Quantitative easing and the price-liquidity trade-off

Marien Ferdinandusse, Maximilian Freier, Annukka Ristiniemi[1]

European Central Bank and Sveriges Riksbank

November 2016

[1]The views expressed here do not necessarily reflect the views of neither the ECB or Sveriges Riksbank.

Introduction

How should a central bank weigh together the costs and benefits of buying different assets?

- Benefits: yields decline
- Costs: bonds become less liquid or scarce
- In a standard term structure model with deep pocketed arbitrageurs, QE has no effect.
- Have to make demand and supply matter to have an effect.
- Preferred habitat investors: Require a premium to move. Reduction in supply of bonds correlates with amounts bought from preferred habitat investors Vayanos and Vila (2009); Hamilton and Wu (2012)
  - Cannot explain differences in yields in the Eurozone since amounts purchased are similar
  - QE is costless

Results

Search model of over-the-counter debt:

- The measures of sellers and buyers (demand and supply) matter for price.
- Increase in demand from central bank increases price
- The increase depends on the share of preferred habitat investors holding the bonds
- Impact of purchases is larger, the tighter the markets
- However, there is a liquidity trade-off
  - High rating bonds: scarcity
  - Low rating bonds: crowding out of scarce buyers

Impact of public sector purchase programme (PSPP)

Relative impact of ECB purchases largest in countries with more preferred habitat investors

		22 Jan 2015		5 Mar 2015	
Country	Credit rating	Basis points	Percent	Basis points	Percent
Germany	AAA	-9.3	-15.5***	-3.7	-7.0*
Netherlands	AA+	-9.9	-15.3***	-4.1	-7.3**
Finland	AA+	-7.7	-14.8***	-5.9	-9.8***
Austria	AA+	-9.3	-14.3***	-4.4	-7.7**
France	AA	-7.6	-11***	-2.2	-2.9
Belgium	AA	-7	-9.5***	-3.1	-5.2**
Ireland	A-	-9.4	-9.0***	-4.4	-5.9***
Spain	BBB	-10.7	-8.2***	-5.9	-4.7**
Italy	BBB	-8.3	-7.1***	-2.9	-2.4
Portugal	BB	-17.6*	-6.3***	-9.5	-5.8***

Change in 10-year benchmark yields of Eurozone sovereign bonds following announcement of QE on 22 Jan 2015 and start of purchases on 5 Mar 2015, controlling for bid-ask spreads, local stock index, and Greek stock index. Ratings are S&P's long-term sovereign ratings.

Preferred habitat investors

- Foreign central banks: Interested of liquidity rather than returns
- Insurance companies/pension funds: institutional preferences for certain maturities, international accounting rules prevent selling assets

Table: Fixed income assets in foreign reserves, end 2014

Riksbank		**Swiss National Bank**	
Germany	68%	AAA -rated	60%
France	12%	AA -rated	25%
Netherlands	9%	A -rated	10%
Belgium	5%	Other	5%
Austria	4%		
Italy	2%		

Construct an index of preferred habitat investors from ECB securities holding statistics:

Preferred habitat investors

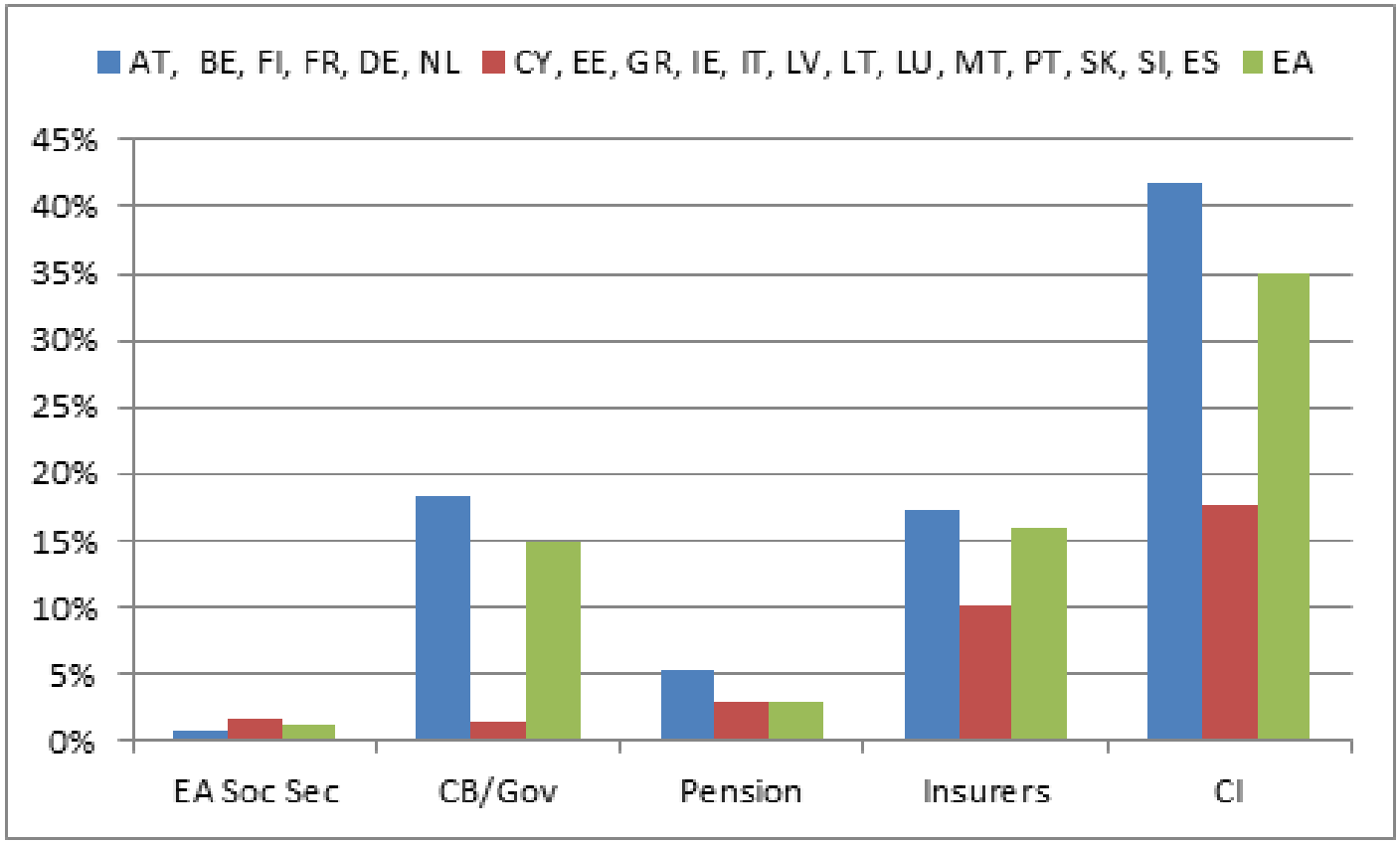


Figure: Preferred habitat investors index per sector, 2014 average

Preferred habitat investors

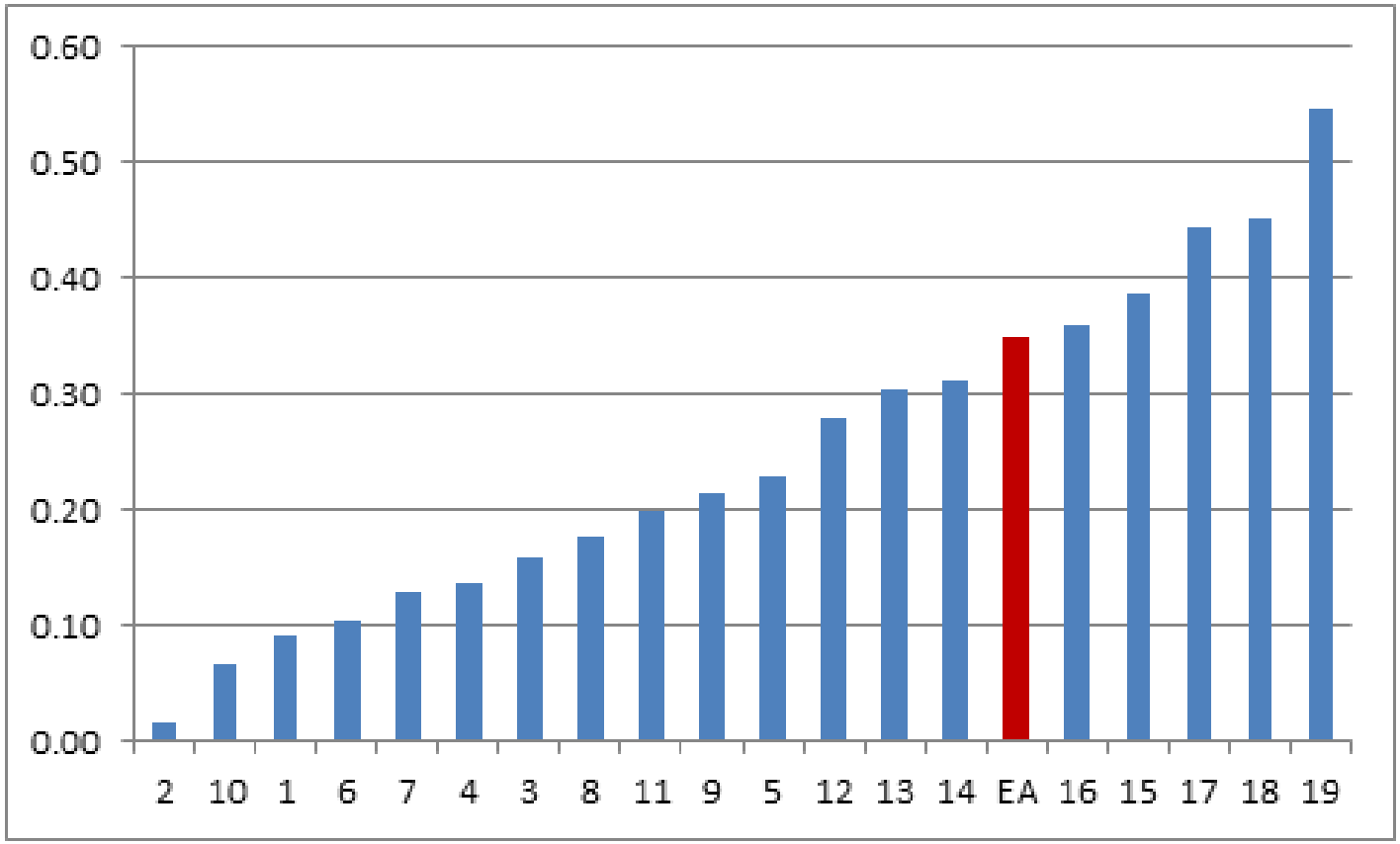


Figure: Preferred habitat investor index per Eurozone country

Model

Search model of over-the counter debt as in Duffie, Garleanu and Pedersen (2005); Vayanos and Wang (2007); Afonso (2011):

- We add bonds with default risk, preferred habitat investors, and central bank purchases to the model
- Can model supply and demand explicitly and give an endogenous explanation to why yields move.
- Term structure models suggest that central banks should buy the most illiquid assets. Does not happen in practice. We show that there is a liquidity trade-off.
- Calibrate the model to Eurozone.
  - Prices decline most in countries with most preferred habitat investors.
  - Liquidity improves most in countries with fewest sellers (least preferred habitat investors).
  - Liquidity is worse when central bank stops the purchases.

