

# Non-conventional CB measures: monetary policy or LOLR?

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U. Bindseil

(opinions are those of the author, not necessarily of the ECB)

# The questions

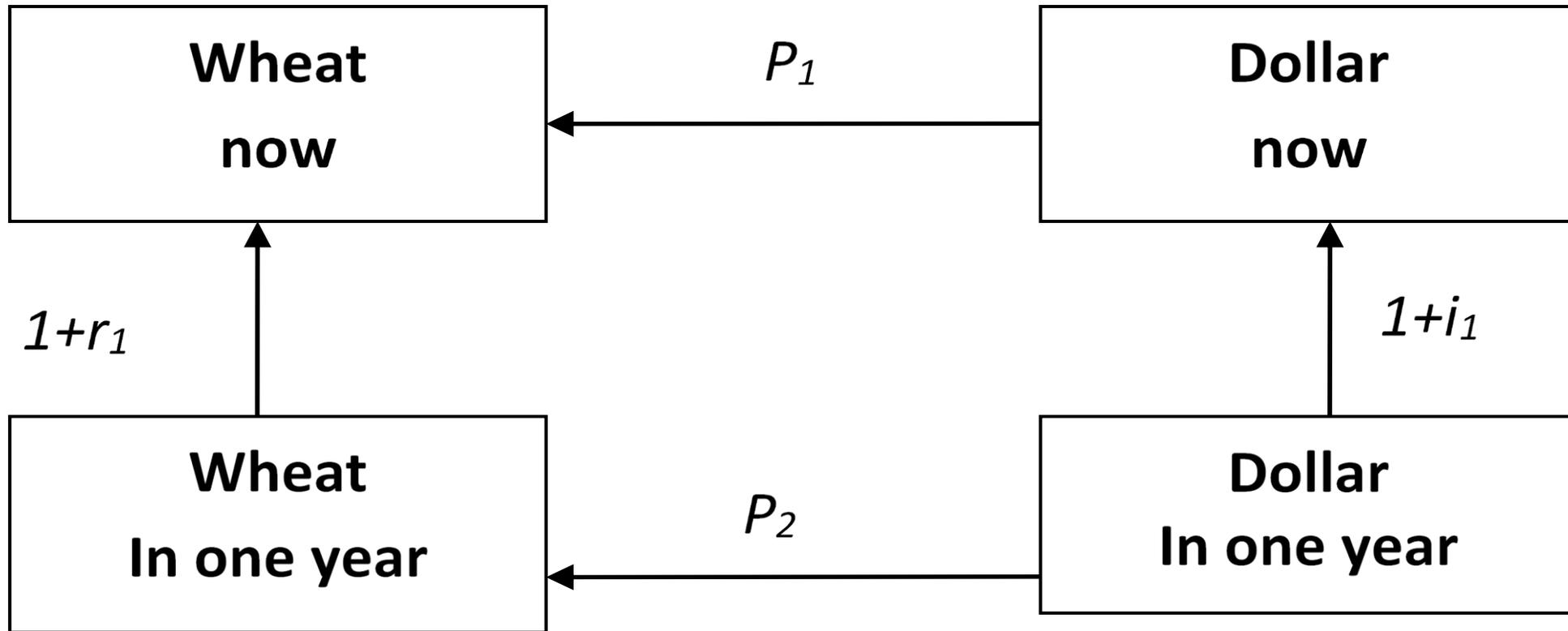
- During financial crisis, central banks have taken various unconventional measures.
- However, often unclear, both in literature and in communication of central banks, whether unconventional measures are *monetary policy*, or *LOLR/financial stability* related measure, or both.
- How does the literature on central bank crisis measures typically understand the two concepts, including the related role of the zero lower bound?
- What logic has been applied by the ECB, as revealed by its acts and its explanations?

# Overview

- Theory:
  - Wicksell's „natural rate“ - slightly extended
  - Survey of literature: what do academics think about the LOLR in practice and about what the central bank is doing in crisis times?
  - LOLR in financial crisis – two simple models with a more precise role for central bank credit and limits to it
- ECB practice
  - Chronology of ECB measures since 2007
  - What is what, and how can we understand the sequence?
- Conclusions

# Theory

# The natural rate concept – slightly extended



# The natural rate logic

Resulting arbitrage equation: Non accelerating nominal interest rate:

$$i_t^* = E(r_t) + E(\pi_t).$$

- If  $i_t > E(r_t) + E(\pi_t) \Rightarrow$  it is profitable to sell real goods and hold more money investments  $\Rightarrow$  demand for goods today  $\downarrow \Rightarrow$  disinflationary pressures  $\Rightarrow$  actual inflation will fall below expected inflation:  $\pi_t < E(\pi_t)$
- If  $i_t < E(r_t) + E(\pi_t) \Rightarrow$  buy more real goods for real investment projects, hold less money investments (or be short in money, i.e. borrow money),  $\Rightarrow$  demand for goods today  $\uparrow \Rightarrow$  inflationary pressures  $\Rightarrow$  actual inflation will turn out to be above expected inflation:  $\pi_t > E(\pi_t)$

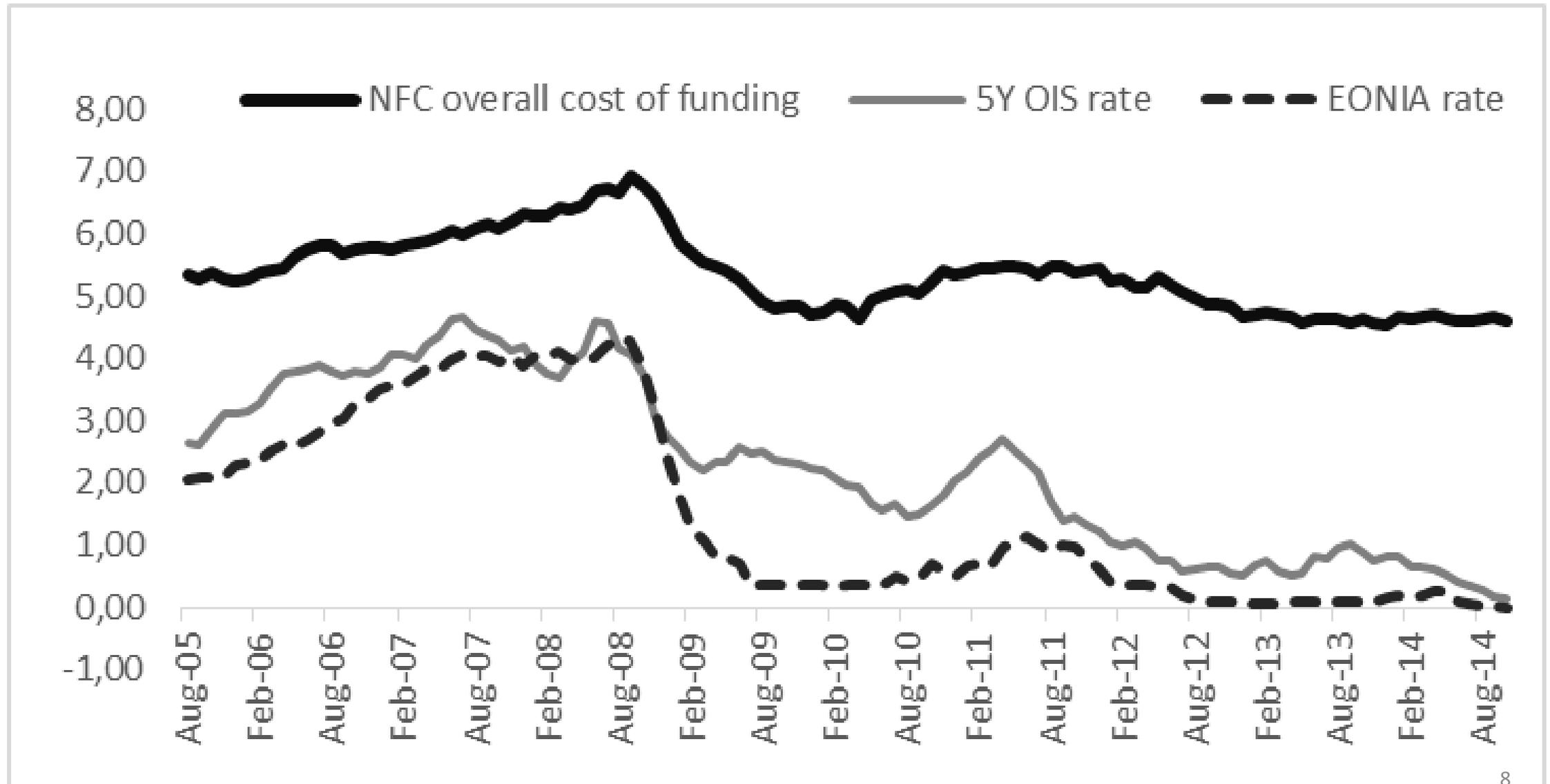
Four concepts of real interest rates

	Ex ante	Ex post
capital good investment	$E(r_t)$	$r_t$
money investment	$i_t - E(\pi_t)$	$i_t - \pi_t$

