



EUROPEAN CENTRAL BANK

EUROSYSTEM

# Banking Sector Stress test design(s) at Corona times

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The views expressed are those of the author and do not necessarily reflect those of the ECB.

# Overview

- 1** A unique and multifaceted crisis, also for banks
- 2** A structured review of 3 banking system-wide stress tests
- 3** A stronger case for (macro) Reverse Stress Testing

## 1.1 Corona crisis – one of its kind

- **Specific features (eg IMF WEO June 2020)**

Not initially financial – not the GFC, financial side impacts still substantial

Severity, from lockdowns – largely unseen, GFC dwarfed-like

World-wide spread – truly global, no secure areas

Trade, coming to a halt – both external and internal

Sector-specific hits (services) – tourism, leisure, transportation...

Policy measures unprecedented – prompt, varied fiscal + monetary + financial, with coordinated moves

- **What is next ??? Still ongoing, even restarting, uncertainty issue!**

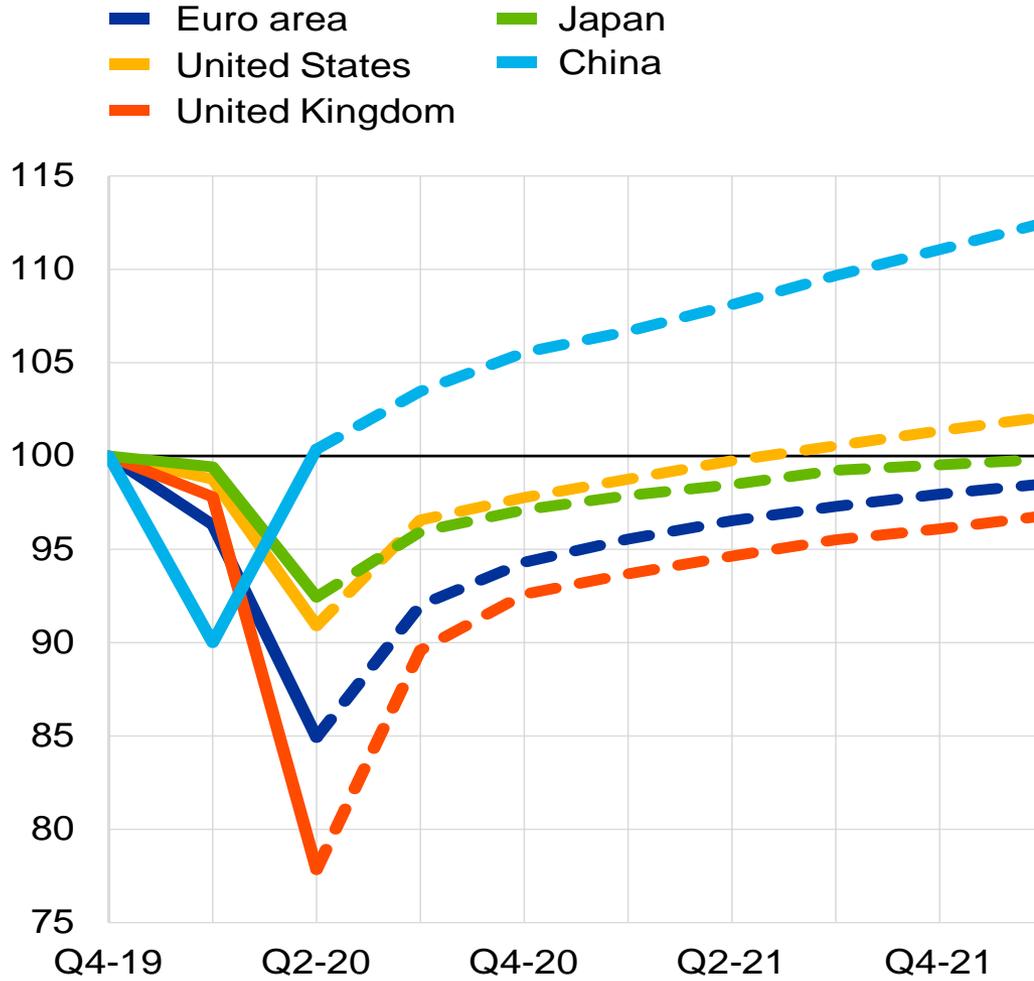
Unknown unknowns, huge uncertainty – eg virus transmission / cure, real side profile going forward, alphabet soup (K, W, ???), banking ???

