Breaking through the zero line

The ECB’s Negative Interest Rate Policy

Negative interest rates: Lessons learned...so far
Brookings Institution, Washington DC, 6 June 2016

The views expressed in this presentation are those of the authors and do not necessarily reflect those of the ECB or the Eurosystem
**Backdrop: Weak inflation outlook and sluggish recovery**

**Euro area HICP inflation**
*(year-on-year percent change)*

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<th>2008</th>
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- Non-core contribution to HICP inflation
- Core contribution to HICP inflation
- Realised y-o-y HICP inflation
- Swap-implied HICP inflation path (26 May 16)
- March 2016 MPE

**Real GDP**
*(Index, 1999Q1=100)*

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<th>1999</th>
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- EA
- US
- Japan

**Sources:** Thomson Reuters, Eurostat, ECB calculations.
Latest observation: April 2016 for HICP and 26 May 2016 for swap-implied inflation path.

**Notes:**
- Horizontal dotted lines represent pre-crisis peak real GDP level.
ECB policy rates and overnight money market rates May 2012 – May 2016

(Percent)

Sources: ECB and Reuters.
Latest observation: 26 May 2016.

Four small steps into the negative
## Overview

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Why? NIRP rehabilitates monetary policy in low rate world

Short-term interest rate expectations when the effective lower bound is zero (percent p.a.)

A calamitous misadventure?

Why a negative interest rate policy

Removes non-negativity restriction on future expected short rates: forward curve becomes flatter than it would be if short rates were expected to be constrained by a zero lower bound.

Source: ECB calculations, based on Lemke/Vludu (2016).
Notes: The chart presents the sequence of risk-neutral predictive distributions of the one-month OIS rate, conditional on term structure information on the indicated date, together with the model-implied one-month forward curve. The results are from a 3-factor arbitrage-free shadow rate term structure model for the euro area EONIA swap curve. The model allows for a shift in the lower bound. Note that for short-term horizons, the model can imply that the risk-neutral probability of the short rate sticking to the lower bound is close to one, so that only high percentiles (or none at all) of the predictive distribution are visible.
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A simple model: the bond market

- Simple 2-period model with representative investor

- Investor allocates time $t$ wealth $W_t$ into one-period and two-period bonds to maximize next period’s expected wealth $W_{t+1}$ minus variance penalty:

$$\max [E(W_{t+1}) - \frac{1}{2} \gamma \text{Var}(W_{t+1})]$$

- First-order condition gives demand $B$ for long-term bonds:

$$B = [\text{Var}(R_{1t+1})]^{-1} \cdot [2 R^2_t - R^1_t - E(R^1_{t+1})]$$

where $R^n_t$ is the yield to maturity of an $n$-period bond at time $t$.

- Short-term bond is in elastic supply, rate set by the central bank

- Fixed supply $Q$ of long-term bonds: in equilibrium $Q=B$.

- Two-year yield in equilibrium:

$$R^2_t = \frac{1}{2} \cdot \left[ R^1_t + E(R^1_{t+1}) \right] + \frac{1}{2} \gamma Q \text{Var}(R^1_{t+1})$$

Expectations component Term premium
Simple model: The policy rate in “normal times”

- Central bank follows a (simplified and modified) Orphanides/Wieland rule, so that the intended short rate $S_t$ is

$$S_t = S_{t-1} + \beta \cdot (\pi_t - \pi_{t-1}),$$

where $\pi_t - \pi_{t-1} \sim N(0, \sigma_{\pi}^2)$

- Distribution of next period’s intended policy (=‘shadow’) rate is a simple normal:

$$S_{t+1} \sim N(S_t, \beta^2 \sigma_{\pi}^2)$$

- In normal times, when lower bound is far away:

$$E(R_{t+1}^1) = E(S_{t+1}) = S_t$$

Sources: ECB calculations.
Notes: Hypothetical and illustrative example with current and intended short rate $S_t$ equal to -0.2%, $\beta = 1.2$ and $\sigma_{\pi}^2 = 0.25$. 

