EUROPEAN CENTRAL BANK

BANKING SUPERVISION

Sensitivity Analysis of IRRBB – Stress test 2017

Final results

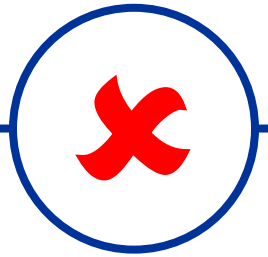
9 October 2017

Stress test 2017 – Interest rate risk is well managed by most European banks

- **Higher interest rates** would lead to **higher Net Interest Income** in the next 3 years for a majority of banks
- Banks heavily **rely on models of customer behavior** which were **calibrated in a declining interest rate environment**
- Results are being used by Joint Supervisory Teams in the SREP, amongst other factors to **adjust the level of P2 Guidance**
- Supervisors will **further follow up on the results** in supervisory dialogues with the banks individually

Overview of topics to be covered/not covered in this presentation

- Recap of **structure**, **objective** and **applied interest rate shocks** of **the Sensitivity Analysis of Interest Rate Risk in the Banking Book (IRRBB) – Stress Test 2017**
- **Aggregate results**
- **Integration** of 2017 stress test results in the **Supervisory Review and Evaluation Processes** (SREP)



- Discussion of **individual bank performance or implications** of stress test results
- Discussion of **methodological questions** or of **specific benchmarks/models**

Overview

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Technical annex

What are the differences between the 2016 stress test and the 2017 IRRBB stress test?

Focus of the presentation

2016 stress test: EBA Stress Test exercise

- **Two** consistent **macro-economic scenarios** (baseline and adverse)
- Testing **multiple risk factors**
  - Credit risk
  - Market risk, counterparty credit risk
  - Net interest income
  - Conduct risk and other operational risks
  - Non-interest income, expenses and capital
- Amongst which **IRRBB partially captured via net interest income**

2017 stress test: IRRBB Sensitivity Analysis*

- **Multiple** heuristic instantaneous **interest rate shocks**
- Exclusively **testing interest rate risk in the banking book (IRRBB)** by focusing on interest income and interest expenses
- With **two perspectives:**
  - **Net interest income (NII)**
  - **Economic value of equity (EVE)**

* The exercise was carried out in compliance with CRDIV requirements for competent authorities to conduct annual supervisory stress tests.

What is Interest Rate Risk in the Banking Book?

Definition

IRRBB refers to the current or prospective risk to the bank's capital and earnings arising from adverse movements in interest rates that affect the bank's banking book positions.

Basel Committee (2016)

Challenge

In the banking book, a bank has to manage both:

i) the stability of the income produced by assets and liabilities;

ii) the stability of the underlying value of assets and liabilities

The main items included in the banking book are loans and debt securities portfolios (assets), and deposits and debt securities issued (liabilities)

Two risk management metrics*

Net Interest Income (NII)

By how much would NII change in response to a change in IR?

Economic Value of Equity (EVE)

By how much would the net present value of the banking book change in response to IR changes?

* The two metrics are discussed in detail in the EBA Guidelines on the management of interest rate risk arising from non-trading activities and in the BCBS Standards on IRRBB

Why is IRRBB measured through two different metrics?

Net Interest Income (NII)

- When IR move, instruments with a **short duration** (e.g. Euribor-indexed loans) drive fluctuations on interest income / expenses
- NII fluctuations are measured over a **limited time period** (usually up to 3 years) assuming no balance sheet growth / reduction

➢ This metric reflects the **effect on earnings of interest rate shifts over a short to medium-term horizon**

Economic Value of Equity (EVE)*

- When IR move, instruments with a **long duration** (e.g. long dated fixed rate bonds) drive fluctuations in the net value of assets and liabilities
- EVE fluctuations capture the **exposure to IR movements over the entire life** of the balance sheet
- EVE also better captures changes in the **valuation of fair value instruments**, such as bonds and derivatives

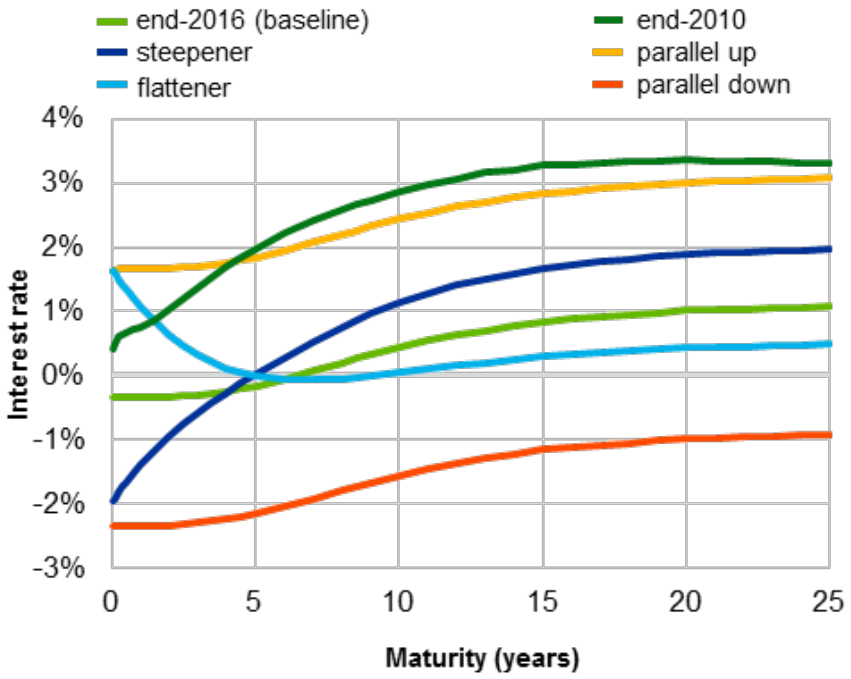
➢ EVE reflects the **effect of interest rate shifts on the value of a bank**