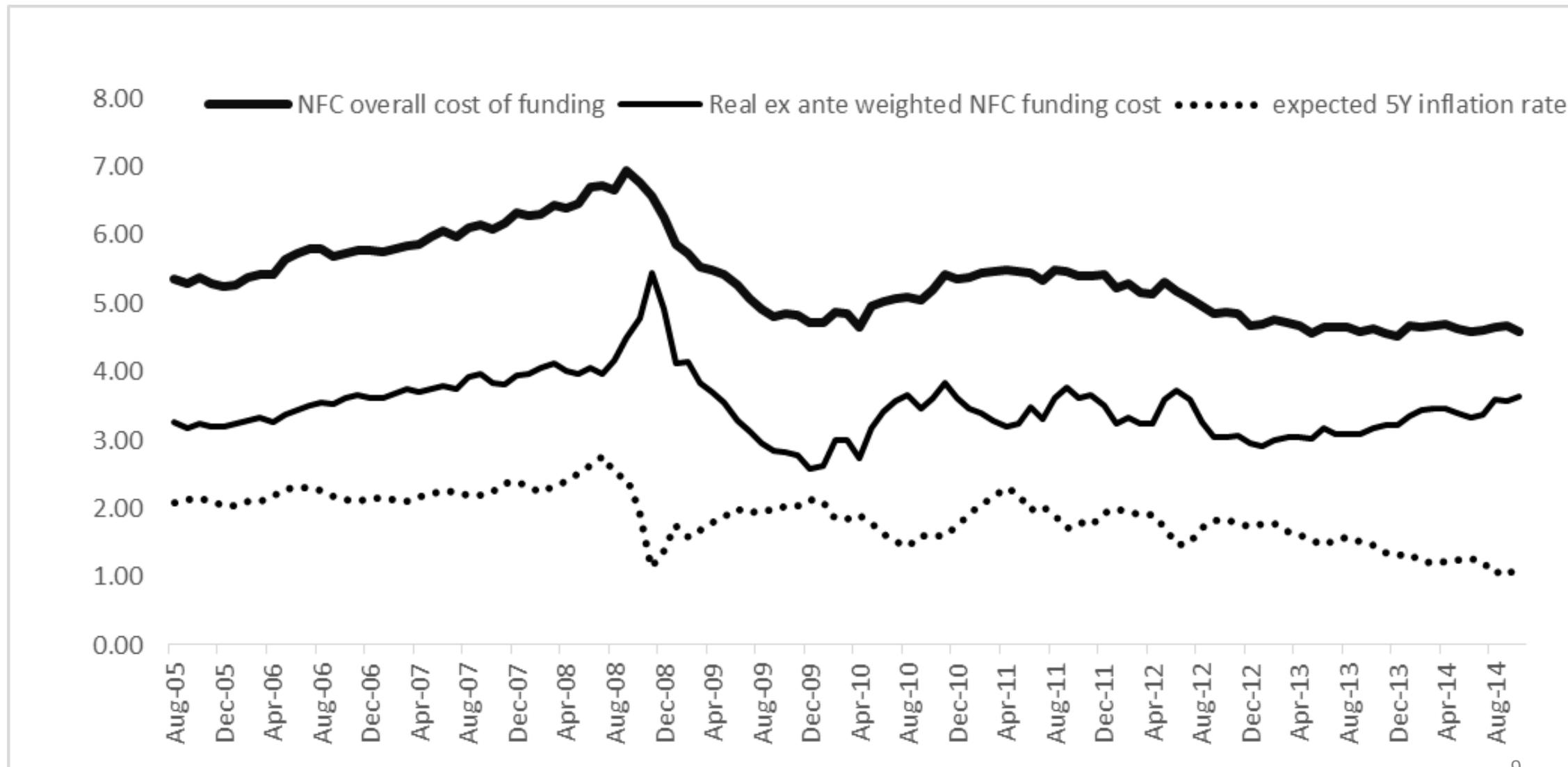
# The extension

- The weighted average nominal lending rate of the economy can be thought to reflect three main factors:
  - (i) The short term interbank interest rate which is normally controlled precisely by the central bank “i” ;
  - (ii) The slope of the risk free benchmark yield curve “j”;
  - (iii) The various instrument specific liquidity and credit risk premia “k”.
- The non-accelerating central bank interest rate becomes:  $i_t^* = E(r_t) + E(\pi_t) - j_t - k_t$

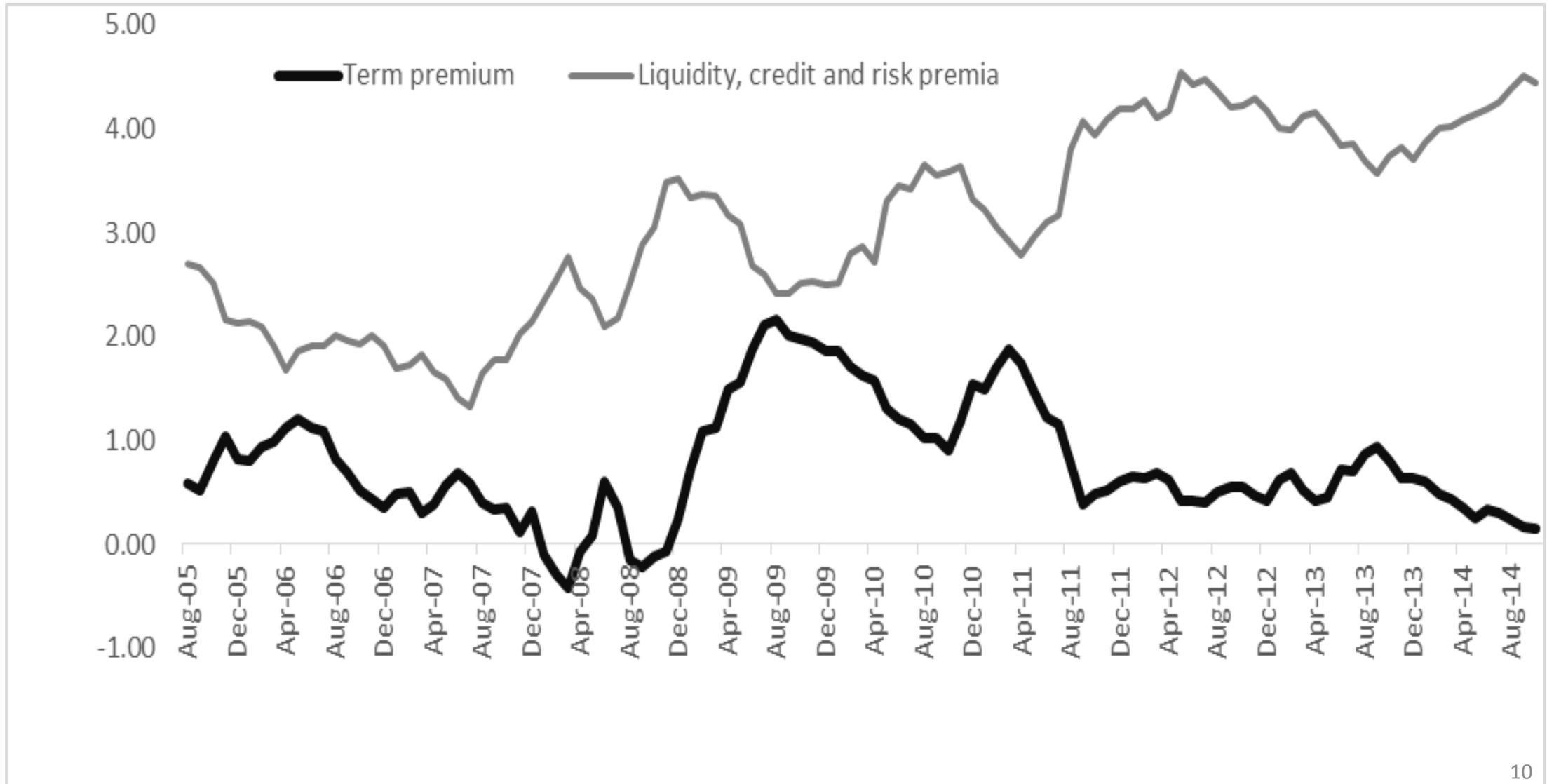
# Wicksell+: illustration



# Wicksell+: illustration



# Wicksell+: illustration



Survey of literature: what are CB crisis measures about, according to academic literature?

11 papers on central bank non-conventional measures are reviewed on what they believe CB crisis measures are about.