# 1.2 GDP unseen falls across the world – major revisions to forecasts

## Real GDP growth path and expectations

Q4 2019=100

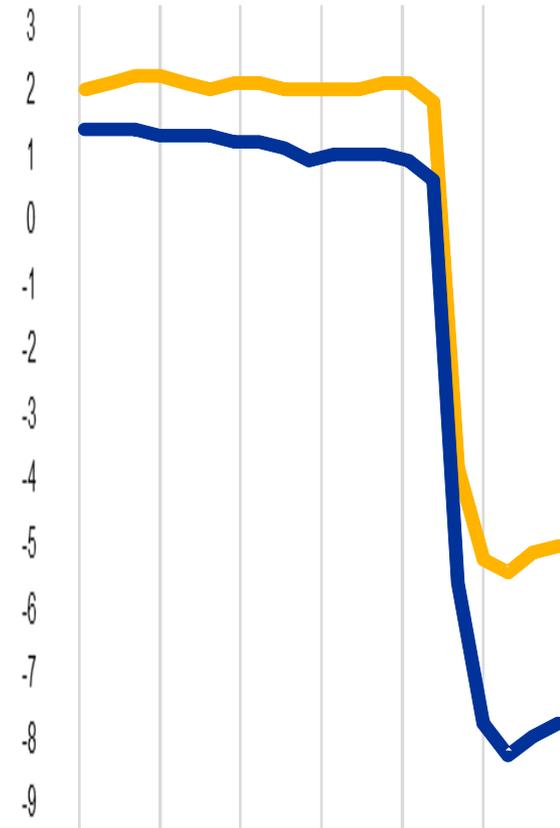
Bloomberg



## Sequence of 2020 GDP growth expectations

(EA and US, %) Jan-2019 to Jul-2020

Consensus Economics



## 1.3 Prompt, huge and varied policy responses – GFC lesson learnt

- **Monetary policy** – funding short-long, asset purchases, stabilisation
- **Fiscal policy** – unemployment / furlough, targeted support sectoral + SMEs grants, loan guarantees, recovery funding plans (EU-wide too)
- **Financial policy** – moratoria, CCyB releases, relaxation of regulatory constraints, capital relief

### Objectives:

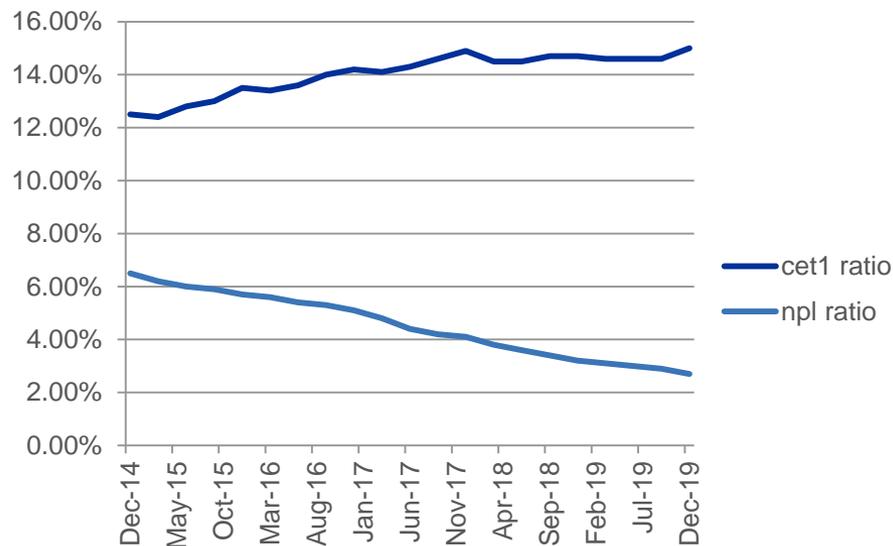
Cushion the shock – broad-based labour income; targeted for companies

