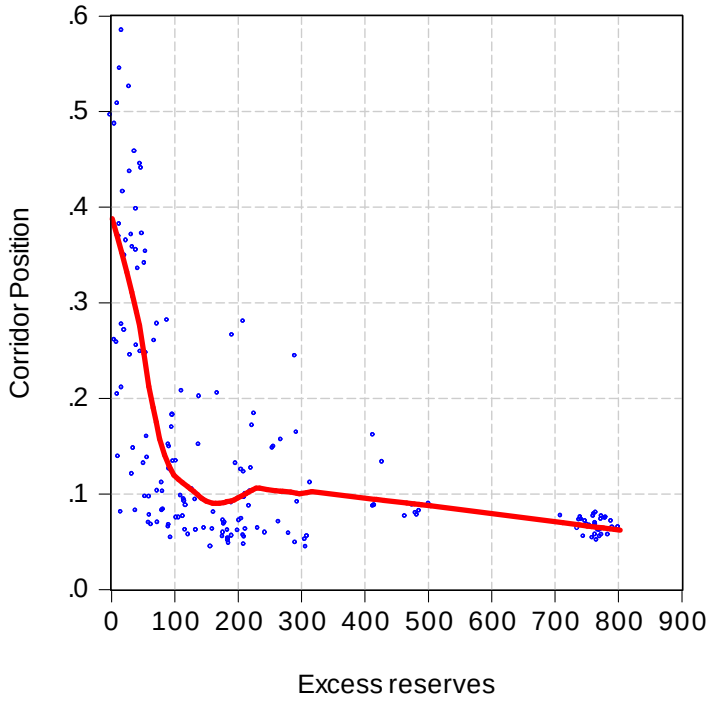


Excess Reserves and corridor position

weekly averages



Corridor width = 150 bps



Estimating the demand curve for reserves

- Non-linear relationship
  - minimum extreme distribution $\theta_t = 1 - e^{-e^{x_t\beta}}$.
    - our variable of interest is bounded between zero and one ,
    - fat tail fit our data well + computationally efficient,
- Factors, x_t, that affect the daily corridor position, θ_t.

$$\begin{aligned} x_t\beta &= \beta_0 + \beta_1 excess_t + \beta_2 transaction_t + \beta_3 credit_t + \\ &\quad \beta_4 policy_t + \beta_5 corridor_t + \beta_6 calendar_t + \varepsilon_t \end{aligned}$$

  - Credit risk: iTraxx CDS + Transaction cost: $E_{t-7} i_t$ (Eonia swap)
- Sample: 10/30/2008 - 8/31/2012. Full allotment.
  - "Early" = prior first 1 year LTRO
- Error term
  - ARMA(7,0) and Power GARCH
    $\sigma_t^2 = \omega + \beta\sigma_{t-1}^{\delta} + \alpha\left(|\varepsilon_{t-1}| - \gamma\varepsilon_{t-1}\right)^{\delta}$

Regression results

	II		IV	
	Minimum extreme value		Logit	
Variable	Coeff	SE	Coeff	SE
Excess reserves	-11.70**	0.35	-4.75**	0.07
— x Week 4	-12.45**	1.45	0.07	0.05
iTraxx CDS	3.23**	0.16	0.39**	0.10
Corridor width	-1.32**	0.13	0.06	0.19
Transaction cost	-1.26**	0.14	1.10**	0.08
— x Early	2.11**	0.29		
⋮				
⋮				

Notes: Sample10/30/2008 - 8/31/2012 (N = 979), MP = maintenance period, ** and * denotes significance at the 5% and 10% level,.

Liquidity effects

- The marginal effect of any particular variable changes with the value of all of the independent variables.
- At the mean of the data,

	I	II	III	IV
Variable	Minimum extreme value			Logit
			%-points	
Excess reserves (per €100B)	–4.78	-2.09	-2.91	-10.09
— × Week 4	–4.29	-2.16	0.03	0.16
Sample: 10/30/2008 - 8/31/2012 (N = 979)				

Conclusion

- Corridor position is useful tool for analyzing the demand for reserves.
- Extended version of the canonical model of monetary policy implementation fits the ECB experience
  - Credit risk have had, and continue to have, important effects on money market rates.
  - Important in terms of "targeting" in the future.
- Caveats
  - Heterogeneity and segmentation

Regression results

Regression results

	I		II		III		IV	
	Minimum extreme value						Logit	
Variable	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Excess reserves	–11.66**	0.43	-11.70**	0.35	-13.66**	0.41	-4.75**	0.07
— x Week 4	-10.50**	1.60	-12.45**	1.45	-13.02**	1.34	0.07	0.05
iTraxx CDS	2.41**	0.16	3.23**	0.16			0.39**	0.10
Corridor width	-0.61**	0.13	-1.32**	0.13			0.06	0.19
iTraxx/corridor					4.20**	0.26		
Transaction cost	-0.77**	0.19	-1.26**	0.14	-1.19**	0.15	1.10**	0.08
— x Early			2.11**	0.29	2.25**	0.10		
...								

Notes: Sample10/30/2008 - 8/31/2012 (N = 979), MP = maintenance period,

** and * denotes significance at the 5% and 10% level,.

Simplified ECB Balance sheet