- LOLR and/or monetary policy?
- Operational, intermediate and ultimate targets of the measures?
- Plausibility and relevance from the practitioner's point of view?

# Survey of literature: what are CB crisis measures about, according to academic literature?

- 4 Bank run papers
  - Diamond/Dybvig 83: no actual modelling of CB as LOLR (but deposit insurance)
  - Repullo 2005; Rochet/Vives 2005: CB as LOLR but crude modelling of CB credit and collateral
  - Acharya and Viswanathan 2011: funding stability model (wholesale funding + fire sales)
- 3 papers on non-LOLR central bank crisis measures as „bail-outs“
  - Diamond/Rajan (2012); Fahri/Tirole (2012): lowering interest rates as bail out of banks
  - Stein (2012): liquidity injections through purchase programmes as bail out of banks
- 2 Monetary economics papers with „credit easing“
  - Curdia-Woodford (2011); Gertler/Karadi (2010): DSGE models with impaired banks and credit channel
- 2 simple own models are presented that link monetary policy operations to the LOLR and to monetary policy

# LOLR: two simple models with detail on central bank credit

- Central bankers will:
  - tend to have a Wicksellian logic on monetary policy in mind; reality of non-conventional monetary policy measures to be captured (reducing term and credit premium)
  - want to see that LOLR models are closer to reality of market operations and collateral
- Two small own models from a central bank market operations perspective:
- Model I: equilibrium bank run model with continuous bank asset liquidity / central bank haircuts. Cheapest stable funding structure of banks; implications of collateral framework on bank intermediation spread; broadening collateral set makes sense from a financial stability (and hence economic efficiency) perspective and from the monetary policy perspective.
- Model II: Exogenous liquidity shocks hit banks, central bank collateral haircuts determine whether these result in default or not; trade-off between costs of firm value destruction through default vs. cost of zombification. A “real” model not directly linked to monetary policy issues.

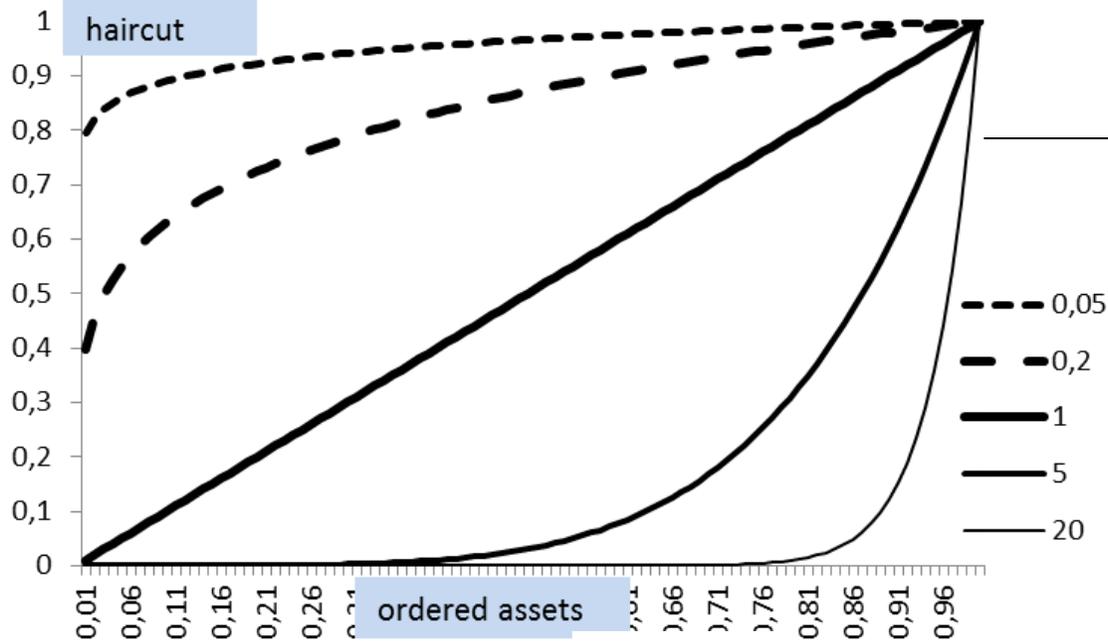
# Model I (Bindseil 2013): Key assumptions

- *“Central bank collateral, asset fire sales, regulation and liquidity” ECB WPS No. 1610, November 2013*
- Short term funding is cheapest form of funding, but may be unstable. “Cheap” also means: where banks provide maturity transformation services to society
- Problem of banks is to sustain a maximum stable amount of short term funding = maximum maturity transformation
- Assets of banks mapped into  $[0,1]$ ; asset properties are assumed to be described by power functions  $x^\delta$  (central bank haircuts) and  $x^\theta$  (fire sale discounts)
- Three liabilities: short term funding (split into two depositors), long term funding, equity + central bank liability – but only in case of outflows
- Two kinds of default: due to illiquidity and due to insolvency
- If bank defaults for either reasons, it is immediately liquidated such that its residual asset value is  $\theta/(1+\theta)$

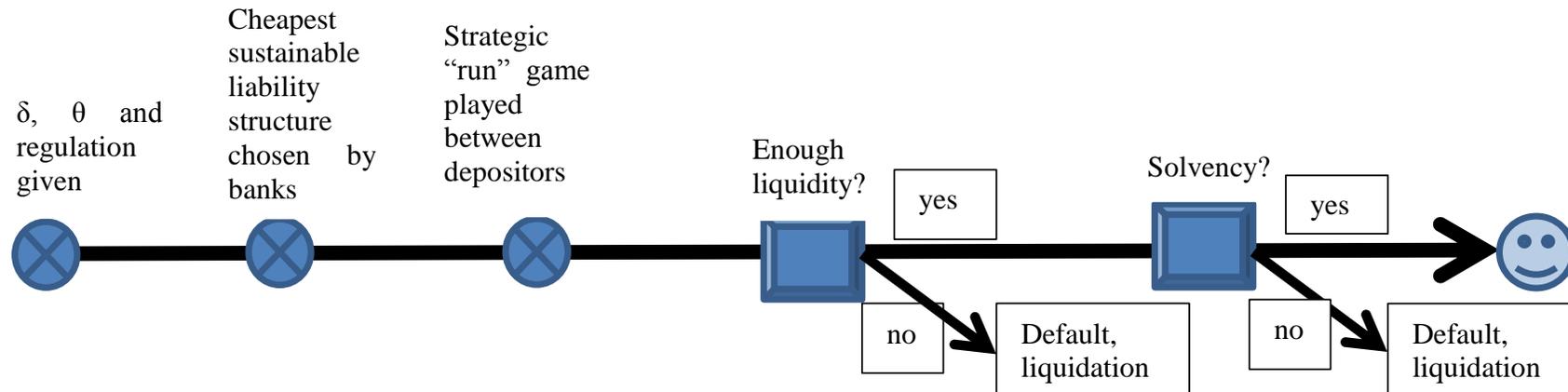
# Key assumptions of model

Figure 1: A stylised bank balance sheet to analyse liquidity uncertainty

Assets		Liabilities	
Assets	1	Short term debt 1	$(1-t-e)/2$
		Short term debt 2	$(1-t-e)/2$
		Long term debt ("term funding")	$t$
		Equity	$e$



Haircut function:  $h(x)=x^\delta$   
 Asset fire sale loss function:  $d(x)=x^\theta$   
 Extremely crude estimation suggests that  $\theta= 3$  and  $\delta = 0.2$  could be an order of magnitude in euro area



# Conditions for stable funding

- Modelled as strategic “run” game between depositors. To sustain stability, “not running” should be better than “running” regardless of what the other short term depositor is doing. Strict Nash No Run (“SNNR”) equilibrium.  $U_1(K_1, K_2) > U_1(R_1, K_2) \cap U_1(K_1, R_2) > U_1(R_1, R_2)$
- This is constraint to banks’ maximising the role of this cheapest source of funding
- Paper considers in detail the various cases to establish the “no-run” conditions under all combinations of external parameters
- Then, paper reports on simulation of cheapest liability structure and emergency liquidity strategy depending on exogenous, central bank, and regulatory parameters

# Condition for stable funding: both fire sales and central bank credit available

**Proposition 5:** Let  $z \in [0,1]$  determine which share of its assets is foreseen by the bank to be used for fire sales (i.e. the less liquid share  $1-z$  of assets are foreseen for pledging with the central bank). Let  $k=h(z)$  be the fire sales from fire selling the  $z$  most liquid assets and let  $y=f(z)$  be the total liquidity generated from fire selling the most liquid assets  $z$  and from pledging the least liquid assets  $(1-z)$ .

Then a SNNR equilibrium exists if and only if  $\exists z \in [0,1]: y = f(z) = \frac{\delta}{\delta+1} + \frac{z^{\delta+1}}{\delta+1} - \frac{z^{(\theta+1)}}{\theta+1} \geq (1 - t - e)/2$  and  $k = h(z) = \frac{z^{(\theta+1)}}{\theta+1} \leq e$ .