Distribution of Central Bank’s intended (=shadow) policy rate $S$ next period

![Density of shadow rate](#)
Simple model: The policy rate close to the lower bound

Central bank follows a (simplified and modified) Orphanides/Wieland rule, so that the intended short rate \( S_t \) is

\[
S_t = S_{t-1} + \beta \cdot (\pi_t - \pi_{t-1}),
\]

where \( \pi_t - \pi_{t-1} \sim N(0, \sigma^2_\pi) \)

Distribution of next period’s intended policy (=‘shadow’) rate is a simple normal:

\[
S_{t+1} \sim N(S_t, \beta^2 \sigma^2_\pi)
\]

But if CB is constrained by lower bound (LB):

\[
R_{t+1}^i = \max \{LB, S_t\}
\]

... and the predictive distribution of the actual short rate is a censored normal with

\[
E(R_{t+1}^i) = LB + (S_t - LB) \cdot \Phi[(S_t - LB)/(\beta \sigma_\pi)] + \beta \sigma_\pi \phi[(S_t - LB)/(\beta \sigma_\pi)]
\]

Sources: ECB calculations.
Notes: Hypothetical and illustrative example with current and intended short rate \( S_t \) equal to -0.2%, \( \beta = 1.2 \), \( \sigma^2_\pi = 0.25 \), and lower bound LB=0; hence actual current short rate \( R_{t+1}^i = LB = 0 \). Expected future short rate \( E(R_{t+1}^i) = 4 \) bps.
**Simple model: ZLB reduces influence on term structure**

Relation between current policy rate \( S \) and expected next period’s short-term rate \( R \) (percent)

- **In normal times**, when short-term policy rate are is above \( LB \):
  - \( E(R_{t+1}^1) = E(S_{t+1}) \)
  - Relation between current policy rate \( R_t^1 = S_t \) and expected future short rate \( E(R_{t+1}^1) \) is almost linear

- When short-term rates approach \( LB \):
  - \( E(R_{t+1}^1) > E(S_{t+1}) \)
  - Relation between current policy rate \( R_t^1 \) and expected future short rate \( E(R_{t+1}^1) \) is convex: rate cuts have weaker and weaker impact on \( E(R_{t+1}^1) \) and (under certain conditions) on \( R_{2t}^1 \)

*Sources: ECB calculations.*

*Notes: Hypothetical and illustrative example with current and intended short rate \( S_t \) equal to -0.2%, \( \beta = 1.2 \), \( \sigma^2 = 0.25 \), and lower bound \( LB = 0 \).*
Simple model: Under ZLB, $E(R^1_{t+1})$ is biased upwards

$$R^2_t = \frac{1}{2} \cdot [R^1_t + E(R^1_{t+1})] + \frac{1}{2} Q \cdot \text{Var}(R^1_{t+1})$$

Distribution of short-term rate $R$ next period

Term structure of interest rates (percent p.a.)

Sources: ECB calculations.
Notes: Hypothetical and illustrative example with current and intended short rate $S_t$ equal to -0.2%, $\beta = 1.2$, $\sigma^2 = 0.25$, and lower bound $LB=0$, hence actual current short rate $R^1_t = LB = 0$. Expected future short rate $E(R^1_{t+1}) = 4$ bps.

Sources: ECB calculations.
Notes: Yield (=3 bps) decomposition into expectational component (2 bps) and term premium (1 bp), with 'risk aversion' parameter $\gamma=2$ and $Q=1$. 

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Option 1: ZLB plus credible forward guidance on $R_{t+1}^1 = 0$

$$R_t^2 = \frac{1}{2} \cdot [0 + 0] + \frac{1}{2} Q(0) = 0$$

Distribution of short-term rate $R$ next period

Term structure of interest rates

(Percent p.a.)

Sources: ECB calculations.

Notes: Hypothetical and illustrative example with current short rate $S_t$ equal to $-0.2\%$, $\beta = 1.2$ and $\sigma^2 = 0.25$, and lower bound LB=0, hence actual current short rate $R_t^1 = LB = 0$. Unconditional ('Odyssean') forward guidance makes markets expect $R_{t+1}^1 = 0$ with certainty.

Sources: ECB calculations.

Notes: Yield decomposition into expectational component and term premium, with 'risk aversion' parameter $\gamma=2$ and $Q=1$. Term premium vanishes as under the assumed forward guidance, the variance is zero.
Option 2: NIRP with no forward guidance on $R^1_{t+1}$ …

\[ R^2_t = \frac{1}{2} \cdot [S_t + E(S_{t+1})] + \frac{1}{2} Q \text{Var}(S_{t+1}) \]

Distribution of short-term rate $R$ next period

Term structure of interest rates (percent p.a.)

Sources: ECB calculations.
Notes: Hypothetical and illustrative example with current short rate $S_t$ equal to -0.2%, $\beta = 1.2$ and $\sigma^2 = 0.25$, and lower bound removed. Hence actual current and expected short rate $R^1_t = E(R^1_{t+1}) = -0.2\%$. The variance is now maximal, i.e. equal to the variance of the shadow rate distribution.