Avoid amplification, esp. via financial intermediation

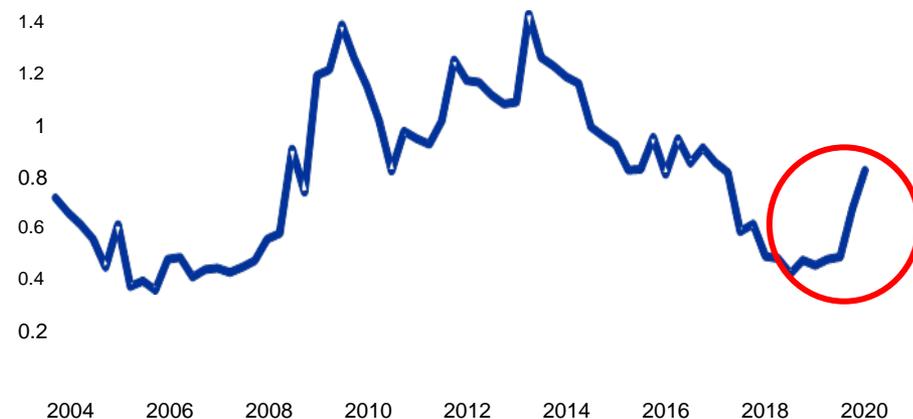
In particular contain 2<sup>nd</sup> round effects from banks' weakened solvency prospects; preserve sufficient credit supply to accompany a recovery

## 2.1 Banks resilience – OK for now, not least thanks to post-GFC reforms

EU banks' Capital and NPL ratios – source EBA



Euro area banks' provisions to total loans ratio – source ECB



**Banks resilient, to date** – far stronger positions than pre-GFC times !

Continuous improvements in solvency and defaulted loans... 'til now.

**Provisioning just up** – possibly not commensurate to what may come ?

**No deleveraging, as yet** – possibly stronger pressure ahead...

## 2.2 Quantifying the impacts, tentatively – textbook case for stress-testing

- **Textbook case for a (system-wide) stress test**

forward-looking scenario exercise under (possibly very) adverse conditions

- **3 major authorities with a “special” Corona Stress Test**

Reviewing jointly these 1<sup>st</sup> reactions to assess possibly common features



BANK OF ENGLAND



Assessment of Bank Capital during  
the Recent Coronavirus Event

June 2020

Interim Financial  
Stability Report

May 2020

COVID-19 Vulnerability  
Analysis

Results overview

28 July 2020

## 2.3 Aligning Stress-test design features with specific purposes

(Source: BIS *FSI Insight #12, 2018*)



Illustrative mapping between stress test features and the exercise focus

Key features	1. Macroprudential	2. Microprudential	3. Risk-specific
<b>Governance</b>	Central bank	Supervisor	Not critical
<b>Implementation</b>			
Exercise severity	Not critical	Not critical	Stronger on specific areas
Scenario coverage	Systemic risks	Also idiosyncratic risks	Specific risk factors
Bank coverage	Systemic banks	Broad-based	Specifically exposed banks
Information granularity	Contained	Extensive	Granular for that risk
Top-down / bottom-up	Top-down favoured	Bottom-up helpful	Not critical
Dynamic vs static B/S	DBS favoured	SBS sufficient	Not critical
Second-round effect	Explicit account favoured	Not critical	Not critical
<b>Outcomes</b>			
Results disclosure	Aggregate	Bank-level	Risk-specific metrics

Orange cells indicate that a given decision on a (horizontal) feature is guided by a specific approach in response to a (vertical) perspective dimension.

Source: FSI. Entries in the table are based on FSI staff interpretation of authorities' practices.

## 2.4 Special features of these Special issues ST – eg the ECB (inter alia)

- **Top-Down rather than Bottom-Up** – ECB Model-based work, usually used for microprudential ST Quality Assurance purposes or macroprudential exercises as reported in the ECB FSR
- **3 scenarios** – ECB macro projections and EBA 2020 baseline (pre-Corona); easier with a TD approach to run many alternative scenarios
- **Severity re-gauged** – well beyond previous CEBS-EBA-SSM exercises; baseline coming closer to a stress environment already
- **Impacts of policies** – (via scenarios, but not only) IFRS9, TLTRO, Guarantees... WIP by construction as new steps may / will come...
- **Publication of aggregates – no bank-level info**, no direct link to supervisory review, hence closer to a macroprudential approach

**Further extensions towards a risk-specific approach** – ad hoc granular data, sector-specific focus, business model deeper dive, etc.