# Illustration of strategy “z”

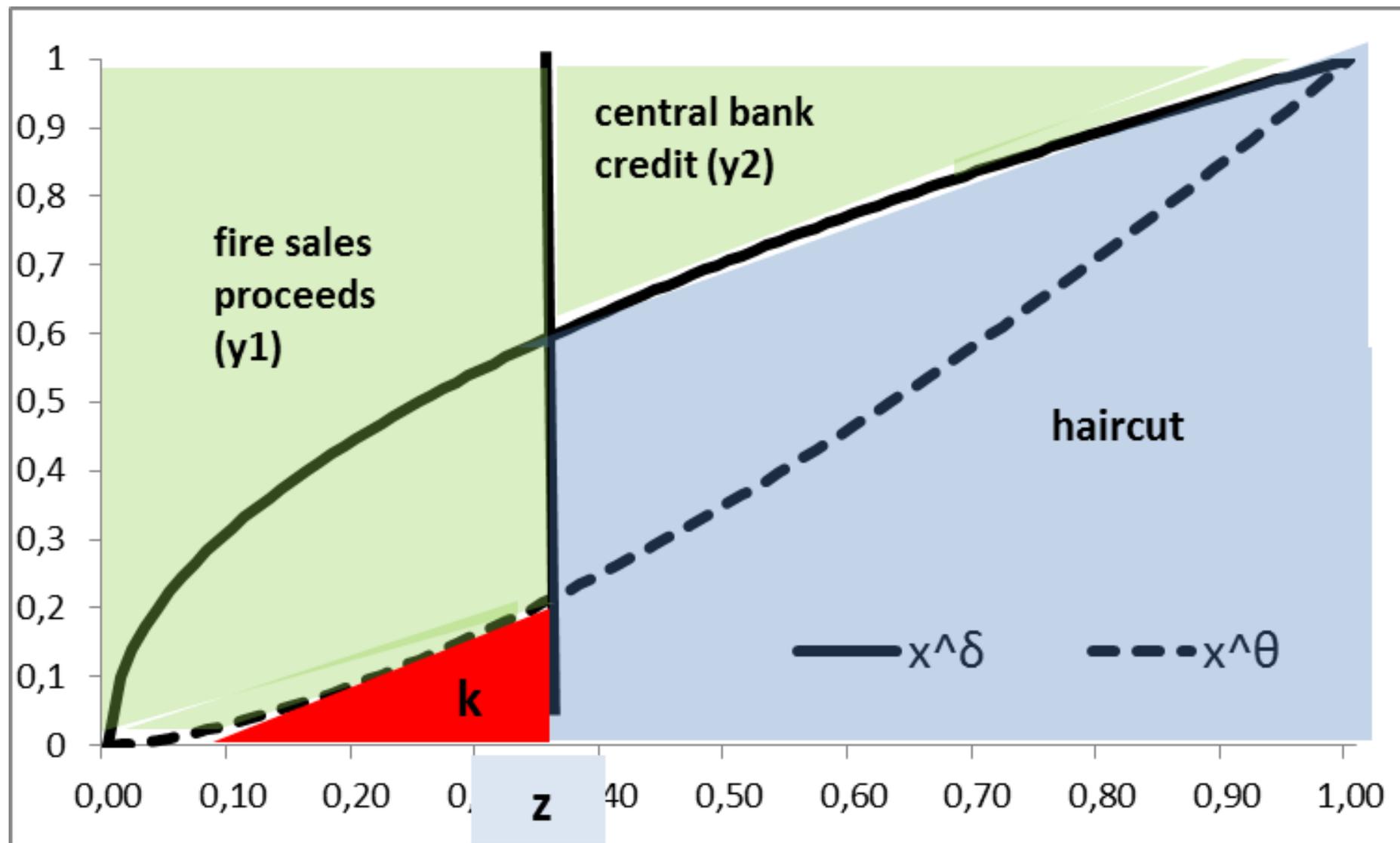


Table 1: The impact of the central bank collateral framework on banks' liability structure and funding cost

Exogenous parameters					
$\delta$	0.01	0.1	0.2	0.5	1
$\Theta$	1				
$r_t$	2%				
$r_e$	10%				
Results					
t	0.39	0.39	0.38	0.29	0.00
e	0.05	0.04	0.03	0.01	0.00
Implied short term funding (1-t-e)	0.56	0.57	0.59	0.70	1.00
Share of assets foreseen for fire sales (z)	0.33	0.29	0.25	0.11	0.00
Refinancing costs of bank	1.32%	1.21%	1.08%	0.64%	0.00%

**The *less* restrictive the central bank collateral framework:**

The higher the equilibrium share of short term funding

The lower the equilibrium share of term funding

The lower the equilibrium share of equity

The lower the equilibrium ratio between equity and term funding

The lower the potential role of asset fire sales relative to central bank pledging

The lower the funding costs of banks and hence the lower, in competitive equilibrium, the costs of bank funding to the real economy.

Table 2: The impact of asset liquidity on banks' liability structure and funding cost

Exogenous parameters						
$\delta$	0.1					
$\theta$	0.4	0.7	1	1.5	2	4
$r_t$	2%					
$r_e$	10%					
Results						
t	0.79	0.60	0.39	0.11	0.00	0.00
e	0.00	0.03	0.04	0.06	0.04	0.01
Implied short term funding (1-t-e)	0.21	0.37	0.57	0.84	0.96	0.99
Share of assets foreseen for fire sales (z)	0.03	0.16	0.30	0.46	0.51	0.49
Refinancing costs of bank	1.62%	1.47%	1.21%	0.78%	0.43%	0.05%

**The higher  $\theta$ , i.e. the higher the asset liquidity (i.e. the lower the asset fire sales discount parameter):**

The higher the equilibrium share of short term funding

The lower the equilibrium share of short term funding

The equilibrium share of equity first increases, and then decreases again

The share of assets foreseen for fire sales first increases and then decreases again.

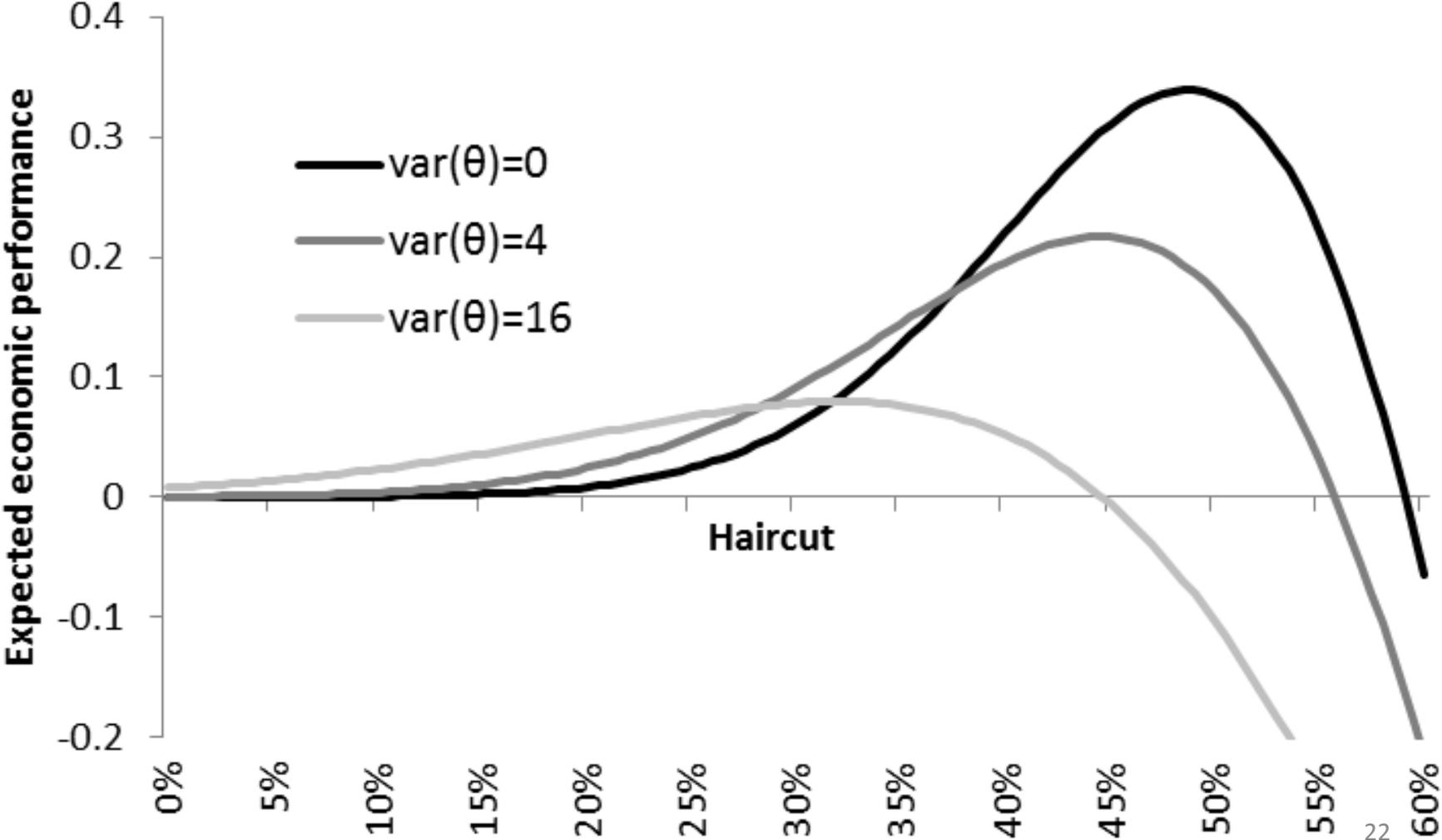
The lower the funding costs of banks and hence the lower, in competitive equilibrium, the costs of bank funding to the real economy.