* The Economic Value of Equity excludes capital from the banking book liabilities since fluctuations in the net present value of the banking book are ultimately born by equity investors

What were the interest rate shocks employed in the 2017 Sensitivity Analysis?

EUR Yield curves post interest rate shocks

(x-axis: maturity in years; y-axis: Interest rate in %)



The interest rate shocks are heuristic and purely hypothetical. They do not reflect monetary policy considerations

Six total interest rate shocks

- The *"end-2016"* curve → 'Low-rates-for-long'
- The two regulatory shocks → *parallel up/parallel down* shocks
- Two additional shocks calibrated as per the 2016 BCBS methodology
  - *Steepener* → lower short term rates / higher long term rates
  - *Flattener* → a shock similar to the 2008 post-Lehman episode, e.g. inverted curve
- An *"end-2010"* shock → the interest rate environment before the acute phase of the Euro Area crisis

All shocks calibrated for EUR and relevant major non-EUR currencies (USD, GBP, CZK)

The exercise was carried out smoothly despite the novelty of testing IRRBB on such a scale

Innovative concept to test as a major risk factor

- **Relatively new risk factor**: no precedent for an exercise on IRRBB of this scale (111 significant institutions*) and granularity**
- **Focused exercise**: ~700 data points vs up to 200.000 in 2016
- **Deep dive analyses** of different components driving banks' risks

Substantial Quality Assurance to ensure comparable results

- **Several rounds** of QA completed on time
- In total, SIs received **410** requests for **resubmission** and **652** requests for **clarification**
- Banks addressed the requests rather promptly: **93% of submissions on time**
- A dedicated **ECB helpdesk** addressed 192 FAQs

We thank bank teams involved for overall very good response to the ECB requests!

* The combined number of SIs included in the sample does not equal total number of SIs under SSM supervision, as some exceptions apply (e.g. SIs that are subsidiaries of other SSM SIs, already covered at the highest level of consolidation). Banking book exposures tested in the exercise amount to approximately 70% of sample banks' total assets.

** The exercise methodology for Net Interest Income projections is similar to the one employed by Bundesbank and BaFin in its Low-interest-rate environment survey in 2017 covering German Less Significant Institutions

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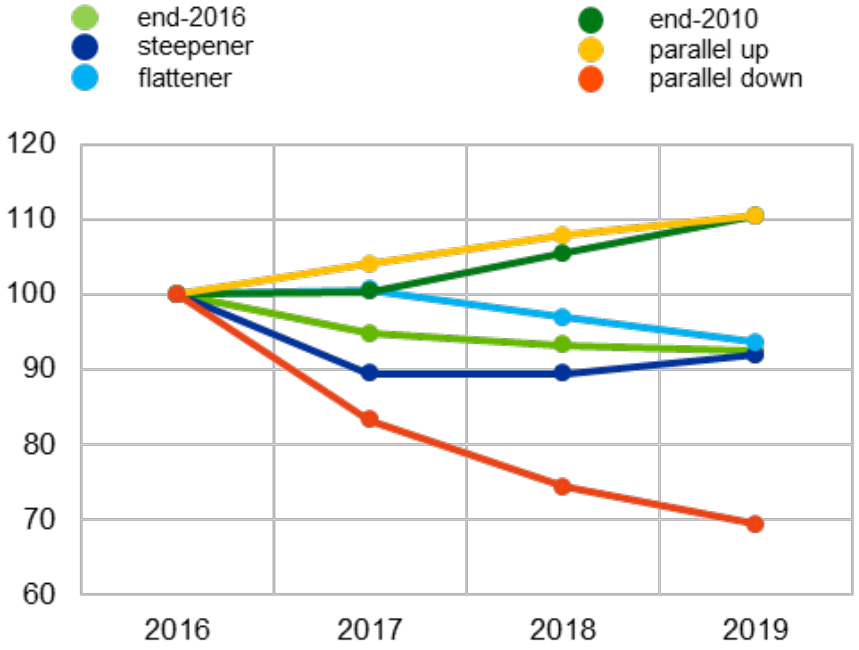
NII would decrease in the current IR environment but it would progressively recover if IR were to rise

Average projected NII 2017-2019 by interest rate shocks
(index 2016=100)