Sources: ECB calculations.
Notes: Yield decomposition into expectational component and term premium, with ‘risk aversion’ parameter $\gamma = 2$ and $Q = 1$. Compared to status quo, yield drops from 3 to -11 bps. Expectational component drops from 2 to -20 bps. Term premium is higher than under ‘status quo’ (9 vs 1 bps) as the variance is higher.
\[ R^2_t = \frac{1}{2} \cdot [S_t + E(S_{t+1})] + \frac{1}{2} Q' \text{Var}(S_{t+1}) \]

**Distribution of short-term rate \( R \) next period**

- Density of \( R^1_{t+1} \)
- "Shadow" distribution of short rate (in absence of LB)

**Term structure of interest rates**

(\text{percent p.a.})

- Expec. comp.: 0.5 \([R^1_t + E(R^1_{t+1})]\)
- Term premium: \(Q \cdot \text{Var}(R^1_{t+1})\)
- Yield: \(R^i_t\)

Sources: ECB calculations.
Notes: Hypothetical and illustrative example with current short rate \( S_t \) equal to -0.2%, \( \beta = 1.2 \) and \( \sigma^2 = 0.25 \), and lower bound removed. Hence actual current and expected short rate \( R^1_t = E(R^1_{t+1}) \) = -0.2%. The variance is now maximal, i.e. equal to the variance of the shadow rate distribution.

Sources: ECB calculations.
Notes: Yield decomposition into expectational component and term premium, with 'risk aversion' parameter \( \gamma = 2 \) and \( Q = 0.5 \), i.e. reducing private sector bond holdings by one half. Compared to status quo, yield drops from 3 to -16 bps. Expectational component drops from 2 to -20 bps. QE reduces term premium further to below 5 bps.
Overview

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Transmission: smooth pass-through with ample liquidity

Change in deposit rate and money market rates and excess liquidity
(average rate in the maintenance period (MP) after the rate cut (solid) and as of second MP until next rate change (stripes), in % (lhs) and billion euro (rhs))

Spreads of money market rates with deposit rates and excess liquidity
(basis points (lhs) and billion euro (rhs))

Sources: ECB, EMMI, Eurex repo and Bloomberg.

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- Charges bank cash hoarding: extra downward pressure on long-term rates via term premium compression and push to portfolio shifts
- NIRP has flattened and stabilized the term structure since 2014

Sources: ECB and Reuters
Note: Curve shows instantaneous EONIA forward rates based on OIS.
A calamitous misadventure?

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- NIRP has compressed levels and dispersion of banks’ lending rates across euro area …

Bank lending rates on loans for companies
(percentage per annum; three-month moving averages)

Source: ECB.
Notes: The indicator for the total cost of lending is calculated by aggregating short- and long-term rates using a 24-month moving average of new business volumes.
Latest observation: March 2016.
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- … as the charge on excess liquidity shifts the risk-reward calculus of bank s’ portfolio allocation


Note: estimates refer to less vulnerable euro area countries (Belgium, Germany, Estonia, France, Latvia, Luxembourg, Malta, the Netherlands, Austria, Slovakia and Finland)
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- … as the charge on excess liquidity shifts the risk-reward calculus of banks’ portfolio allocation
- … and makes loans more attractive


Note: The chart refers to the sample of banks for which individual bank data is available. Less vulnerable euro area countries are Belgium, Germany, Estonia, France, Latvia, Luxembourg, Malta, the Netherlands, Austria, Slovakia and Finland.
Overview

A Why? NIRP rehabilitates monetary policy in a low rate world
B A simple model exercise: NIRP versus ZLB plus forward guidance
C Transmission
D Financial stability
E Outlook and open issues
Financial stability: A tax on bank intermediation?

Bank profitability and monetary policy: 2014-2017
(contribution to ROA, percentage points)

A calamitous misadventure?

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Multiple channels

- Charge on bank cash is a tax on core banks
- Falling Euribor pressures margins in periphery
- But there are several offsetting factors …
- … and net impact is muted over next few years

Source: EBA, ECB and ECB estimates.
Notes: Deviation from no policy action scenario. Capital gains based on data on a consolidated basis for 68 euro area banking groups under direct ECB supervision and included in the 2014 EU-wide stress test. Euro area figures calculated as the weighted average for the countries included in the sample using Consolidated Banking Data (CBD) information on the weight of each country’s banking system on the euro area aggregate. Effect on net interest income based on aggregate BSI data and obtained by simulation of the interest income and interest expenses based on estimates of the effect of APP on bond yields, lending and deposit rates, excess liquidity and economic growth taking into account BIS projections for interest rates and credit aggregates. Effect on credit quality based on the median of estimates obtained from a suite of empirical studies.
Financial stability: The TLTRO safeguard

Banks’ lending costs and lending margins
(annual percent change)

ECB Constrained optimisation

- **Preserve downward pressure on borrowing costs**
- **But avoid that a tax on banks’ cash hoarding turn into a tax on bank intermediation**