# Model II - Bindseil and Jablecki 2013

- „*Central bank liquidity provision, risk-taking and economic efficiency*“, *ECB WPS No. 1542, May 2013.*
- Deposit withdrawals from banks modelled ad hoc assuming some (normal) probability distribution; One bank finances one corporate
- Deposit withdrawals are noisy reflections of quality of corporates. Quality = mean of change of asset values (which also follows some probability distribution, but is persistent over time)
- Two types of mistakes: letting default a healthy corporate and bank which were subject to a large random liquidity outflow AND letting poor performers survive and associated zombification of the economy.
- Haircut allows to optimise within this trade-off.
- This is a model of the LOLR that is completely independent of the interest rate level and the ZLB problem. Related LOLR activities (missing the broadening the collateral set) would make sense before the ZLB is reached.
- Indirect relevance: missing the optimal haircut means reducing growth rates => impact via the non-accelerating rate formula.

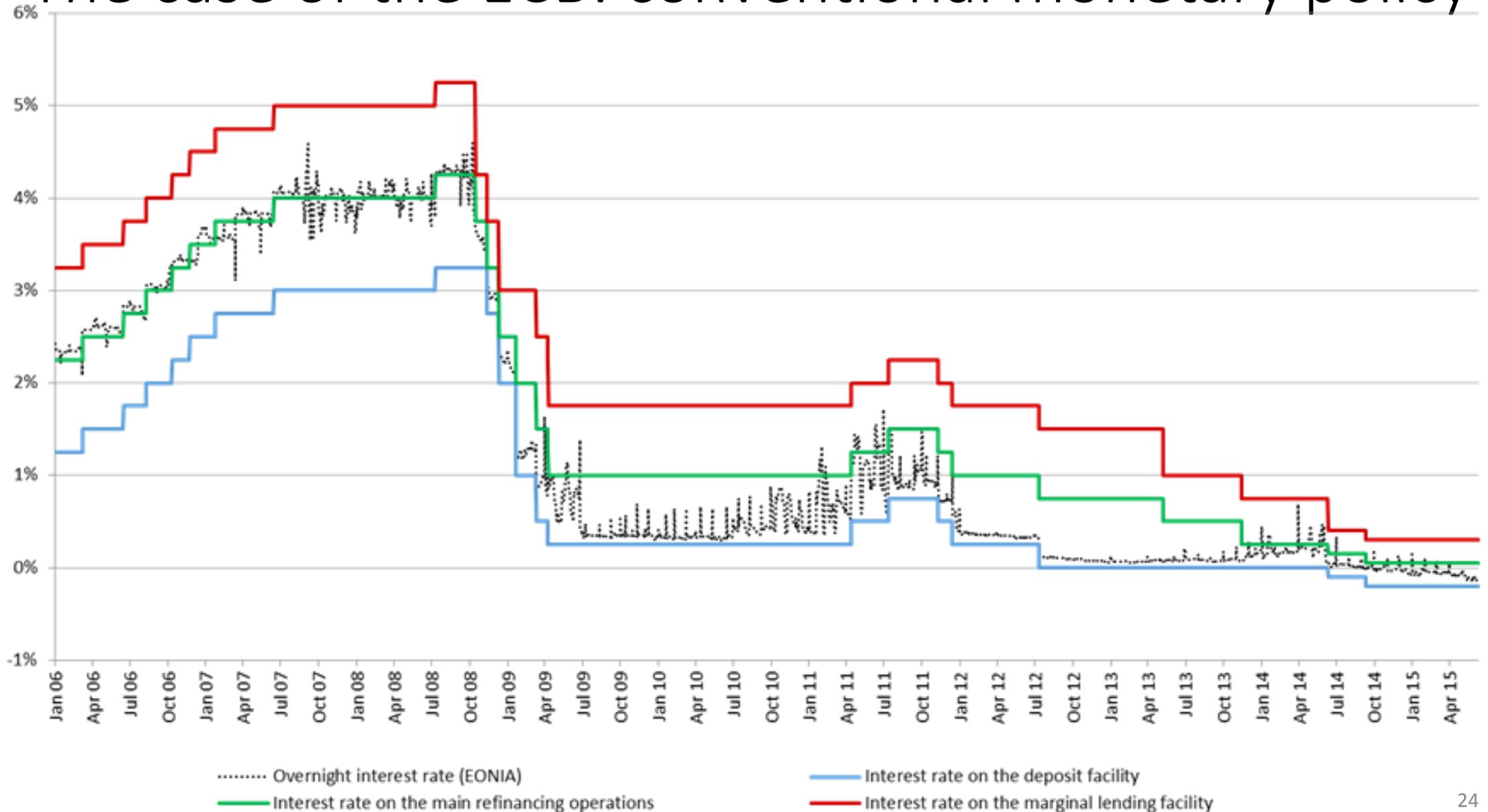
# B&J 2013

Expected economic performance (growth) as a function of the elasticity of central bank credit provision, for three different levels of the noise in credit quality signals, (x-axis: collateral haircut applied by central bank; y-axis: expected economic growth)



# ECB practice

# The case of the ECB: conventional monetary policy



# List of unconventional measures – Part 1: credit

1. Liquidity injecting fine tuning operations (08/2007)
2. USD providing operations (12/2007)
3. Longer term credit operations (6M, 12M, 36M, 48 M)
4. Fixed rate full allotment (as of 10/2008)
5. Collateral set widening: BBB, waiver; ACC; Bank-Kurzläufer etc
6. Narrowing corridor
7. Widening the counterparty set
8. Negative interest rates