## 3.1 One step beyond, Worst Case Scenario and Reverse Stress Tests

- **Severity with a new “extreme + plausible” benchmark replacing GFC ?**

Extreme (Worst Case) Scenarios, up to Reverse Stress Testing (eg BoE), with methodological challenges – identification of drivers, probability algebra...

- **Definition:** generic inversion of the ST (not necessarily extreme shocks)

$$Output = ST [ Input ] (1)$$

Find  $\{Inputs\}$  such that (1) holds for a given *Output*

- Micro RST for **recovery / resolution planning** – what can go really wrong

Micro ST (bank) = Bank failure vs Macro ST (SYSTEM) = Outcome

**3 Options:** (scalar approach, full Monte Carlo, combination of factors)

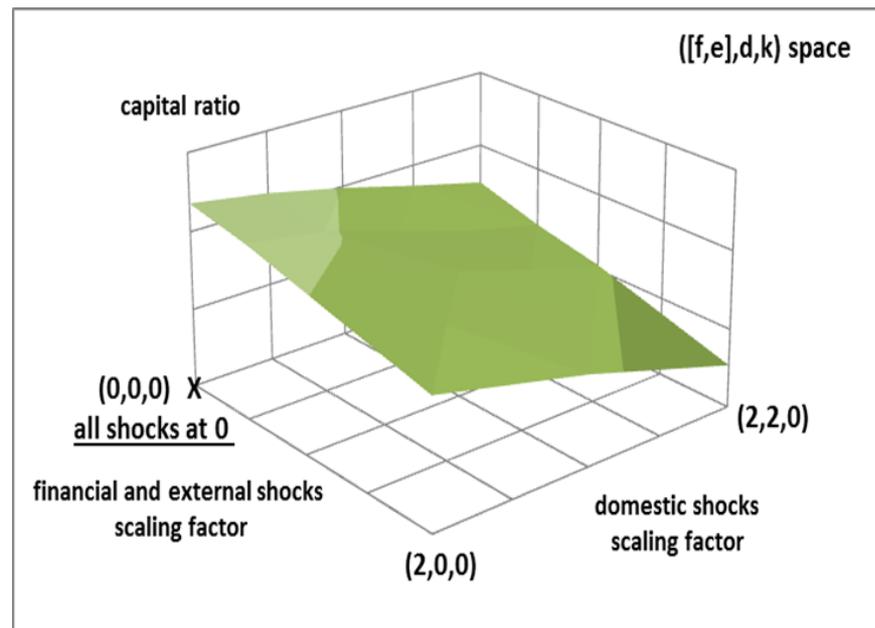
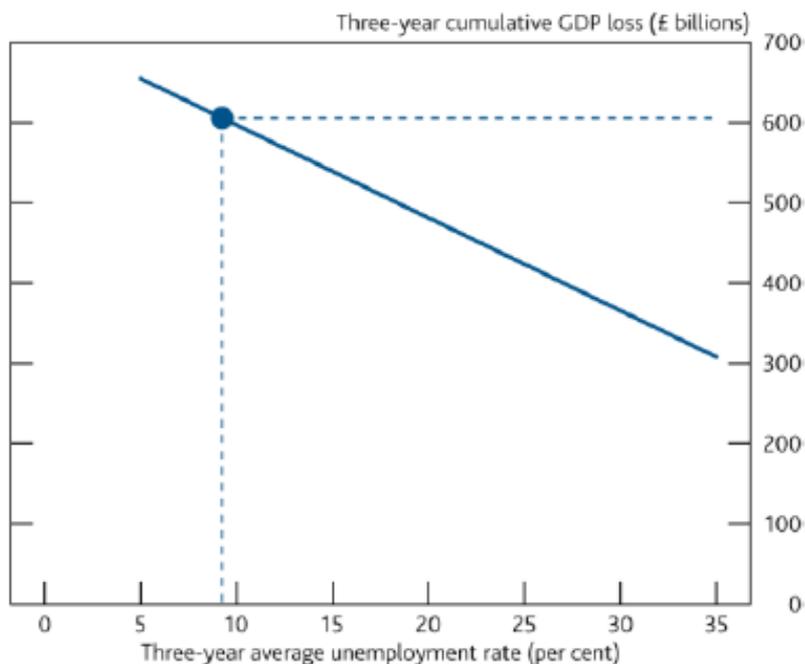
## 3.2 Computational method – risk-based vs random scenario generation