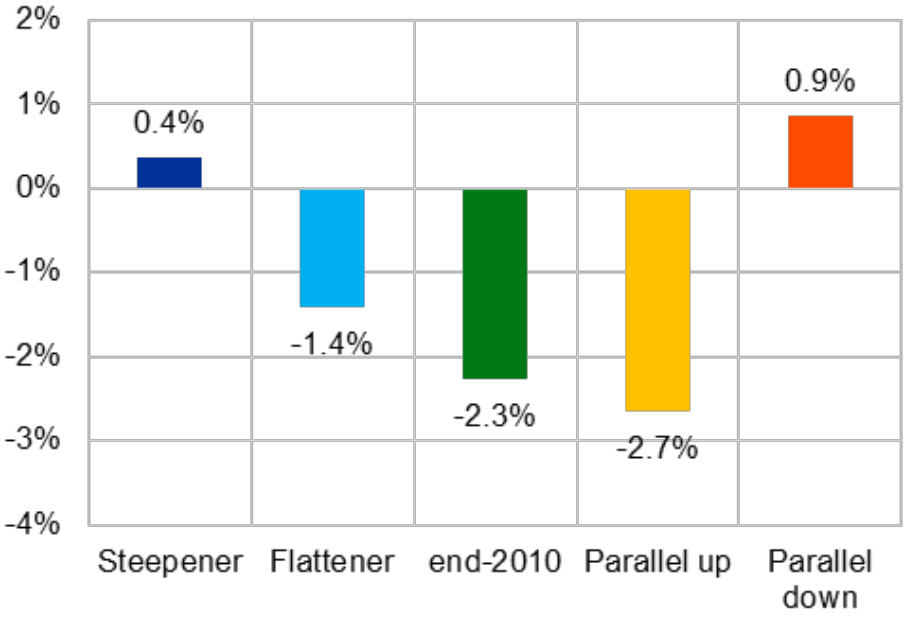


Note: Figures based on Net Interest Income projections aggregated across all major currencies for 111 banks.

- Absent any credit growth (*end-2016*) **NII** would **keep decreasing** in the current **low interest rate environment**
- **NII would decrease** over the next 3 years **under most IR shocks**…
  - The most severe decrease (*parallel down)* is associated to the assumption that retail deposits would not be remunerated below 0%
- …**but NII** would progressively **recover** on average **with an increase in IR**
  - Stable costs of retail deposits constitute a crucial assumption for the increase to take place

Risks under the EVE perspective appear contained on average

Average change in EVE by interest rate shocks
(change in EVE as a % of CET1)



Note: Figures related to aggregate position across all major currencies for the full sample of 111 banks. Average weighted by CET1 capital. In end-2016 (baseline) there is no EVE change. Figures refer to EVE projections including/excluding commercial margins depending on banks' IRRBB measurement.

- **Impact on Economic Value of Equity rather limited** on average
- An **increase in IR would negatively affect EVE** (on average a -2.7% CET1 impact under the parallel up shock)
- Positions are **more heterogeneous at bank-level**

An interest rate increase would be beneficial for NII, but have a negative EVE impact for most banks

Distribution of changes in NII (1-year horizon) **and EVE in parallel-up IR shock**
(% of banks in the sample)

	Delta EVE > 0	Delta EVE < 0
Delta NII > 0	19%	**57%**
Delta NII < 0	4%	20%

NII increase for 76% of banks

NII decrease for 24% of banks

EVE increase for 23% of banks

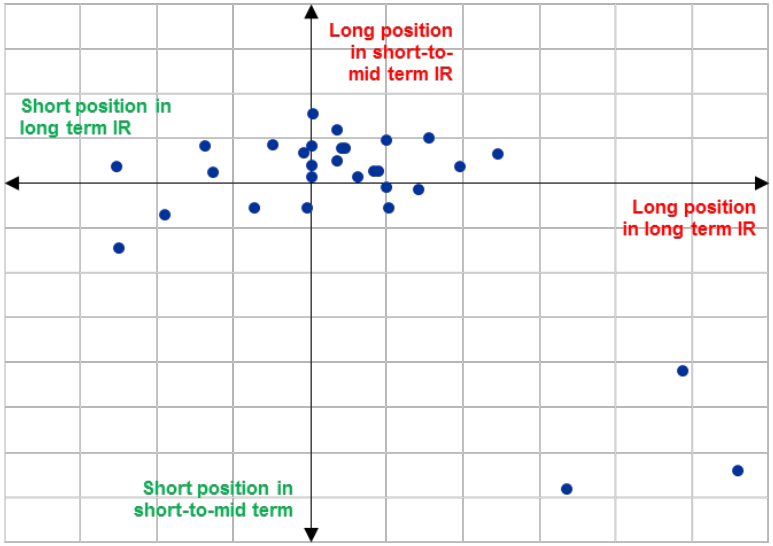
EVE decrease for 77% of banks

- Banks with positive impact on both NII and EVE (19%) are characterized by a large fraction of floating rate loans on their asset side
- Banks with a negative exposure under both profiles (20%) show vulnerabilities related to a hypothetical sudden large IR shock, mostly due to long asset duration (e.g. fixed rate mortgages)

Note: Figures refer to aggregate values across all major currencies

The information collected offers a comprehensive picture bank by bank

Breakdown of bank sensitivity to a +200bps EUR IR shock for the 30 largest Significant Institutions by total assets
(y-axis: short-to-mid term ΔEVE; x-axis: long-term ΔEVE)



Note: For each repricing bucket (e.g. 0-3 months; 3-6 months; etc), the local sensitivity to a +200bps shock has been proxied based on raw gap information. Local sensitivities were computed using the discount rate corresponding to the midpoint maturity of the bucket. Local sensitivities were then aggregated across buckets above and below 5 years and standardized by CET1. The chart refers to EUR positions only for the largest 30 institutions by total assets in the sample.