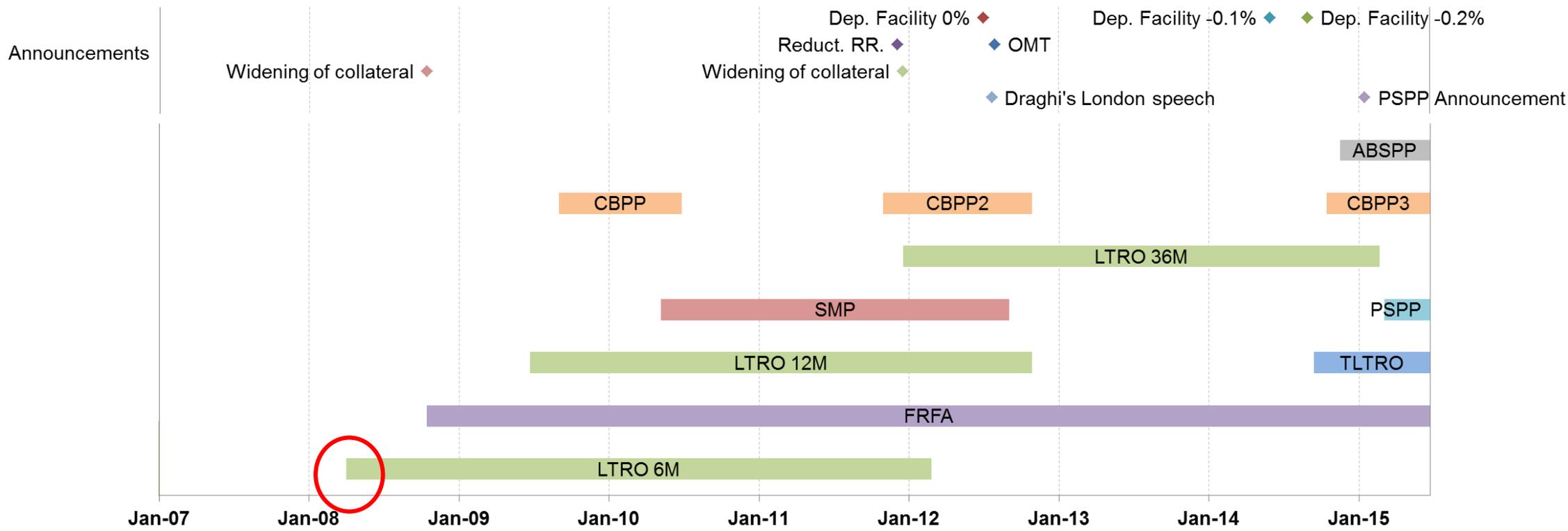
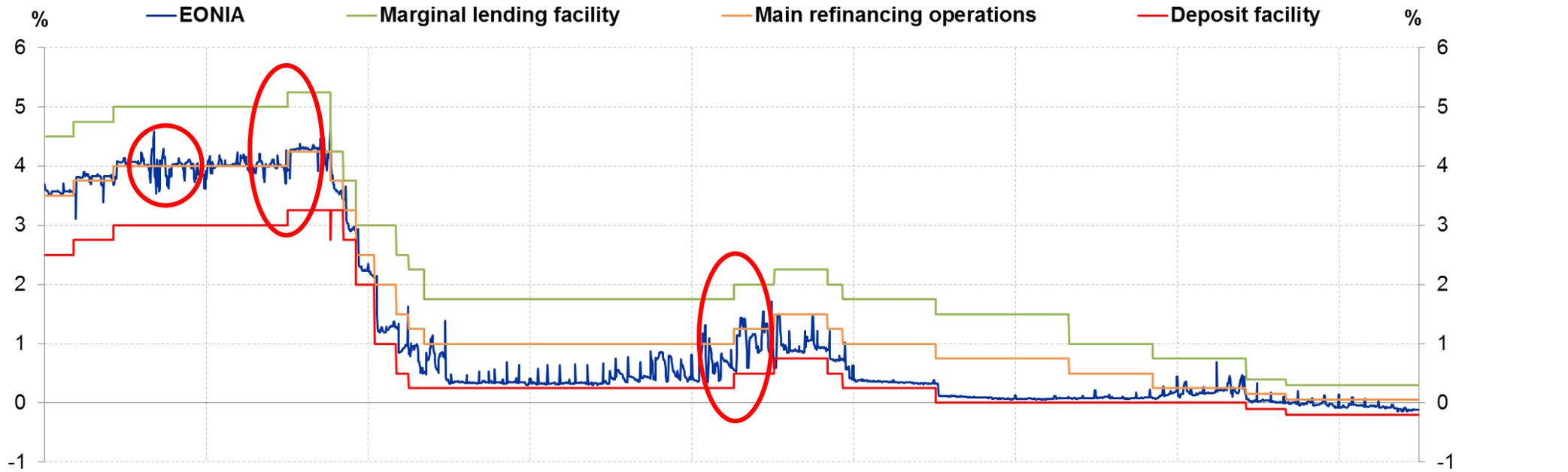
# List of unconventional measures – Part II: Purchases

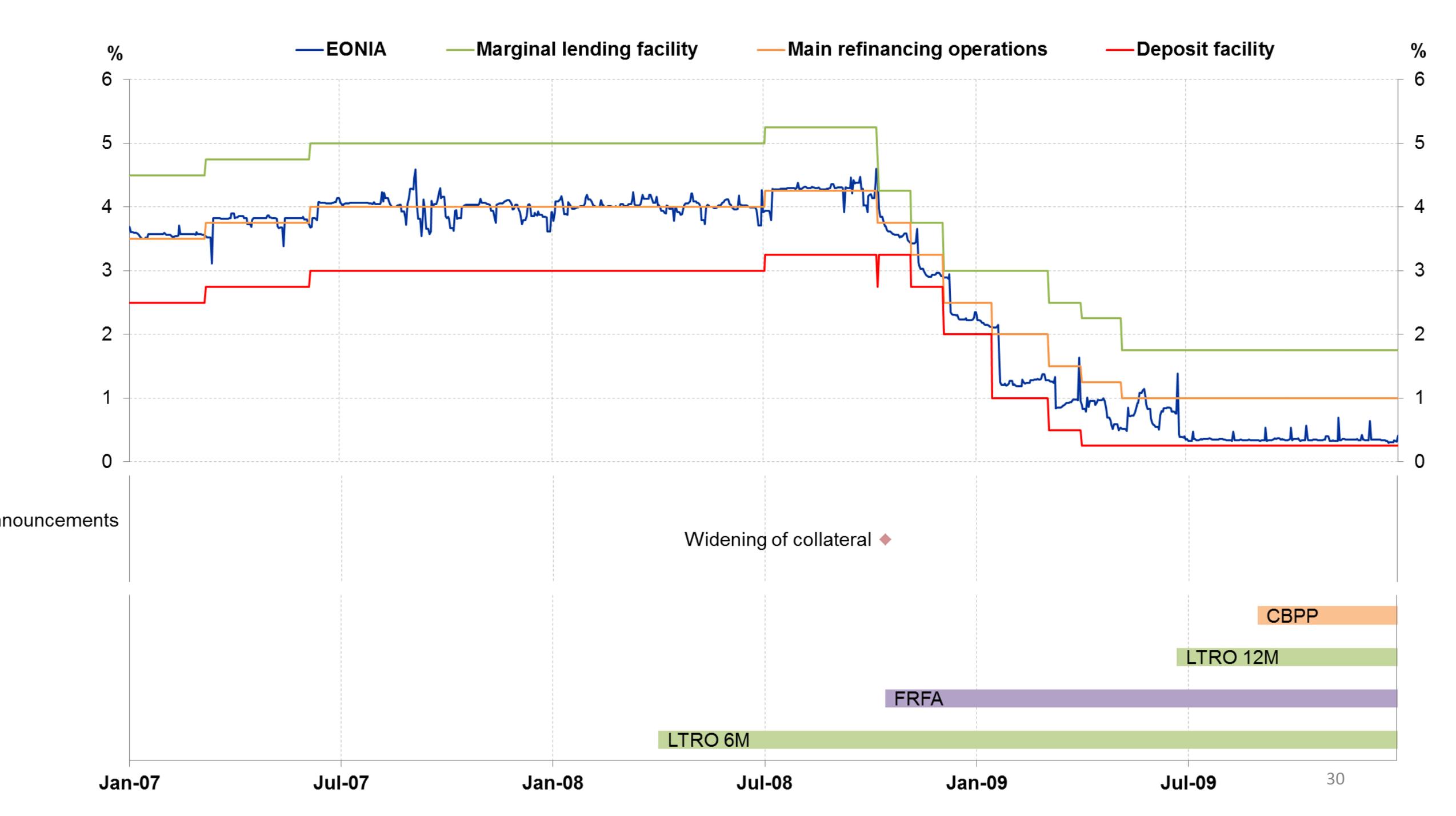
1. CBPP 1, 2, 3 (2009 - 2015)
2. SMP (2010-2012)
3. OMT (Announced Sept 2012)
4. ABSPP (Since 10/2014)
5. PSPP (Since March 2015)