**TLTRO-2**

- Announce series of 4-year lending operations with reward for banks outperforming lending benchmark
- The TLTRO reward calibrated so as to give banks some room for recovering lending margins (purple bars on the left) while keeping lending rates on a declining trend
- In practice: index ex post TLTRO-2 borrowing rate for outperformers to deposit facility rate …
- … and thereby pull down the base rate (light blue bars on the left) off which banks price loans

Sources: ECB calculations.
Financial stability: No property price bubble in sight

Real household loans around starting period of house price booms
(indices, normalised to 100 at T=trough; T=2013Q4)

Real house prices around starting period of house price booms
(indices, normalised to 100 at T=trough; T=2013Q4)

Sources: BIS, ECB and ECB calculations.
Notes: Based on data from 1970Q1 to 2015Q4 for euro area countries. All indicators are deflated by HICP. Projections for euro area are June 2016 BMPE Projections while for countries are December 2015 BMPE projections. Trough (starting point of house price normal increases or booms) identified via quarterly version of Bry-Boschan algorithm by Harding and Pagan, 2002. Dotted line refers to median during house price booms. Grey range refers to interquartile range during normal house price increases.

Sources: BIS, ECB, Fed Dallas, OECD and ECB calculations.
Notes: Based on data from 1975Q1 to 2015Q4 for euro area countries. All indicators are deflated by HICP. Projections for euro area are June 2016 BMPE projections. Trough (starting point of house price normal increases or booms) identified via quarterly version of Bry-Boschan algorithm by Harding and Pagan, 2002. Dotted line refers to median during house price booms. Grey range refers to interquartile range during normal house price increases.
Financial stability: Insurance industry slowly adapting

Projection of solvency ratios under the “adverse” scenario  
(2014-2021; SCR ratio)

Net equity of households in unit-linked and non-unit-linked life insurance  
(2009-2015; EUR billions; percentages)

Source: ECB-DGMF/FSS calculations.  
Note: The solid lines represent the median solvency ratios defined as Own Funds over Solvency Capital Requirements. C.I. is the confidence interval containing the 95% of the simulated solvency ratios for the considered countries.

Source: ECB.
Financial stability: No expropriation of savers in aggregate

Euro area household interest payments/earnings
(as a share of disposable income)

Change in household interest payments/earnings since 2008Q3
(as a share of disposable income, percentage points)

Sources: Eurostat and ECB calculations.
Note: The change has been computed for the period 2008Q3-2015Q4. Interest payments/earnings after FISIM allocation (Financial Intermediation Services Indirectly Measured).
Latest observation: 2015Q4
Financial stability: Policy helps deleveraging

Change in private debt since mid-2007
(as a percent of nominal GDP; percentage point contributions)

The estimated cumulative impact of ECB measures on the euro area private debt in 2015-18
(percentage points)

Sources: Eurostat, ECB, Fed, ONS, Bank of Japan, ECB calculations.
Notes: Corporate debt is defined as the sum of total loans granted to NFCs net of inter-company loans, debt securities issued and pension liabilities. Household debt includes total loans granted to households. Other factors include possible valuation effects and reclassifications. Latest observation: 2015 Q4 for EA, US and JP and 2015 Q3 for DE, FR, IT, ES and UK. The impact of APP on NFCs and HHs debt (RHS) excludes the March 2016 package.
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Outlook and open issues

Government bonds with negative rates
(yields by maturity)

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<td>Norway</td>
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<tr>
<td>UK</td>
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</tbody>
</table>

Source: Deutsche Bank and ECB calculations
Note: Maturities are shown on the horizontal axis. For NL, SE, FR and IT the 1 year maturity refers to T-Bills. The last observation available for NL 1y T-Bill is 18/01/2015 and for SE is 20/01/2016. The last observation for the 2y Government Bond for NO is 18/02/2016. The last observation available for the 3y Government Bond for DK is 12/01/2016 and for SE is 05/02/2015. The last observation available for the 4y Government Bond for DK is 01/2/2013 and for NO is 18/02/2016. The last observation available for the 6y Government Bond for DK is 22/10/2015 and for NO is the 18/02/2016. No observations are available for 6, 8 and 9 years maturity for SE; for 1, 7, 8 and 9 years for DK, and 9 years maturity for the UK. The maturity without observation obtains the same colour as of one maturity below and above, in case these have the same colour or the colour following the yield curve. Latest observation: 26 May 2016.

A calamitous misadventure?