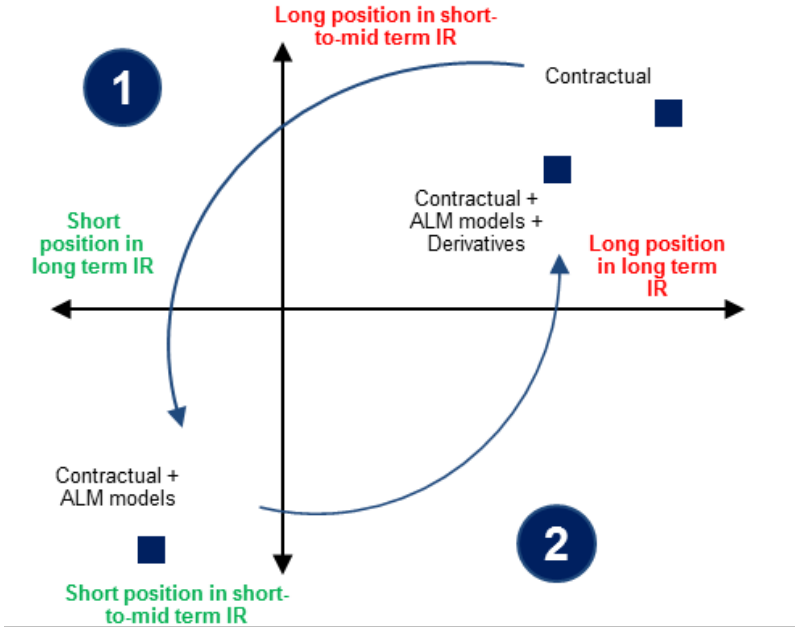
- The proxy representation of the IRRBB position of each bank **distinguishes between exposure to short/medium and long term IR changes** (below and above 5 years)

- **The information will enable supervisors to discuss with individual banks the details of their IRRBB exposure**
- **Follow-up will focus on institutions for which the exercise revealed potential vulnerabilities**

Breakdown between different components shows how banks steer their IRRBB

Breakdown of different IRRBB components for a sample bank

(y-axis: short-to-mid term ΔEVE; x-axis: long-term ΔEVE)



Note: Each point refers to the same bank for which raw gap information over contractual IRRBB; modelled IRRBB and banking book IR derivatives has been used in the computation, as per the methodology described in the previous chart.

Information collected allows to deep dive on:

1. **Customer behavior risk** inherent to the recourse to **ALM models**
2. **Frictions** related to **IR derivatives**

1 The behavior of customers is a crucial input for banks' IRRBB – especially deposits

- The **behavior of banks' customers** can **significantly differ from the 'contractual' features** of the underlying contract
- Banks **use behavioral models** to better measure and manage their IRRBB
- **Deposit models are particularly important**, as deposits are the main funding source of euro area banks

A Non-Maturing Deposits (NMD)

e.g. current accounts

- NMD contracts allow to withdraw balances at will, but depositors tend to keep part of their balances even if IR change
- NMDs are the **most relevant model** (87 banks out of 111 use them)
- Most stable share of deposits (core) is modeled as a fixed rate liability with varying maturity (average repricing profile)

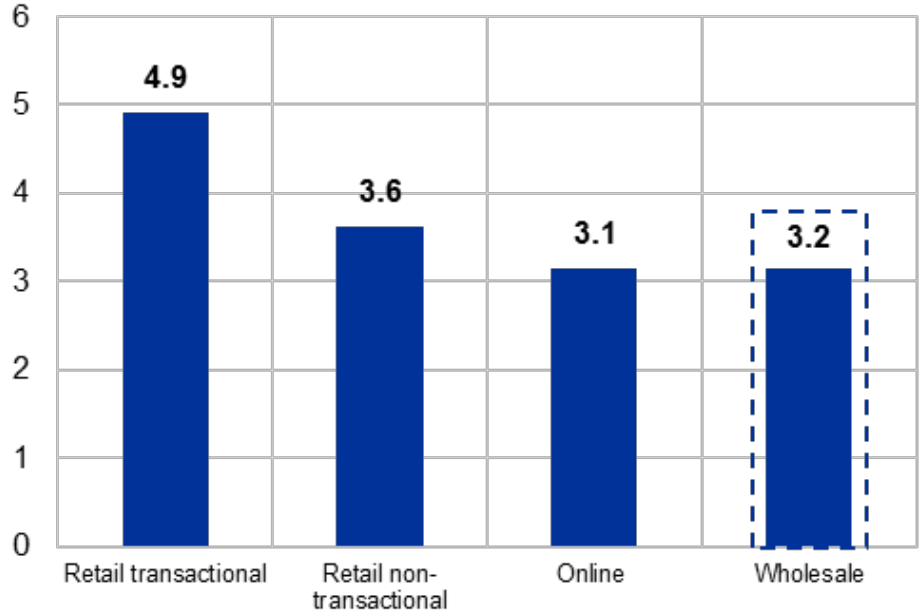
➧ **If NMDs considered as overnight liability, average EVE impact -28.1% CET1 under a +200bps shock instead of -2.7% CET1**