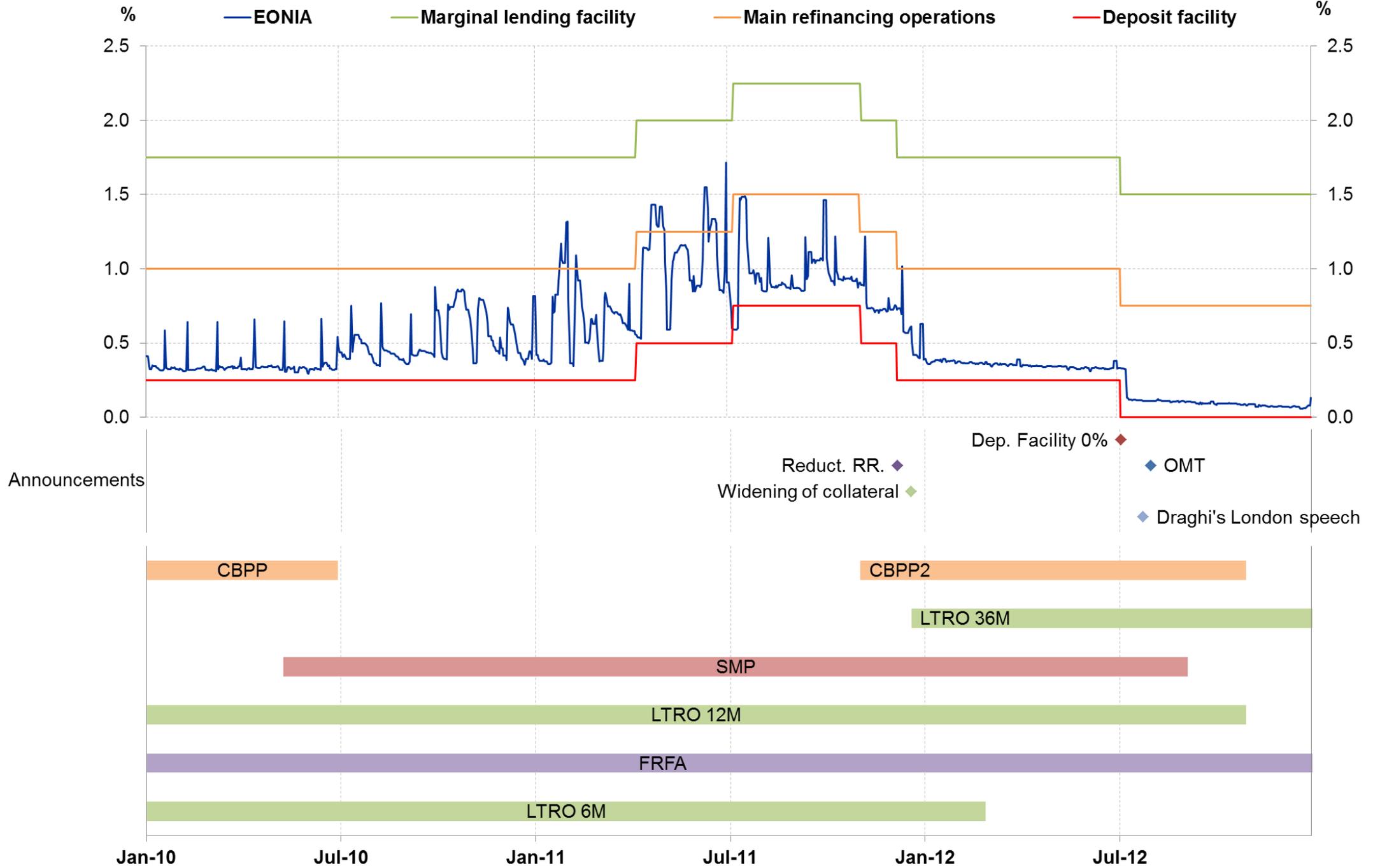
# Possible academic interpretation of non-conv measures

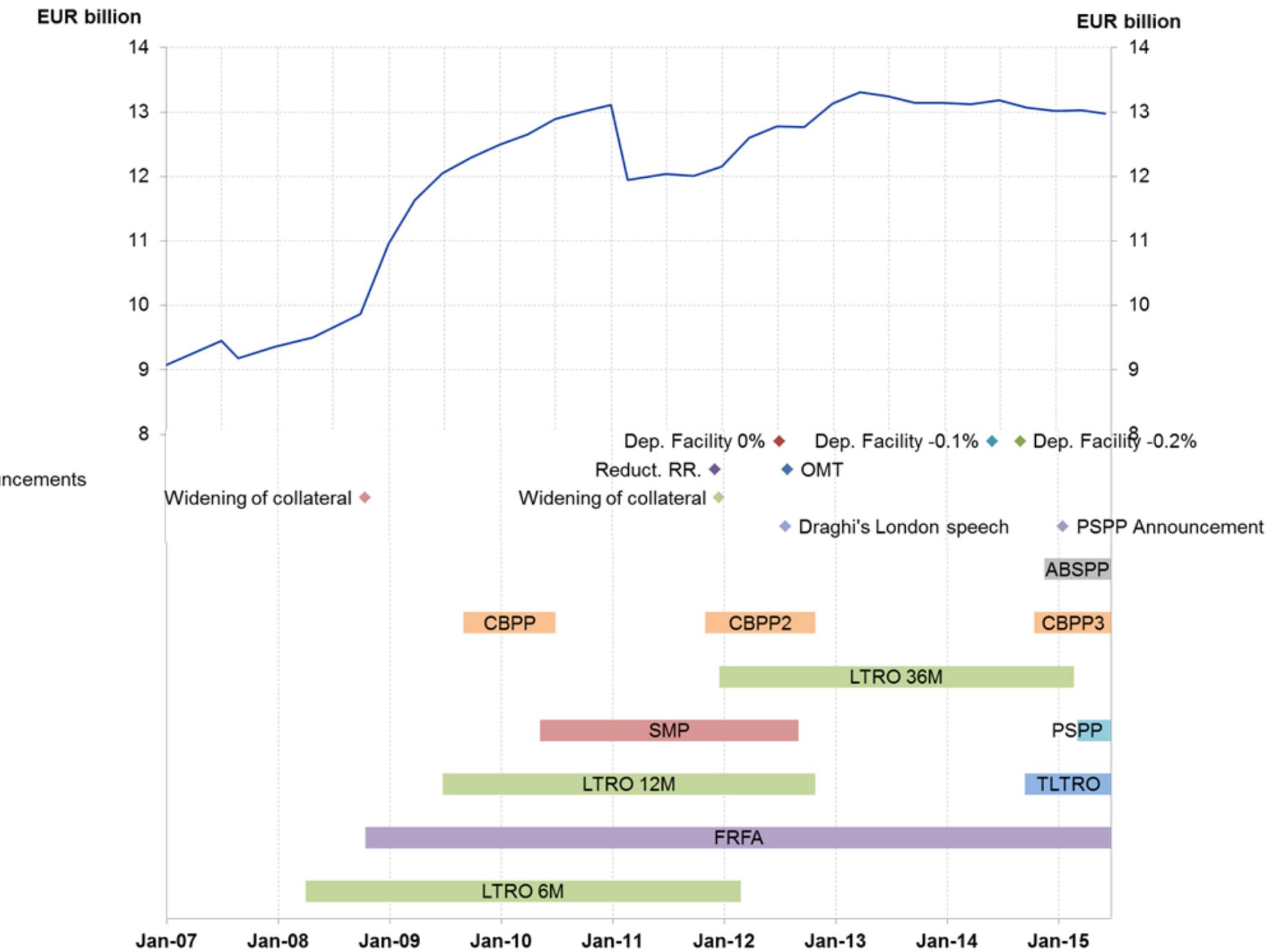
	Diam Dybvig 83	Repullo 05	Rochet Vives 05	Ach Visw 11	Diam Raj 12	Fahri Tirole 12	Stein 12	Curdia Wood 11	Gertler Karadi 10	Bindseil Jablecki 13	Binds 13
Lowering of i					*	*		*	*		(*)
Fine tuning injection 9 Aug											
Collateral widen	(*)	(*)	(*)							*	*
ELA	(*)	*	*							*	*
Longer duration											
FRFA											
USD provision										*	
CBPP/ABSPP				*			*	*	*		
SMP											
OMT											
PSPP							*				
Mon Pol								*	*		*
LOLR / "bail out"	*	*	*	*	*	*	*			*	*











Total eligible collateral (as LOLR indicator?)

# Announcements: additional LTROs; USD provision

- **6 September 2007 - Pre-announcement of supplementary longer-term refinancing operation.** The Governing Council of the European Central Bank has today decided to conduct a supplementary liquidity-providing longer-term refinancing operation with a maturity of three months. **This operation aims to support a normalisation of the functioning of the euro money market.**
- **12 December 2007 - Measures designed to address elevated pressures in short-term funding markets.** Today, five central banks are announcing measures **designed to address elevated pressures in short-term funding markets.** The Eurosystem shall conduct two US dollar liquidity-providing operations, in connection with the US dollar Term Auction Facility, against ECB-eligible collateral for a maturity of 28 and 35 days.

# Announcements – Fixed rate full allotment and more narrow corridor

- **8 October 2008 - Changes in tender procedure and in the standing facilities corridor.** As from the operation settled on 15 October, the weekly main refinancing operations will be carried out through a fixed rate tender procedure with full allotment at the interest rate on the main refinancing operation, i.e. currently 3.75%.
- As of 9 October, the ECB will reduce the corridor of standing facilities from 200 basis points to 100 basis points around the interest rate on the main refinancing operation. ..
- The two measures will remain in place for as long as needed

# Announcements – Collateral extension

- **15 October 2008 - Measures to further expand the collateral framework and enhance the provision of liquidity**
- The Governing Council of the European Central Bank (ECB) today decided, by means of a teleconference, on the following measures:
  - The list of assets eligible as collateral in Eurosystem credit operations will be expanded as set out below, with this expansion remaining into force until the end of 2009.
  - ...