- No. NIRP is a symptom: incidence of negative rates attests to the global nature of the phenomenon
- Safe assets have been decimated during the crisis (especially in Europe), their price has surged
- Two ways to curb excess demand for safety: Let incomes fall or make safe assets very expensive
- NIRP is an efficient way to accomplish the latter
- In the short term, NIRP re-empowers monetary policy, conventional and unconventional
- But, if reflation is retarded, transmission could change in unknown directions:
  - Protracted period of low rates is fertile ground for asset price bubbles
  - Bank disintermediation could proceed faster
  - Insurers could become asset managers
  - Savers could feel more exposed to risk than desired, and de-risk more aggressively
- Fast return of inflation to objective is key to avoiding these risks
Thank you
Goodbye ZLB: Four rate cuts into negative since June 2014

Key ECB policy rates since 2014
(percent p.a.)

- Interest rate on the marginal lending facility
- Interest rate on the main refinancing operations
- Overnight interest rate (EONIA)
- Interest rate on the deposit facility

Sources: ECB, Thomson Reuters.
Latest observation: 26 May 2016.

Money market forward curves
(percent p.a.)

Sources: Reuters and ECB calculations.
Notes: 26 May 2016.
Currency in circulation and income velocity of currency (annual percentage changes (left); multiples of currency in circulation (right))

Estimated negative rate threshold based on cost of cash storage

<table>
<thead>
<tr>
<th>Country</th>
<th>Largest Denomination</th>
<th>Value of 1 Unit of Currency in USD</th>
<th>Estimated Cash Storage Cost</th>
<th>Implied Minimum Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switzerland</td>
<td>1000</td>
<td>1.03</td>
<td>0.2%</td>
<td>-0.5%</td>
</tr>
<tr>
<td>Euro area (DEU)</td>
<td>500</td>
<td>1.11</td>
<td>0.4%</td>
<td>-0.7%</td>
</tr>
<tr>
<td>Denmark</td>
<td>1000</td>
<td>0.15</td>
<td>1.2%</td>
<td>-1.5%</td>
</tr>
<tr>
<td>Sweden</td>
<td>1000</td>
<td>0.12</td>
<td>1.3%</td>
<td>-1.6%</td>
</tr>
</tbody>
</table>

Sources: ECB, ECB estimates.
Notes: Velocity of currency in circulation is defined as nominal GDP over currency in circulation. Nominal GDP is converted to monthly frequency using a cubic spline interpolation.
Latest observation: March 2016.

Sources: Prince et al. (2016).
Notes: Policy rates could likely dip a bit below the storage cost of cash, given factors like the inconvenience of transacting in cash and the spread between policy and deposit rates.

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ZLB: Rate cut has less impact on $E(R_{t+1}^1)$, reduces $\text{Var}(R_{1t+1})$

$R_t^2$ as function of $S_t$: decomposition (top) and relevance of $Q$ (bottom) (percent p.a.)

Sources: ECB computations

Notes: Hypothetical and illustrative example with $\beta = 1.2$ and $\sigma_\pi^2 = 0.25$, and LB=0. Recall that the long-term rate is given as $R_t^2 = 0.5 R_t^1 + 0.5 E(R_{t+1}^1) + Q \text{Var}(R_{1t+1})$. The first row, from left to right, shows the constituting elements as a function of $S_t$: $R_t^1$, $E(R_{t+1}^1)$, $\text{Var}(R_{1t+1})$. The second row shows the full $R_t^2$ as a function of $S_t$ for different levels of $Q$. 

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Option 3: Shifting the LB from 0 to -20 bps

Distribution of short-term rate $R$ next period

Term structure of interest rates (percent p.a.)

Sources: ECB calculations.
Notes: Hypothetical and illustrative example with current short rate $S_t$ equal to -0.2%, $\beta = 1.2$ and $\sigma^2 = 0.25$, and new lower bound LB=-0.2%, hence actual current short rate $R_1^t = LB = -0.2\%$. Expected future short rate $E(R_1^{t+1}) = -8$ bps. Note that the variance is higher than under ‘status quo’ as the distribution is again censored, but less asymmetric (as shadow rate distribution unchanged). It is still lower than under the shadow rate distribution.

Sources: ECB calculations.
Notes: Yield decomposition into expectational component and term premium, with ‘risk aversion’ parameter $\gamma=2$ and $Q=1$. Compared to status quo, yield drops from 3 to -11 bps. Expectational component drops from 2 to around -14 bps (=0.5*(-20-8) bps). Term premium is a bit higher than under ‘status quo’ (3 vs 1 bps) as the variance is the same.
### Summary: Policy options to reduce the LB-induced bias