Search model

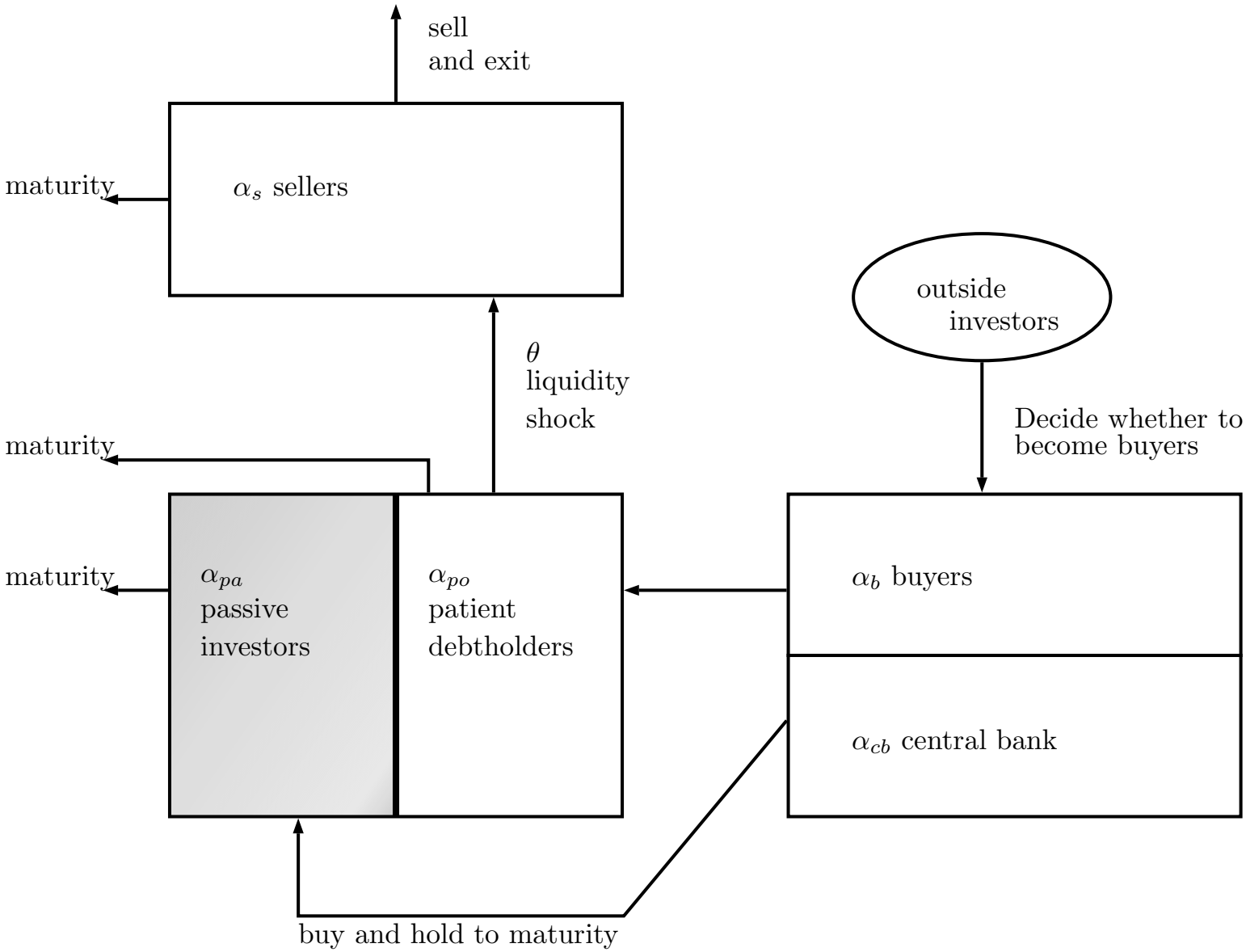


Figure: Flows of investors

Value functions

Buyer:

$$J_b = -e + \lambda\alpha_s(J_{po} - P) + (1 - \lambda\alpha_s)J_b$$

Central bank:

$$J_{cb} = -e + \lambda\alpha_s(J_{pa} - P) + (1 - \lambda\alpha_s)J_{cb}$$

Seller:

$$J_s = \frac{1}{1+\rho}[\delta(1-q) + \delta q\gamma + \lambda(\alpha_b + \alpha_{cb})P + (1 - \delta - \lambda\alpha_b + \lambda\alpha_{cb})J_s]$$

Patient debtholder:

$$J_{po} = \delta(1-q) + \delta q\gamma + \theta J_s + (1 - \delta - \theta)J_{po}$$

Passive investor:

$$J_{pa} = \delta(1-q) + \delta q\gamma + \theta c + (1 - \delta - \theta)J_{pa}$$

Bargaining

Nash bargaining over surpluses:

$$P = \beta J_s + (1-\beta)(J_{po} - J_b) \tag{1}$$

$$P = \underbrace{\frac{(\delta(1-q) + \delta\gamma q)}{\rho + \delta}}_{\text{fundamental value}} + \underbrace{\frac{(1-\beta)}{\beta}\frac{e(\lambda\alpha_b + \lambda\alpha_{cb} + \rho + \delta)}{\lambda\alpha_s(\rho + \delta)}}_{\text{liquidity premium}}$$

Results

1. Price increases with increased central bank demand:

$$P = \frac{(\delta(1-q)+\delta\gamma q)}{\rho+\delta} + \frac{(1-\beta)}{\beta}\frac{e(\lambda\alpha_b + \boxed{\lambda\alpha_{cb}} + \rho + \delta)}{\lambda\alpha_s(\rho+\delta)}$$

Results

1. Price increases with increased central bank demand:

$$P = \frac{(\delta(1-q)+\delta\gamma q)}{\rho+\delta} + \frac{(1-\beta)}{\beta}\frac{e(\lambda\alpha_b + \boxed{\lambda\alpha_{cb}} + \rho + \delta)}{\lambda\alpha_s(\rho+\delta)}$$

2. Without excess demand for bonds, central bank purchases crowd out other buyers with smaller impact on price

Increasing measure of buyers (α_{cb}) reduces J_b causing the inflows of buyers to fall.