- **Option 1:** take a given scenario post-RI and push to extreme – homothetic / scalar approach (on a single factor or group thereof)
  - Pros – narrative, linked to exercises, trackable
  - Cons – not capturing the unknowns (event, correlation, proba...)
- **Option 2:** Experiment with no ex ante identified risks – many (eg Monte Carlo) simulations needed, as no priors
  - Pros – no priors nor gaps, unknown unknowns (still a bounded list)
  - Cons – identify / select drivers ex post, heavy modelling
- **Option 3:** Mixed strategy, ie combine groups of factors with a variety of shocks at alternative probability levels
  - Pros – related to the RI but not bound by it, room for unknowns
  - Cons – still need proba considerations to ex post select scenario(s)

### 3.3 Illustrative visualisations of RSTs – eg BoE and own simulations

- **LHS: BoE results** illustrate that many combinations of GDP and unemployment shocks would yield the same capital depletion – an increase in one offsetting a decrease in the other
- **RHS: Experiments with EU bank data** for more shocks are similar, stronger (financial/external) shocks make up for weaker domestic shocks – full surface of outcomes shown in the 3D chart

Shocks to GDP and unemployment that could result in the same level of capital depletion as in the 'reverse stress test'<sup>(a)</sup>



# Conclusions

- **Resilience to date, shocks not within the banking sector**

External shock of limited impact on banks, stronger position wrt GFC, short-lived hit via financial markets, help from broad policy responses

- **More to come – not out of the woods**

2<sup>nd</sup> wave health and real side shocks, expiration of policy effects and policy themselves, lagged (adverse) impacts on P&L and capital...

- **Pin down uncertainties / play with parameters – update results**

- Be in a position to run and analyse assessments frequently and promptly; integrated approach.
- Stress test toolkit to analyse and assess alternative baselineS; consider also a range of models and configurations
- Severity and risk factors vary, up to Reverse Stress Testing – challenging methodological and<sup>13</sup> interpretation issues...

## Background slides – and references

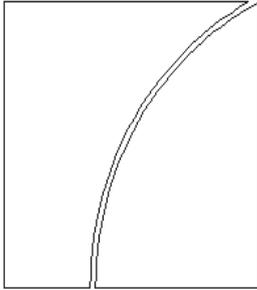
- Baudino et al 2018, FSI Insights #12, BIS
- Dees et al Eds 2017, Stamp€, ECB
- Henry 2020, “Reflections on macroprudential reverse stress testing”, forthcoming in Bellini et al, “Reverse stress testing in banking”, De Gruyter

**Publication** late November 2018

**Authors** BoJ, ECB, FRB, SNB, FSI

- **Granular survey on 4 jurisdictions**  
*(with a detailed stand-alone Annex)*
- **System-wide, banks, solvency ST**
- **Key features, mapped to policy**
- **Drivers to authorities' choices**
- **Lessons and best practices**

<https://www.bis.org/fsi/publ/insights12.pdf>



Financial Stability  
Institute

FSI Insights  
on policy implementation  
*Forthcoming*

Stress testing banks – a  
comparative analysis

By Patrizia Baudino, Roland Goetschmann,  
Jérôme Henry, Ken Taniguchi and Weisha Zhu

November 2018

JEL Classification: E37, E44, G10, G21, G28  
Keyword: stress test, macroprudential, microprudential



**BANK FOR INTERNATIONAL SETTLEMENTS**

# B2 Microprudential and Macroprudential SST – Bottom-Up / Top-Down

(BIS FSI survey 2018)

- In the **euro area, Japan and Switzerland**, authorities also run next to their supervisory exercises **additional exercises that are *primarily* macroprudential**
- These follow a **top-down approach** ie results are generated by the authority with their models, not based on banks' models