# Announcements - SMP

- **10 May 2010 - ECB decides on measures to address severe tensions in financial markets**
- The Governing Council of the European Central Bank (ECB) decided on several measures to address the severe tensions in certain market segments which are hampering the monetary policy transmission mechanism and thereby the effective conduct of monetary policy oriented towards price stability in the medium term. The measures will not affect the stance of monetary policy. In **view of the current exceptional circumstances prevailing in the market**, the Governing Council decided:
- To conduct interventions in the euro area public and private debt securities markets (Securities Markets Programme) to ensure depth and liquidity in those market segments which are dysfunctional. **The objective of this programme is to address the malfunctioning of securities markets and restore an appropriate monetary policy transmission mechanism.** The scope of the interventions will be determined by the Governing Council. In making this decision we have taken note of the statement of the euro area governments that they *“will take all measures needed to meet [their] fiscal targets this year and the years ahead in line with excessive deficit procedures”* and ...
- In order to sterilise the impact of the above interventions, specific operations will be conducted to re-absorb the liquidity injected through the Securities Markets Programme. **This will ensure that the monetary policy stance will not be affected.**

# Conclusions

- LOLR and “bail out” literature not always close to details of central bank liquidity provision and the actual constraints to it
- Modelling of non-conventional monetary policy measures partially intuitive to Wicksellian central banker
- Worth trying to model LOLR closer to real central bank credit constraints, and with link to monetary policy
  
- LOLR has merits on its own, that kick in before reaching the ZLB
- LOLR also provides monetary accommodation (limits increases of the banks’ intermediation spread and supports willingness of banks to lend) and supports real growth rates, which both are relevant in the context of the ZLB
- “Pure” unconventional monetary policy measures associated with the ZLB; various ways term and credit/liquidity spreads can be reduced
  
- In CB practice, this broadly validated, but changing views on where ZLB is

Background slides: 9 papers on  
bank runs / non-conventional  
measures

# (I): Diamond and Dybvig 1983

- “Runs are costly and reduce social welfare by interrupting production (when loans are called) and by destroying optimal risk sharing between depositors. Runs in many banks would cause economy wide economic problems.” (p. 403). This allows for a link to monetary policy in the sense that those “problems” probably mean a lower growth and hence lower non-accelerating interest rates
- “The Federal Reserve discount window can, as a lender of last resort, provide a service similar to deposit insurance. It would buy bank assets with (money creation) tax revenues at  $T = 1$  for prices greater than their liquidating value. If the taxes and transfers were set to be identical to that of the optimal deposit insurance, it would have the same effect. The identity of deposit insurance and discount window services occurs because the technology is riskless.” (p. 417)
- Not a very intuitive and realistic application to the CB LOLR (and many liabilities of banks are non-insured)

## (II) Repullo, (2005), “Liquidity, risk taking and the LOLR”, IJCB, 1, 47

- Repullo “studies the strategic interaction between a bank whose deposits are randomly withdrawn and a lender of last resort (LLR) .... The bank is subject to a capital requirement and chooses the liquidity buffer that it wants to hold and the risk of its loan portfolio. The equilibrium choice of risk is shown to be decreasing in the capital requirement and increasing in the interest rate charged by the LLR. ... the bank chooses the same level of risk and a smaller liquidity buffer than in the absence of an LLR. Thus, in contrast with the general view, the existence of an LLR does not increase the incentives to take risk, while penalty rates do.”
- Model looks at asset side choices of the bank. However, the modelling of collateralization, of asset liquidity and of bank funding is simple, and bank runs do not seem to be really endogenous (exogenous random withdrawals of funds)
- Section 3.2 introduces collateralization of emergency lending. However it seems that the collateralization is only reflected in the returns of the central bank in case of bank failure, with the collateralization level being equal to the return failure. There is no haircut (the word haircut has no matches in the paper) and the implications on other lenders do not seem to be modelled.
- No explicit links to monetary policy

### (III) Rochet – Vives (2004), “Coordination failure and the LOLR: was Bagehot right after all?”

- RV build a model of banks’ liquidity crises that possesses a unique Bayesian equilibrium. In this equilibrium, there is a positive probability that a solvent bank cannot find liquidity assistance in the market.
- Page 9: “in our model, banks essentially finance themselves by two complementary sources: stable resources (equity and long term debt) and uninsured short term deposits.”
- Page 27: “central bank intervention can take the form of open market operations that reduce the fire sales premium, or discount window lending at very low rate”
- The modelling of the central bank collateral eligibility and haircut framework remains very simplistic.
- No link to monetary policy

(IV) Acharya and Viswanathan, Leverage, Moral Hazard and Liquidity, JoF, 66, Issue 1, pages 99–138

- From abstract: “Financial firms raise short-term debt in order to finance asset purchases. When asset fundamentals worsen, debt induces firms to risk-shift; this limits their funding liquidity and their ability to roll over debt. Firms may de-lever by selling assets to better-capitalized firms. Thus the market liquidity of assets depends on the severity of the asset shock and the system-wide distribution of leverage. This distribution of leverage is, however, itself endogenous to future prospects.”
- Sophisticated model in which asset value shocks destabilize funding, which is endogenous. Ex ante stage modelled so as to be able to analyse moral hazard
- AV do not make a link to monetary policy and not even to the LOLR, however this link could be added: asset price shocks => funding destabilization + asset fire sales => intermediation spread goes down and growth rate goes down =>  $i^*$  needs to go down as  $r$  goes down and  $k$  goes up (See below)

## (V) Diamond and Rajan (2012), Illiquid Banks, Financial Stability, and Interest Rate Policy

- DR see central bank intervention in the form of reduced interest rates as “preventing runs” (i.e. suggesting that the most conventional monetary policy tool – interest rates – would in fact also be a LOLR / bailout measure).
- “Should central banks alter interest rates to deal with episodes of illiquidity and financial fragility?”; “the private banking sector is insolvent at rates that would prevail absent interventions, and it is the central bank’s ability to lower overall market rates through its lending (at the expense of depositing households) that allows it to “bail out” the banking system”
- DR call interest rate intervention “constrained bailouts” and believe that they are not as bad as “unconstrained bailouts” in terms of creating moral hazard. It seems that “unconstrained bailouts” consist in recapitalisation of banks.
- For a central banker it is counterintuitive that interest rate can be used freely as a bail out tool or not. The price stability mandate does not provide for degrees of freedom, in the view of CBs.

(VI) Fahri Tirole (2012), "Collective Moral Hazard, Maturity Mismatch, and Systemic Bailouts." *American Economic Review*, 102(1): 60-93

- Similar, to DR, FT treat nominal interest rate set by central bank exclusively as a financial stability tool. Only at the end, the authors mention that one could extend the model to encompass monetary policy considerations.
- Central bankers again may be puzzled by the assumption that choosing interest rate levels would not be constrained by monetary policy considerations (price stability)
- Paper does not seem to see particular merits in maturity transformation of banks, but strongly emphasizes the social costs of it and negative externalities. Also it assumed that central bank interventions to “bail out” banks through low interest rates is problematic as it creates moral hazard.

(VII) Stein (2012), “Monetary policy and financial stability regulation”, QJE, 127 (1): 57-95.

- Stein describes role of the banking system in maturity transformation in a more balanced way than others, highlighting both its merits and welfare benefits and the risks
- However, the bail-out measures of the central bank described later on in the paper relate to open market operations and a sort of money multiplier logic.
- Again, central bankers may be puzzled by the idea that a money multiplier logic could apply to central bank LOLR operations
- Finally, Stein makes the link to regulatory topics

## (VIII) Curdia, V. and M. Woodford (2011), “The central bank balance sheet as an instrument of monetary policy”.

- New Keynesian DSGE model enriched by elements reflecting “balance sheet decisions” of the central bank.
- “Credit policy” consists in CB lending directly to real economy (instead of banks doing it), while normally the central bank holds only risk free Government bonds. Stylized economy consists in households that either lend or borrow, normally using financial intermediaries.
- The other policies of the central bank are “interest rate policies” and (excess) “reserve supply policy”
- Banking system as intermediary between households is subject to two frictions: a loan loss ratio (the share of bad borrowers that do not pay back anything and that cannot be identified ex ante) and administrative costs. Both can increase in a crisis. The central bank also has administrative costs. It is argued that in a reasonable calibration, in normal times the CB should because of its higher administrative costs not engage in the activity of direct lending.
- The model is not a LOLR model, as the role of “credit policy” is only captured as mentioned above. Banks are homogeneous, so there is no interbank-run issue. Also, banknotes are not modelled, so there is no run into banknotes either

(IX) Gertler, M. and P. Karadi (2010), A model of unconventional monetary policy, *Journal of Monetary Economics*, 58, 17-34.

- A DSGE model is enriched by elements to capture financial instability and a related breakdown of the usual efficiency of the private sector to intermediate.
- Again, central bank “credit policy” is understood as direct lending of the central bank to the real economy. The central bank is assumed to normally be in a competitive disadvantage in doing so, but in a financial crisis doing so may be welfare enhancing. “The prime reason is that central bank intermediation dampens the rise in the spread, which in turn dampens the investment decline.” (p. 28).
- (p. 33): “ in a financial crisis there are benefits [of] credit policy even if the nominal interest has not reached the zero lower bound. In the event the zero lower bound constraint is binding, however, the net benefits from credit policy may be significantly enhanced.”