La Estadística y Mercados Financieros

Session IV

Stress-testing banks

Objetivo:

Conocer los ejercicios de pruebas de estrés en el sistema financiero

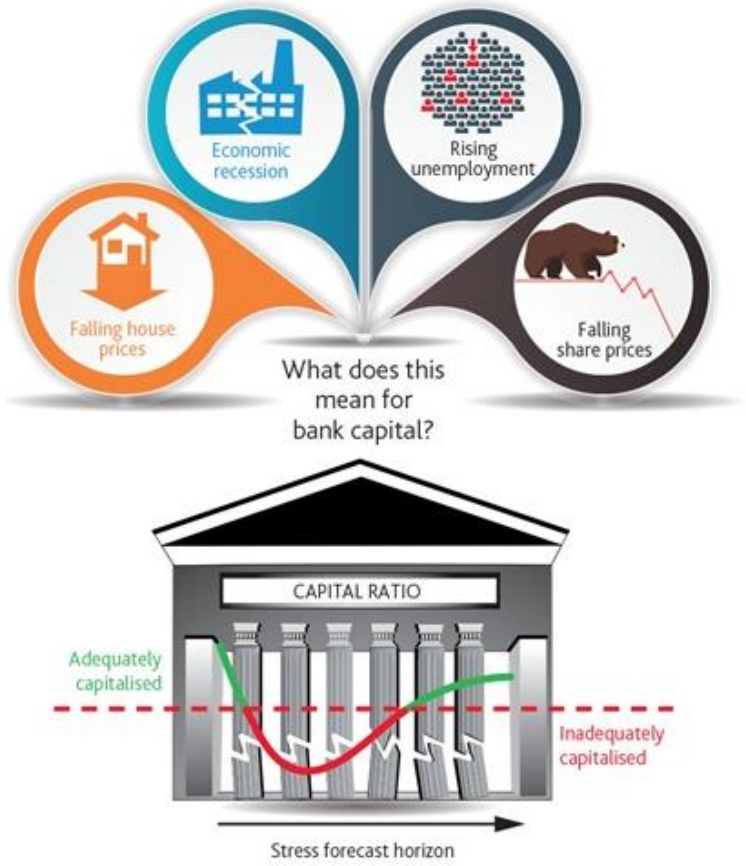
*In response to the **Covid**-19 pandemic, a number of authorities that regularly conduct **stress tests** on individual **banks** adjusted their approach. ... It may also help authorities to achieve the necessary balance between keeping **banks** safe and sound, and ensuring an adequate flow of credit to the real economy.*