	Macroprudential Objective	Microprudential Objective
Top-Down Approach	(2) Euro area ECB Macroprudential Top Down (MTD) ST (3) Euro area ECB Macroprudential Extension (MPE) ST (6) JP Bank of Japan (BoJ) ST (8) and (9) Swiss Building Block Analysis (BBA) – Large Bank (LB) and Domestic Focused Bank (DFB)	4) US Dodd-Frank Act Stress Test (DFAST) (5) US Comprehensive Capital Analysis & Review (CCAR) (8) and (9) Swiss Building Block Analysis (BBA) – LB and DFB
Bottom-Up Approach		(1) Euro area Single Supervisory Mechanism ST (SSM) (7) Japan Financial Services Agency (JFSA) ST (10) Swiss Financial Market Supervisory Authority (FINMA) ST

## B3 Literature – selected pieces, WCS morphing into RST...

- *Cihak 2004* **key concepts** (macro, **WCS** vs metric threshold, equiprobability ellipsoids and loss curves)
- *Breuer 2009* **WCS trade-off loss-probability** explored w/ tech steps (Mahalanobis probabilistic distance, respective individual risk factor contributions, expected conditional values for non-calibrated shocks)
- *Abymomounov 2011* **range of impacts** for each scenarios w/ a certain likelihood, **WCS** = highest lower band at a given frequency
- *Breuer 2013* entropy vs hand-pick **scenario selection** (Min distance to a reference **distribution**) – variety of examples incl. macro ST
- *Pritzker 2012* defines **Metrics system-wide** (Constrained) Max Stress
- *Glassermann 2014* introduces **RST** definition, applies to **equities**, picks the most likely **Max ES** - given a set of shocks (also w/ **tail** adjustment)

### MICRO

- *Grundke 2012 WCS* for banks **BU vs TD – (interaction across risks)**
- *McNeil 2012, RST* for banks (MLRuinE), from **single factor to combination**
- *Nyberg 2013 RST process* for banks based on a **BU approach**
- *Grundke 2017 Stress Macro* impacts a bank PF, **PCA** to use less (YC) factors
- *Flick 2019 / Tracucci 2019 – optimisation* algorithms/ **non-linear P&L**

### MACRO

- *Dridi 2015 RST Banking system* losses – GDP and IR impact on VaR for CR
- *Kapinos 2015 TD RST banking system* w/ ex ante **PCA on macro variables**
- *Flood 2019 RST macro* w/ ex post **PCA** as a rank reduction device
- *Breuer 2018 large model*, scenario selection – risk vs plausibility
- *Baes 2020 stochastic simulations*, focus on Market Risk and Contagion

## An ECB e-book, staff tools for “macropru ST”



### STAMP€:

#### Stress-Test Analytics for Macroprudential Purposes in the euro area

Edited by Stéphane Dees, Jérôme Henry  
and Reiner Martin

February 2017

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### Macroprudential stress tests: A new analytical tool

Vitor Constâncio  
22 February 2017

*The Global Crisis and its aftermath led to greater use of stress tests and to the establishment of macroprudential policy as a new policy area. In this column, ECB Vice-President Vitor Constâncio introduces new suite of analytical tools that support the design and calibration of macroprudential policy. The tools go well beyond the requirements of the traditional solvency stress tests applied to banks, and include a broader set of institutions than just banks, an analysis of the financial cycle, as well as an assessment of systemic risk levels associated with the economic and financial shocks considered in adverse scenarios.*

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**Related**

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<http://www.ecb.europa.eu/pub/pdf/other/stampe201702.en.pdf>

## B6 Linking outcomes and probabilities – a la Cihak 2004

Equi-proba and equi-capital loci – single factor results and WCS

1. As expected, for any given capital “target”, there exist **combinations of factors with higher probability** than the single factor scenario.

2. An “**optimal**” combination can be identified, maximising probability on a given **equi-capital line**; this is the **conditional WCS** (*Flood, Cihak, Breuer*)

3. For capital below 8%, the **WCS combination implies increasingly less severe (ie more probable) shocks** to factors than the single factor scenario.