B Loan prepayments

- Borrowers pay back or renegotiate some of their loans ahead of schedule, especially when market rates decrease below loan rates and in jurisdictions where penalty fees are low
- Loan prepayments are the **second most relevant model** (used by 61 banks)
- Models **shorten the duration of some loans**, especially if **long-dated** and **fixed rate** (e.g. house mortgages).
- Without loan prepayments models the average EVE impact in a +200 bps shock would be -11.1% CET1 instead of -2.7% CET1

1A Overview of modelled duration for non-maturing deposits (NMDs)

SSM weighted average repricing profile of core deposits
(duration, number of years)



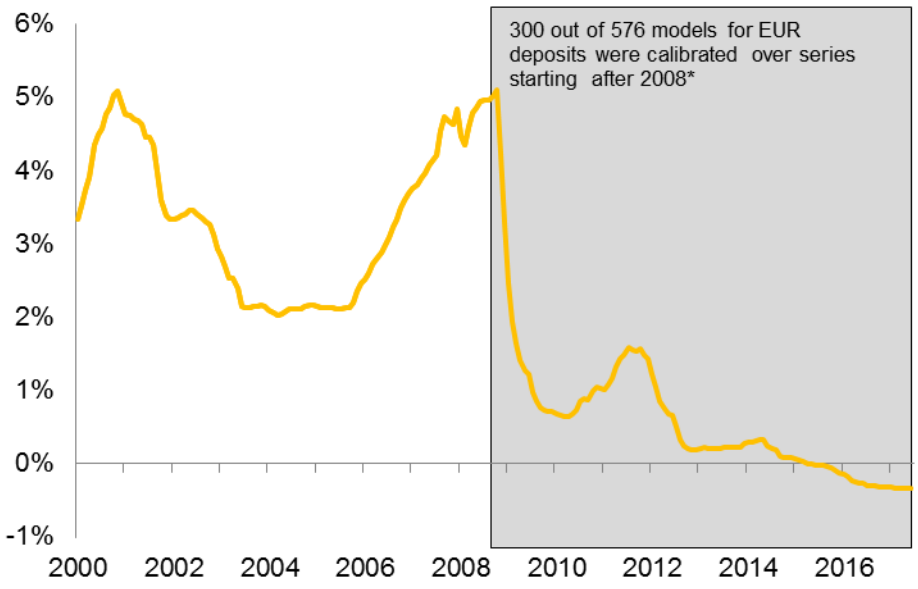
Note: Bars represent the weighted average repricing profile of core deposits (the most stable modelled deposits). Additional statistics are reported in the Technical Annex. EUR positions only.

- **Retail transactional core deposits** exhibit **highest modelled stability** (4.9 years) and with highest share of core deposits (77%)
- **Modelled duration of wholesale core deposits is surprisingly long in some cases**
  - Some banks use the **same calibration** for deposits **for all customer types** suggesting a rather **high-level approach to deposit modelling**

High risk in potentially wrong modelling assumptions will lead to strong supervisory focus

1A Most deposit models have been calibrated on a period of decreasing interest rates only

Evolution of short-term interest rates
(3M Euribor, %)

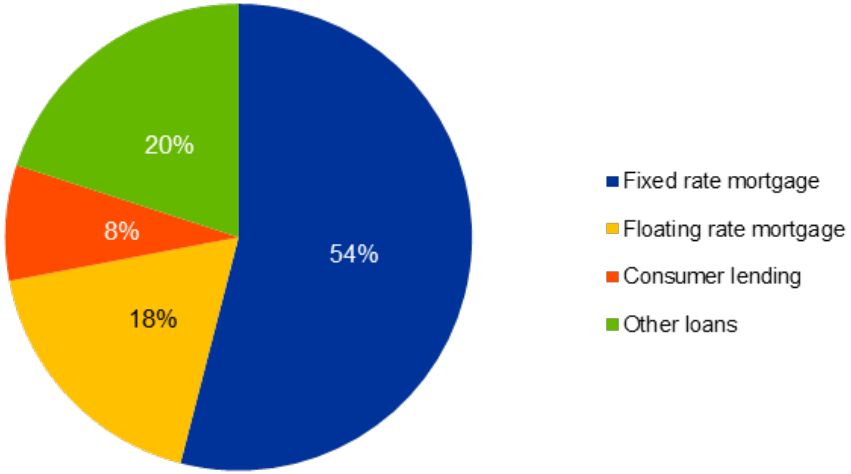


(*) Figures do not include 76 models for which banks did not reported no reference to time series information