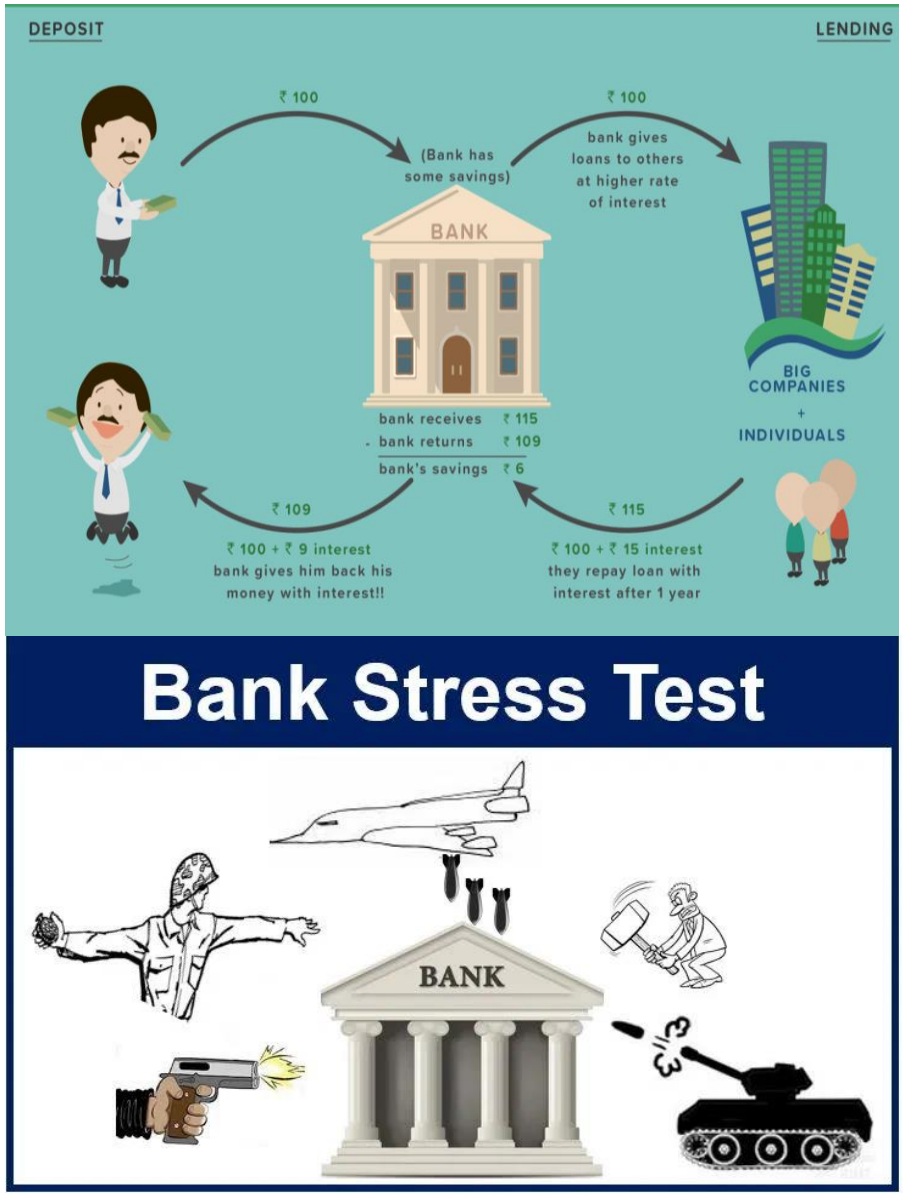
Agenda

What are stress tests?

Modelling approaches and methodologies

One of the goals of stress-testing is to determine whether banks have sufficient capital





What is the difference among IFRS9, Basel AIRB and stress testing?

	IFRS 9	AIRB	Stress Testing
Purpose	Better accounting guidance to manage credit risk than IAS39	Risk Management tool to measure credit risk	Ensure Bank remain solvent in drastic economic conditions
Published by	IASB	Basel Committee	Basel Committee
Time Horizon	12 months/ Life Time	12 months	2 – 3 years 4 – 5 years
Model	ECL = PD*LGD*EAD	RWA =f(PD,LGD,EAD,…) Required Capital = 10.5% * RWA	KPIs = f(PD, LGD,EAD, Stressed Macro Factors)

Stress-testing banks

- Stress tests have become well established tools for authorities to assess the resilience of individual banks and of the banking sector, especially since the Great Financial Crisis* (GFC).
- Sector-wide stress tests differ widely in their design and implementation.
- Stress tests can have a microprudential or macroprudential policy objective.
- Stress tests are most effective when their design is fully aligned with the policy objectives associated with them.
- However, stress tests are no panacea, and are best used in combination with other tools.
- Stress testing is being continually improved, and further developments could help to enhance the implementation and the policy use of stress tests.

*Financial crisis of 2007–2008: The financial crisis of 2007–2008, also known as the global financial crisis (GFC), was a severe worldwide financial crisis. Excessive risk-taking by banks combined with the bursting of the United States housing bubble caused the values of securities tied to U.S. real estate to plummet, damaging financial institutions globally, culminating with the bankruptcy of Lehman Brothers on September 15, 2008, and an international banking crisis.

What are stress tests?

- For the banking sector, stress tests are simulation exercises conducted to ***assess the resilience*** to a hypothetical scenario of either a single bank or the system as a whole.
- Stress tests that **address bank solvency** have become an important supervisory and policy tool.
- Stress tests can fulfil a variety of policy objectives.
- While stress tests have gradually become mainstream, it is important to keep in mind their limitations.

A brief history of stress testing

1990s

- The first use of stress tests can be dated back to the early 1990s, when they were mainly run by individual banks for internal risk management purposes.