Results

1. Price increases with increased central bank demand:

$$P = \frac{(\delta(1-q)+\delta\gamma q)}{\rho+\delta} + \frac{(1-\beta)}{\beta}\frac{e(\lambda\alpha_b + \boxed{\lambda\alpha_{cb}} + \rho + \delta)}{\lambda\alpha_s(\rho+\delta)}$$

2. Without excess demand for bonds, central bank purchases crowd out other buyers with smaller impact on price

Increasing measure of buyers (α_{cb}) reduces J_b causing the inflows of buyers to fall.

3. Price increases more when there are more preferred habitat investors initially.

The fewer α_s, the larger bargaining power they have.

Results

1. Price increases with increased central bank demand:

$$P = \frac{(\delta(1-q)+\delta\gamma q)}{\rho+\delta} + \frac{(1-\beta)}{\beta}\frac{e(\lambda\alpha_b + \boxed{\lambda\alpha_{cb}} + \rho + \delta)}{\lambda\alpha_s(\rho+\delta)}$$

2. Without excess demand for bonds, central bank purchases crowd out other buyers with smaller impact on price

Increasing measure of buyers (α_{cb}) reduces J_b causing the inflows of buyers to fall.

3. Price increases more when there are more preferred habitat investors initially.

The fewer α_s, the larger bargaining power they have.

4. Price increases when bonds become more scarce (standard portfolio balance channel):

The total amount of bonds is $D = \alpha_s + \alpha_{po} + \alpha_{pa}$

$$P = \frac{(\delta(1-q)+\delta\gamma q)}{\rho+\delta} + \frac{(1-\beta)}{\beta}\frac{e}{\lambda(D-\alpha_{po}-\boxed{\alpha_{pa}})}\frac{(\rho+\delta+\lambda\alpha_b+\lambda\alpha_{cb})}{\rho+\delta}$$

Results

5. Liquidity (number of transactions) improves with purchases:

$$\lambda \alpha_s \alpha_b + \boxed{\lambda \alpha_s \alpha_{cb}}$$

Results

5. Liquidity (number of transactions) improves with purchases:

$$\lambda \alpha_s \alpha_b + \boxed{\lambda \alpha_s \alpha_{cb}}$$

6. Liquidity trade-off:

Reduced supply of bonds (increase in α_{pa}) leads to lower α_s,

- Low demand bonds: The reduction in α_s leads to a higher price, crowding out other buyers.
- High demand bonds: Scarcity