- The **majority of deposit models** has been **calibrated over a period of decreasing interest rates only**
- **Only 7%** out of 4.3 trillion of **modelled deposits** take into account the possibility that **deposit stability may decrease with an increase in IR**
- **A wrongly modelled stability of deposits** – and NII projections as a result – **might lead to extensive losses in an increasing rate environment** also in relation to lower transaction costs than in the past (**online banking**)

1B Fixed rate mortgages are the most relevant type of loan prepayment model

Breakdown of modelled prepayment loans
(% share of modelled loans)



Note: Share of modelled loan types across banks reporting information over their loan prepayment models.Different loan types are modelled with different prepayment rates as well as different weighted duration. Additional statistics are reported in the Technical Annex. EUR positions only.

- The prepayment of **fixed rate mortgages** is **modelled** by some **40% of the banks** (46 institutions)
- **Fixed rate mortgages** are the ones for which banks have developed the **most sophisticated modelling approaches**
  - Most of these models **link** the **amount of expected prepayments** to **interest rate levels**

2 Derivatives are crucial for interest rate risk management but they carry risks

- IR derivatives can **serve to mitigate – or 'hedge' – risk exposures** by modifying the duration of financial instruments (e.g. an IR derivative sterilizes impact of interest rate fluctuations in value of a fixed rate bond by shortening its duration: a bank enters into a 'payer-fixed' interest rate swaps in which the fixed rate of the bond is exchanged for a floating one)

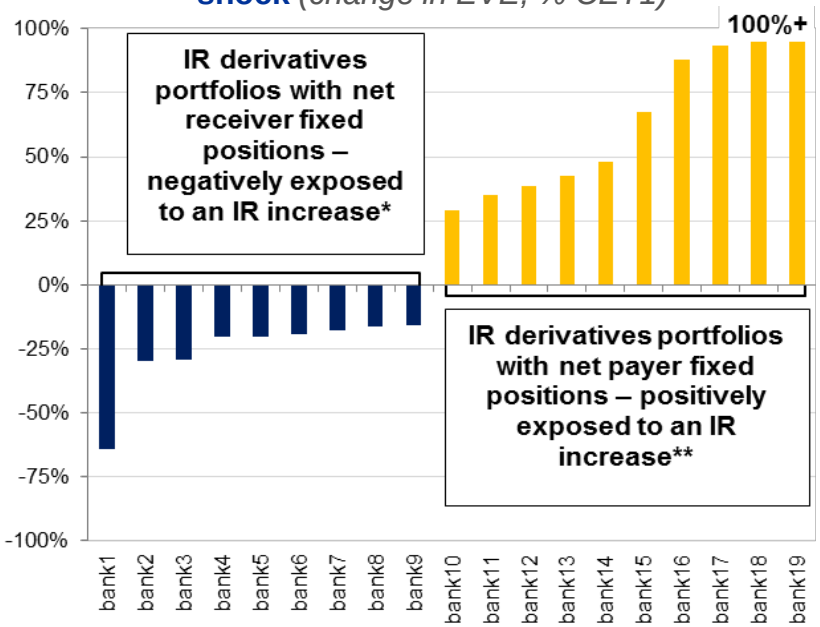
A IR derivatives are an important risk management tool given that banks use IR derivatives **to manage mismatches in the repricing profile of assets and liabilities** (e.g. a bank with very long-dated fixed rate loans and short-term liabilities shortens the duration of its banking book assets by entering into payer-fixed swaps)

B Banks **also use IR derivatives to reach a target IR profile** – a combination of Net interest income stability and Economic Value Equity stability – or even to position themselves in a certain way ("bet")

- Moreover, IR derivatives have **additional risks associated to their use** including:
  - **Counterparty credit risk** – when the contract has a positive value for the bank, the default of the counterparty may lead to credit losses
  - **Replacement costs** – moreover, the bank needs to replace the trades it had with the defaulted counterparty: finding somebody willing to trade on a similar basis may be costly, especially at times of market dislocation
  - **Liquidity risk** – finally, large swings in interest rates could cause the IR derivative to become negative in value, forcing the bank to use part of its liquidity as collateral to its counterparties

2A Interest rate derivatives are a widely used risk management tool

Delta EVE of IR derivatives over CET1 in the parallel up shock *(change in EVE, % CET1)*



Note: Figures based on aggregate projections across all currencies.