<table>
<thead>
<tr>
<th>Impact on:</th>
<th>Status quo: LB=0 binding, (S_t = E(S_{t+1}) = -20)bps</th>
<th>Forward guidance</th>
<th>Reduce LB to negative (say -20 bps)</th>
<th>Drop LB (almost) completely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current rate (R_t)</td>
<td>Zero</td>
<td>Zero</td>
<td>-20 bps</td>
<td>-20 bps</td>
</tr>
<tr>
<td>Expected short rate (E(R^1_t))</td>
<td>Above zero (due to probability mass above LB)</td>
<td>Zero (by construction)</td>
<td>Above -20 bps (due to probability mass above new LB)</td>
<td>-20 bps</td>
</tr>
<tr>
<td>Term premium (TP) (Q Var(R^1_{t+1}))</td>
<td>Small (due to low variance of future rates)</td>
<td>Zero (by construction)</td>
<td>A bit higher than in status quo, but lower than under complete LB drop</td>
<td>Higher than in status quo due to higher variance</td>
</tr>
<tr>
<td>Overall long-term rate (R^2_t) = average expected short rate +TP</td>
<td>Higher than zero and intended rate</td>
<td>Zero</td>
<td>Lower - if expectations decrease not outweighed by term premium</td>
<td>Lower - if expectations decrease not outweighed by term premium</td>
</tr>
<tr>
<td>Deviate from rule?</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>QE effective?</td>
<td>A bit</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Negative DFR spurred interbank lending

Overnight interbank lending
(average daily volumes per reserve maintenance period, EUR bn)

Sources: TARGET2, ECB computations
Notes: The counterfactual volumes illustrate how overnight interbank lending volumes would have evolved if the negative DFR was not significantly associated with higher volumes. These counterfactual volumes are derived from a panel analysis of overnight lending volumes as identified in TARGET2. The panel includes daily observations for 14 euro area countries from 1 August 2011 until 8 December 2015. The results of the panel analysis indicate that after controlling for excess liquidity, the width of the standing facilities corridor and country risk, the period during which the DFR was either -10bps or -20bps is associated with overnight lending volumes that are higher on average by 4.1%.
Setting negative policy rates to follow natural rate

Estimated Natural Real Rate of Interest

*(percent p.a.)*

- Natural Real Interest Rate
- Actual (model-implied) 3M Real Rate
- 90% confidence interval

Sources: ECB computations

Notes: The underlying model is an update and modification of Mesonnier and Renne (2007) “A time-varying natural rate of interest for the euro area”, European Economic Review: a small semi-structural macro model with IS curve and Phillips curve and latent processes for NRI and potential growth. The estimated equilibrium real rate is based on a two-sided filtered (“Kalman smoothed”) series. The actual real rate is the model-implied variable, i.e. short-term nominal rate minus model-implied q-on-q expected inflation. Other approaches to compute (ex ante) real rates may lead to different results. Quarterly data, last observation 2016 Q1.
### The 2014-16 measures

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<tbody>
<tr>
<td><strong>Negative rates</strong></td>
<td>MRO: 0.15%:</td>
<td>MRO: 0.05%:</td>
<td>MRO: 0.05%:</td>
<td>MRO: 0.00%:</td>
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<tr>
<td></td>
<td>MLF: 0.40%;</td>
<td>MLF: 0.30%;</td>
<td>MLF: 0.30%;</td>
<td>MLF: 0.25%;</td>
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<tr>
<td></td>
<td>DRF: -0.10%</td>
<td>DRF: -0.20%</td>
<td>DRF: -0.30%</td>
<td>DRF: -0.40%</td>
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<tr>
<td><strong>TLTRO I &amp; II</strong></td>
<td>Fixed rate (MRO)</td>
<td>Max. maturity: Sep. 2018</td>
<td></td>
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<tr>
<td></td>
<td>Uptake depends on net lending</td>
<td>Mandatory early repayment</td>
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<tr>
<td><strong>Private asset purchases</strong></td>
<td>Broad portfolio of simple &amp; transparent ABS and CBs</td>
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<td><strong>APP</strong></td>
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<td><strong>Public asset purchases</strong></td>
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<td>Purchases of EA sovereign bonds</td>
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<td>€60bn of monthly purchases</td>
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<td>“until end-September 2016 and in</td>
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<td>any case until we see a sustained</td>
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<td>adjustment in the path of inflation</td>
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<td>which is consistent with our aim</td>
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<td>of achieving inflation rates below</td>
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<td>but close to, 2% over the medium</td>
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<td>term.”</td>
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</table>
Borrowing conditions eased across markets

Term structure, yields and financial prices since 4 June 2014
(exchange rates and Eurostoxx in percent; else in basis points)