Calibration

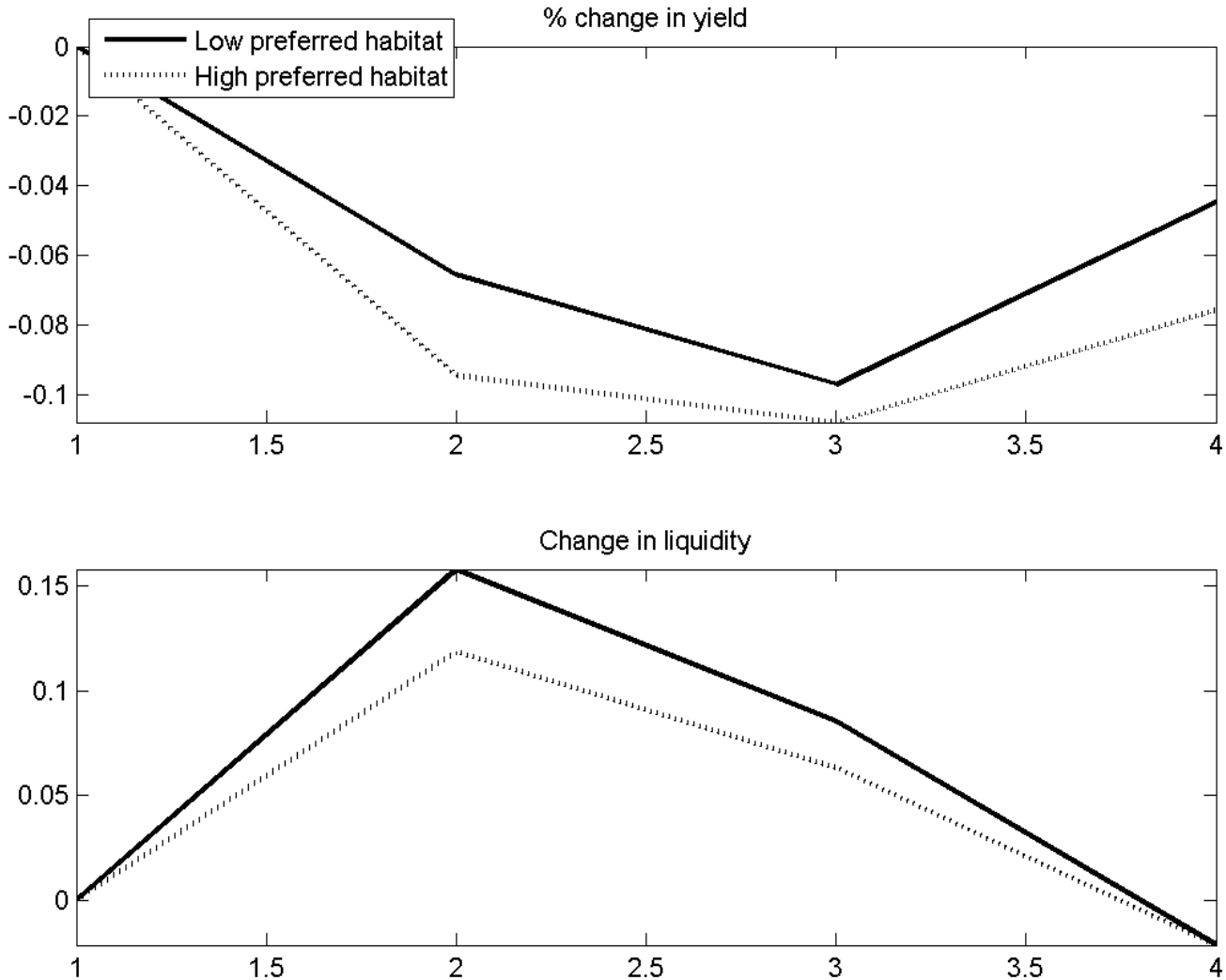
Table: Calibration of the model

Buyers bargaining power	β	0.5	Probability of a liquidity shock	θ	0.1
Probability of debt maturing	δ	0.14	Buyers' search cost	e	0.001
Sellers' discount factor	ρ	0.05	alpha of the beta distribution		1
Recovery rate	γ	0.4	beta of the beta distribution		2
Search intensity	λ	250			

Table: Calibration of groups

	Preferred habitat	Default probability	Purchases as a share of long-term bonds	Average maturity
High rating	0.42	0.23	8.86	6.68
Low rating	0.21	2.14	9.21	7.48

Impact of central bank purchases depends on the share of preferred habitat investors



Conclusion

- Impact of central bank asset purchases depends on demand and supply factors
- Share of preferred habitat investors in the market influences the effect on yield
- There is a liquidity trade-off
- Share of preferred habitat investors differs across euro area bond markets, differentiating the impact of asset purchases

Bibliography

Afonso, Gara (2011) 'Liquidity and congestion.' *Journal of Financial Intermediation* 20(3), 324–360

Duffie, Darrell, Nicolae Garleanu, and Lasse Heje Pedersen (2005) 'Over-the-Counter Markets.' *Econometrica* 73(6), 1815–1847

Hamilton, James D., and Jing Cynthia Wu (2012) 'The Effectiveness of Alternative Monetary Policy Tools in a Zero Lower Bound Environment.' *Journal of Money, Credit and Banking* 44, 3–46

Vayanos, Dimitri, and Jean-Luc Vila (2009) 'A Preferred-Habitat Model of the Term Structure of Interest Rates.' NBER Working Papers 15487, National Bureau of Economic Research, Inc, November

Vayanos, Dimitri, and Tan Wang (2007) 'Search and endogenous concentration of liquidity in asset markets.' *Journal of Economic Theory* 136(1), 66–104