(*) Some of these portfolios have large positive mark-to-markets reflecting the positive contribution to NII. The prevailing counterparty of these trades is the banks' own trading book. In one case, some IR derivatives positions were recently closed – at a gain for the bank – in response to changes in their ALM models

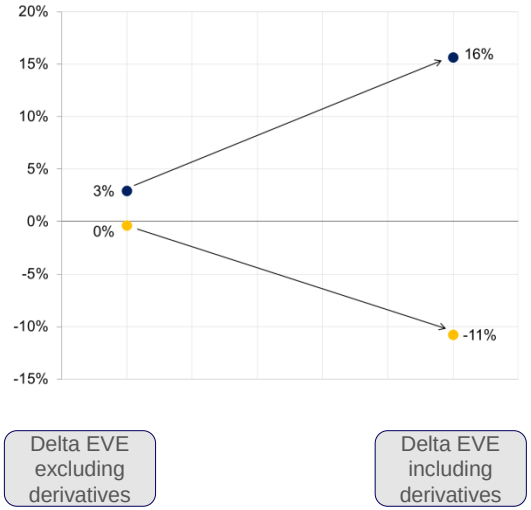
(**) IR derivatives portfolios have a large negative mark-to-market for banks reporting the largest positive sensitivity, reflecting their negative impact on NII. In some cases fair value losses are a multiple of available capital and absorb liquidity (cash collateral) as deals are closed with external counterparties.

- The **vast majority of banks** (97 out of 111) **use IR derivatives**
- The **average weighted EVE impact in a parallel up shock is +1.7% CET1**
  - For **55%** IR derivatives **shorten banking book duration** (net payer-fixed position) – average CET1 impact of +14% for parallel up (+200 bps EUR currency)
  - For **45%** IR derivatives **increase banking book duration** (net receiver-fixed position) – average CET1 impact of -8% for parallel up
- The **average contribution** of banking book IR **derivatives to NII** in 2016 was **negative** (-1.1% of aggregate NII for EUR).
  - Banks with net payer-fixed position: average contribution of -9% of 2016 EUR NII
  - Banks with net received-fixed position: average contribution of +5% to 2016 EUR NII

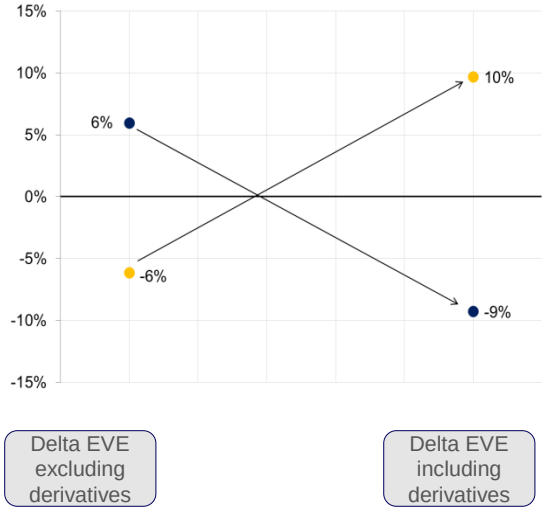
2B Derivatives can significantly change banks' interest rate profile

Real-life examples

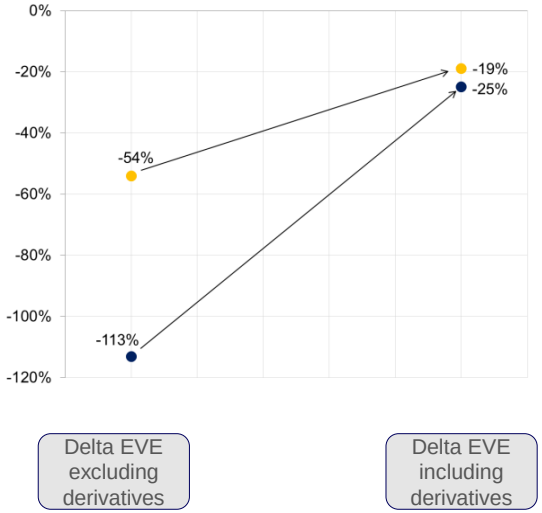
IR derivatives can amplify banks' IRRBB



IR derivatives can overcompensate banks' IRRBB



IR derivatives can undercompensate banks' IRRBB **(hedge a portion of risk)**



Note: Figures represent changes in EVE associated to a parallel up shock with and without IR derivatives: positive figures mean that value of the banking book would increase by % in terms of CET1 in a + 200 bps shock. EUR positions only.

- **The IR positions opened by derivatives help reaching a target IR profile**
- **Supervisors shall assess a) consistency with banks' risk appetite framework and b) adequacy of risk governance**

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The results of the sensitivity analysis have contributed to the overall SREP in several ways

- Quantitative impact of interest rate risk on the **Economic Value of Equity* to adjust up or down the level of 2016 Pillar 2 Guidance**. Three dimensions considered:
  - **Impact of the IR shocks excluding parallel up and parallel down** (already assessed in SREP as part of IRRBB review)
  - Exposure to **customer behaviour risk**
  - Risks related to **mark-to-market fluctuations** of banking book IR derivatives

- **Qualitative information** (data availability, timeliness, quality) as well as **quantitative information** (impact of interest rate risk on **Net Interest Income**) were used to **enrich P2R and qualitative measures**