Sources: Bloomberg, ECB, ECB calculations.
Notes: The impact of credit easing is estimated on the basis of an event-study methodology which focuses on the announcement effects of the June-September package; see the EB article “The transmission of the ECB’s recent non-standard monetary policy measures” (Issue 7 / 2015). The impact of the DFR cut rests on the announcement effects of the September 2014 DFR cut. APP encompasses the effects of both January 2015 and December 2015 measures. The January 2015 APP impact is estimated on the basis of two event-studies exercises by considering a broad set of events that, starting from September 2014, have affected market expectations about the programme; see Altavilla, Carboni, and Motto (2015) “Asset purchase programmes and financial markets: lessons from the euro area” ECB WP No 1864, and De Santis (2015) mimeo. The quantification of the impact of the December 2015 policy package on asset prices rests on a broad-based assessment comprising event studies and model-based counterfactual exercises. The impact of the March 2016 measures is assessed via model-based counterfactual exercises. Latest observation: 26 May 2016.
NIRP: Not an instrument of exchange rate manipulation

EURUSD changes following ECB GovC decisions since 2010

Source: Bloomberg, ECB staff calculations.
Note: 1-day percentage change on the day of the Governing Council based on New York closing time.
**NIRP: Not an instrument of exchange rate manipulation**

**G-3 vs ECB-only rate cut to negative levels**
*(daily; basis points and dollars per euro)*

<table>
<thead>
<tr>
<th>Real GDP (% diff. from baseline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
</tr>
<tr>
<td>0.0</td>
</tr>
<tr>
<td>0.1</td>
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<tr>
<td>0.2</td>
</tr>
<tr>
<td>0.3</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal effective exchange rate (% diff. from baseline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
</tr>
<tr>
<td>0.0</td>
</tr>
<tr>
<td>0.1</td>
</tr>
<tr>
<td>0.2</td>
</tr>
<tr>
<td>0.3</td>
</tr>
</tbody>
</table>

**A calamitous misadventure?**

**Why a negative interest rate policy**

- Removes non-negativity restriction on future *expected short rates*: forward curve becomes flatter than it would be if short rates were expected to be constrained by a zero lower bound
- Charges bank cash hoarding: extra downward pressure on long-term rates via *term premium compression* and push to *portfolio shifts*
- NIRP has flattened and stabilized the term structure since 2014
- NIRP has compressed levels and dispersion of banks’ lending rates across euro area …
- … as the charge on excess liquidity shifts the *risk-reward* calculus of bank s’ portfolio allocation
- … and makes loans more attractive

**Zero-sum redistribution of world scarce demand?**

- Multilateral easing *creates* global demand

Sources: National Institute Global Econometric Model (NiGEM), ECB staff calculations.

Notes: Scenario 1 ("G3 rate cut"): EA cut to -0.5%, US cut to -0.1%, Japan cut to -0.5%. Scenario 2 ("EA rate cut"): EA cut to -0.5%, US and Japan unchanged. A decrease in the nominal effective exchange rate indicates a depreciation of the currency, while an increase indicates an appreciation. Peak impact over three years.
**Policy paths since June 2014**

**ECB and FED key interest rates and EONIA**

* (percent)*

- Credit easing measures
- CEPR recessions
- Fed - Federal Funds Target Rate
- ECB - Main Refinancing Rate
- EONIA

Source: ECB, Federal Reserve.
Notes: Main Refinancing Rate (ECB), Federal Funds Target Rate (Fed), EIONIA (ECB).

**Central bank balance sheets**

* (percent of GDP)*

- Credit easing measures
- CEPR Recessions
- Bank of England
- Federal Reserve
- Eurosystem
- Bank of Japan (RHS)

Notes: The ECB balance sheet only comprises assets related to monetary policy.
Exceptional pass-through via bank lending channel

Bank lending rates on loans for non-financial corporations
(Percentages per annum; three-month moving averages)

MFI loans to non-financial corporations in selected euro area countries
(Annual percentage changes)

Source: ECB.
Notes: The indicator for the total cost of lending is calculated by aggregating short- and long-term rates using a 24-month moving average of new business volumes. Latest observation: March 2016.

Source: ECB.
Model-based decomposition of change in median loan-deposit margin for June 2014 to February 2016 (percentage points)

Impact of negative DFR on margins on loans to enterprises (net percentage of respondents indicating an increase)

Source: ECB (BLS).
Notes: The net percentages are defined as the difference between the sum of the percentages for “increased considerably” and “increased somewhat” and the sum of the percentages for “decreased somewhat” and “decreased considerably”. The results shown are calculated as a percentage of the number of banks which did not reply “not applicable”. “EA” denotes euro area.