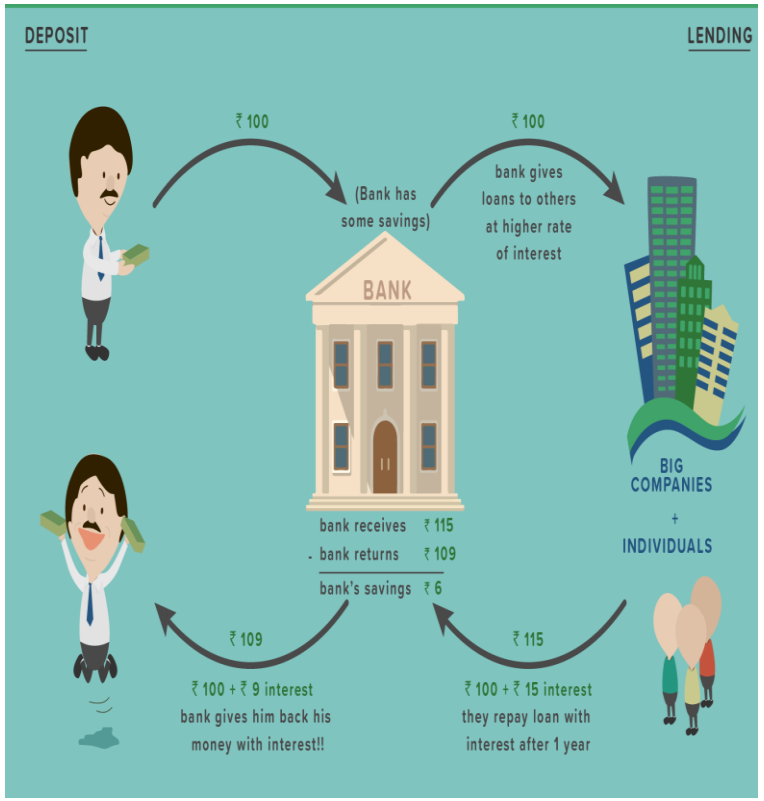
1999-2018

- System-wide stress tests, led by authorities, were introduced by the IMF and the World Bank, prior to the GFC.
- Increasing attention was drawn to stress testing during the GFC, and authorities in the United States and the European Union in particular used stress tests in their crisis response.

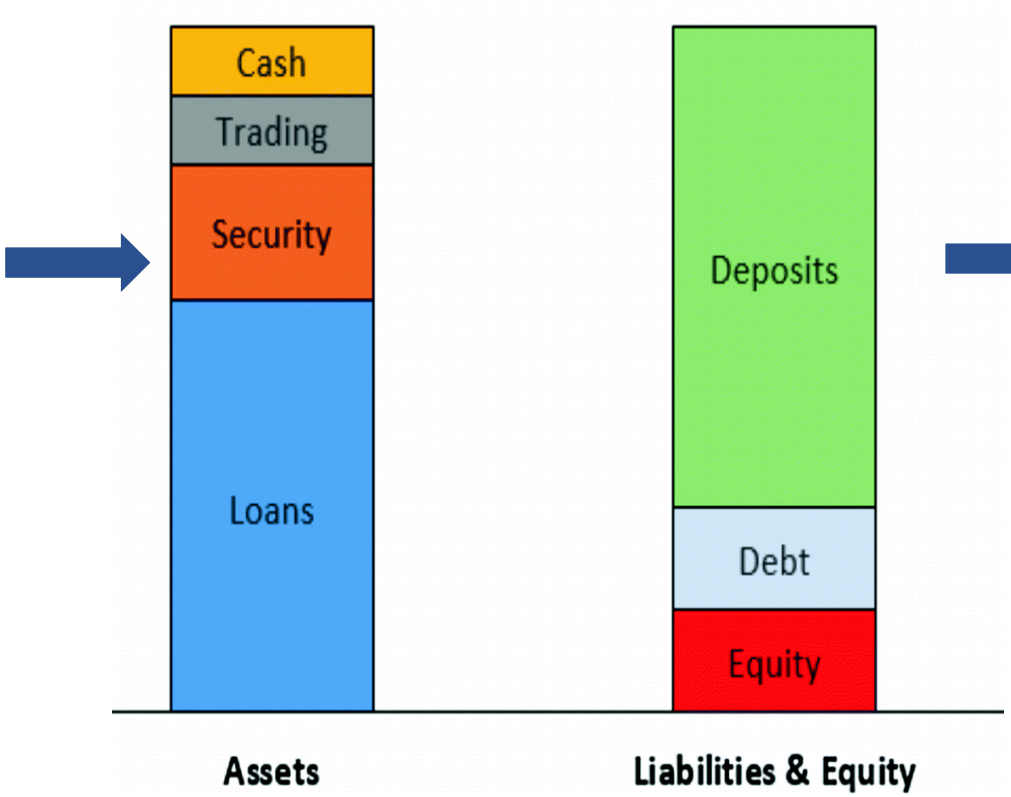
Now

- System-wide stress tests have been conducted on a regular basis
- Therefore, there is now a wide body of experience and a substantial literature on stress testing.