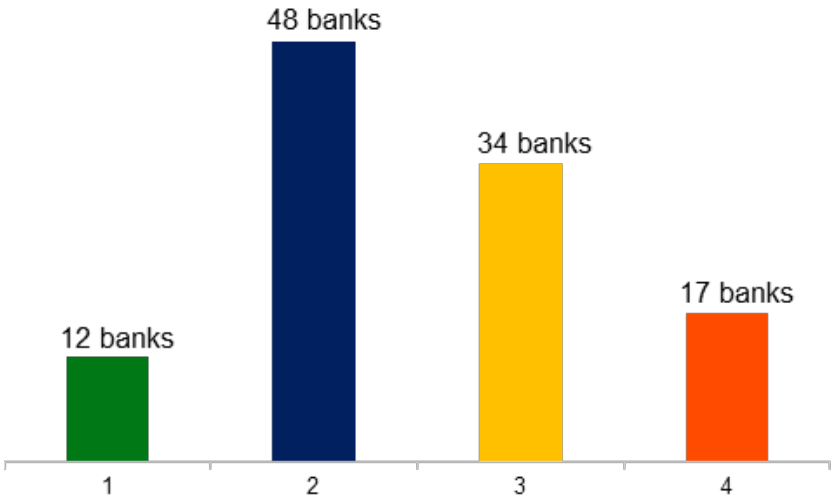
Incorporation of results ensured no double-counting

* Not captured in the interest rate risk component of 2016 Stress Test

Results related to Economic Value of Equity informed the calibration of Pillar 2 Guidance

- The **Pillar 2 Guidance (P2G) starting point** reflected supervisory **risk assessment** including results from the last **EU-wide 2016 stress test**
- In the Sensitivity Analysis of IRRBB – Stress Test 2017, **anchoring scores from 1 to 4** were used by **JSTs to adjust P2G in a +25/-25 bps range**
- **In addition**, JSTs have taken into account **other information sources to adjust P2G**, e.g.:
  - Special circumstances regarding IRRBB
  - New developments from firm-wide ICAAP stress tests if relevant
  - Horizontal analyses

Anchoring scores informing P2G adjustments
(x-axis: bank score)



Aggregate final P2G levels will be disclosed later in the year

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Key takeaways

- Focused exercise with **smooth processes** and banks delivering on time
- Results show that – on average – **banks are equipped to cope with changes in the interest rate environment**
  - **Higher interest rates** would lead to an **increase in Net Interest Income** for most banks even though **Economic Value of Equity would decrease** on average
- Banks heavily **rely on models of customer behavior which were calibrated in a declining interest rate environment** and as such they might bear high model risk
- Banks use **derivatives for hedging but also for "positioning“**
- Results are being used by Joint Supervisory Teams in the SREP, amongst other factors to **adjust the level of P2 Guidance** and enrich P2R and qualitative measures
- Supervisors will **further follow up on the results** focusing on a) Modelling of depositor behavior; b) Use of interest rate derivatives; c) Consistency of IRRBB positions and practices with risk appetite/governance frameworks

Follow-up activities will be led by individual JSTs in the coming months

Dedicated meetings with banks are supported on demand by SSM IRRBB specialists

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Overview of Non Maturing Deposits models

	Repricing maturity of core deposits (years)	Share of core deposits over modelled deposits (%)*	Pass through rate under a +200 bps IR shock (%)**	Total amount modelled NMDs
Retail transactional	4.9	77%	11%	€1.9 trillion
Retail non transactional	3.6	68%	40%	€1.5 trillion
Online accounts	3.1	57%	44%	€0.1 trillion
Wholesale deposits	3.2	55%	35%	€0.9 trillion
Sample average / total	**4.1**	**69%**	**27%**	**€4.5 trillion**

Note: Aggregate information related to the full sample of 111 significant institutions. Each institution was asked to report the five most relevant deposit models for each of the four categories above. Information is related to EUR positions only.

(*) For the purpose of the exercise, Core deposits were defined as the stable part of NMDs which is unlikely to reprice even under significant changes in the interest rate environment (BCBS IRRBB Standards definition).

(**) For the purpose of the exercise, the expected pass-through rate was defined as the proportion of a market interest rate change that the bank will pass on to its customers in order to maintain the same level of stable deposit balances under a certain IR shock. Banks were asked to measure the pass-through rates in response to a shift in interest rates over a one-year time horizon.

Overview of loan prepayment models

	Duration before modelling (years)*	Duration after modelling (years)*	Conditional prepayment rate (%)**	Total amount modelled loans
Fixed rate mortgages	7.6	5.6	7.5%	€1.9 trillion
Floating rate mortgages	0.8	0.7	4.3%	€0.5 trillion
Consumer lending	2.8	2.1	14.3%	€0.3 trillion
Other loans	4.4	3.3	5.4%	€0.7 trillion
Sample average / total	**5.5**	**4.1**	**7.1%**	**€3.5 trillion**

Note: Aggregate information related to the full sample of 111 significant institutions. Each institution was asked to report the five most relevant loan prepayment models for each of the four categories above. Information is related to EUR positions only.

(*) The weighted duration of the modelled loan refers to the weighted average remaining time until repricing in years before and after application of the model.

(**) The conditional prepayment rate (CPR) is measured as the share of outstanding modelled loans that is expected to be renegotiated or paid back within one year under the current interest rate environment.