Sources: ECB, ECB estimates.
Transmission: the macro economy

HICP Inflation, inflation projections and APP/TLTRO contribution (year-on-year percent change)

GDP growth, growth projections and APP/TLTRO contribution (year-on-year percent change)

Source: ECB computations, March 2016 MPE.
Note: The contribution of APP, TLTRO and DFR cut does not include the impact of the measures taken at the March 2016 Governing Council.
Latest observation: April 2016 for HICP inflation and 2016 Q1 for real GDP growth.
Impact of the NIRP on bank lending conditions

Impact of the negative DFR on bank lending to households for house purchase
(net percentage of respondents indicating an increase; over the past and next six months)

Impact of the negative DFR on rates on bank lending to enterprises
(net percentage of respondents indicating an increase; over the past and next six months)

Source: ECB (BLS).
Notes: The net percentages are defined as the difference between the sum of the percentages for “increased considerably” and “increased somewhat” and the sum of the percentages for “decreased somewhat” and “decreased considerably”. The results shown are calculated as a percentage of the number of banks which did not reply “not applicable”. “EA” denotes euro area.
Bank profitability and contributing factors  
(percentages of total assets)

Contributions to the change in net interest income between 2014 and 2015  
(percentages of total assets)

Source: FINREP, ECB.
Notes: Based on data for all institutions under the supervision of the ECB reporting accounting data on a consolidated basis (121 Significant institutions and 168 Less Significant Institutions). These account for around 98 per cent of loans to the non-financial private sector reported for euro area banks in 2015 in the Consolidated Banking Data database. According to this database, banks reporting FINREP data (IFRS and GAAP) account for 90 per cent of total assets reported by euro area banks.

Source: FINREP, ECB.
Notes: Interest expenses are inverted, so that a decrease in costs is shown as a positive contribution to net interest income. Based on data for all institutions under the supervision of the ECB reporting accounting data on a consolidated basis (121 Significant institutions and 168 Less Significant Institutions). Interest expenses are inverted, so that a decrease in costs is shown as a positive contribution to net interest income.
Interest rates on loans and deposits

Loan and deposit interest rates and margins on new business
((percentages per annum)

Distributions of deposit rates to households and NFCs across individual MFIs
(x-axis: deposit rates in percentages per annum, y-axis: frequencies in percentages)

Source: ECB.
Notes: Loan and deposit composite rates are calculated using the corresponding outstanding amount volumes as weights. Latest observation: March 2016.
Low interest rates and banks’ business models

Loan to deposit ratio and level of interest expense
(end 2015 Q4)

Share of interest expenses in assets and share of net interest income in total income
(end 2015Q4)

Sources: ECB, ECB calculations.
Notes: FINREP data for all SI and LSI using IFRS reporting on a consolidated basis. Loan deposit ratios include total loans and deposits to all sectors. Interest expense is as a share of total assets. Horizontal and vertical lines represent median of loan-deposit ratio (0.85) and share of interest expenses in total assets (0.00827) across all euro area institutions. Chart shows banks from 12 of 19 countries.

Sources: ECB, ECB calculations.
Notes: FINREP data for all SI and LSI using IFRS reporting on a consolidated basis. Share of net interest income in total net operating income and interest expense over total assets. Vertical and horizontal lines represent median share of net interest income in total net operating income (0.53) and of interest expense over total assets (0.008) across all euro area institutions. Chart shows banks from 12 of 19 countries.
Reducing incentives for money market activity?

**Euro money market turnover and excess liquidity**
*(cumulative quarterly turnover, billion euro)*

![Graph of Euro money market turnover and excess liquidity](image1.png)

**Volumes in unsecured EONIA and repo market**
*(overnight outstanding amounts, billion euro)*

![Graph of Volumes in unsecured EONIA and repo market](image2.png)

**Sources:** ECB, Euro Money Market Survey.

**Sources:** ECB, EMMI and BrokerTec.
Banks’ short-term issuance with negative rates

STEP volumes by currency
(outstanding amounts, billion euro)

Sources: ECB, STEP.
Hurting the Money Market Fund industry?

Euro area money market funds – major items
(outstanding amounts, billion euro)

MMF holdings of euro area MFI securities by maturity and currency
(outstanding amounts, billion euro)

Sources: ECB, BSI data.
Money Market Fund industry in the euro area

Sales of money market fund shares/units
(12-month flows in EUR bn)

Source: ECB.
Latest observation: March 2016.

Total returns of money market funds
in the euro area
(year-on-year total return in percent)

Sources: Bloomberg, ECB calculations.
Notes: monthly data, latest observation: April 2016.
Money Market Fund industry in other economies: Flow

Inflow and outflow of respective funds to Japan
(billion US$, cumulative flow, 13 March 2013 = 0)

Inflow and outflow of respective funds to Sweden
(billion US$, cumulative flow, 4 January 2012 = 0)

Source: EPFR

Notes: The data is on a weekly basis. The vertical line indicates the introduction of negative interest rate policy or rate changes into the negative territory.