How the does a bank work?



Balance Sheet



Income Statement

Non-interest Revenue
Interest Revenue
Total Revenue
Credit loss provisions
Net gain on trading assets/liabilities
EBIT
Interest Expense
Income Before Tax (EBT)
Taxes
Net Income

https://corporatefinanceinstitute.com/resources/knowledge/accounting/financial-statements-for-banks/

Balance Sheet

Concepto	Total Banca Múltiple
	202012
ACTIVO TOTAL	11,113,540
Disponibilidades e inversiones en valores	3,913,280
Cartera Total	5,161,426
Cartera Vigente	5,041,383
Comercial	3,325,241
Consumo	754,571
Vivienda	961,571
Cartera Vencida	120,043
Comercial	47,513
Consumo	39,260
Vivienda	33,270
Estimación de reservas	*-181,788*
Otros activos	2,220,622
PASIVO TOTAL	9,926,020
Captación Tradicional	6,248,460
Préstamos Interbancarios	350,668
Otros pasivos	3,326,892
CAPITAL CONTABLE	**1,187,520**
IMOR total (%)	2.33
IMOR comercial	1.41
IMOR consumo	4.95
IMOR vivienda	3.34

Income Statement

Concepto	Total Banca Múltiple	
	202012	
	Año en Curso	Mes en Curso
Ingresos por intereses	827,453	62,913
Gastos por intereses	313,037	20,612
Margen financiero	514,415	42,301
Estimación preventiva para riesgos crediticios	**157,636**	**14,482**
Margen financiero ajustado por riesgos crediticios	356,779	27,819
Comisiones netas	95,068	9,248
Gastos de administración y promoción	388,937	37,238
Resultado del negocio tradicional	62,910	-171
Resultado por intermediacion	38,610	3,736
Otros ingresos netos	918	956
Resultado neto	***102,438***	***4,521***

Source: CNBV Mexico SERIES HISTÓRICAS (AJUSTADAS PARA EFECTOS DE ANÁLISIS) Y CALIFICACIONES CREDITICIAS DE BANCOS / https://www.cnbv.gob.mx/Paginas/PortafolioDeInformacion.aspx
Montos en millones de pesos

Conducting a comparative analysis requires defining a few relevant concepts.

In terms of degree of severity, a scenario can be described as either “baseline” or “adverse

- **Baseline scenario**: a set of economic and financial conditions that is generally consistent With the projection of a likely path for **future economic** and financial conditions. The baseline scenario usually does not lead to a stressed result.

- **Adverse scenario**: a set of economic and financial conditions which is designed to stress the performance of the banking sector or an individual bank. The level of stress is significantly stronger than in a baseline scenario. Stress factors could be drawn from historical events or hypothetically created.

In terms of policy objectives, a stress test can be classified as “macroprudential” or “microprudential”:

- **Macroprudential stress test**: a stress test designed to assess the system-wide resilience to financial and **economic shocks**, which may include effects emerging from linkages with the broader financial system or the real economy. Interactions between individual banks can also be taken into account.

- **Microprudential stress test**: a stress test designed to assess the resilience of an individual bank to macroeconomic and financial vulnerabilities and respective shocks. Instruments, mechanisms and measures available to the supervisor are usually applied at the bank level.

Conducting a comparative analysis requires defining a few relevant concepts.

In terms of who performs the exercise, a stress test can be either "top-down" or "bottom-up"

- **Top-down stress test**: a stress test performed by a public authority using its own stress test framework (data, scenarios, assumptions and models). Either bank-level or aggregated data may be used, but always in models with consistent methodology and assumptions, *generally developed by the authority*.

- **Bottom-up stress test**: *a stress test performed by a bank using its own stress test framework* as part of a system-wide exercise, or as part of a stress test where authorities provide banks with common scenario(s) and assumptions.

in terms of balance sheet projections, they can be described as "dynamic" or "static"

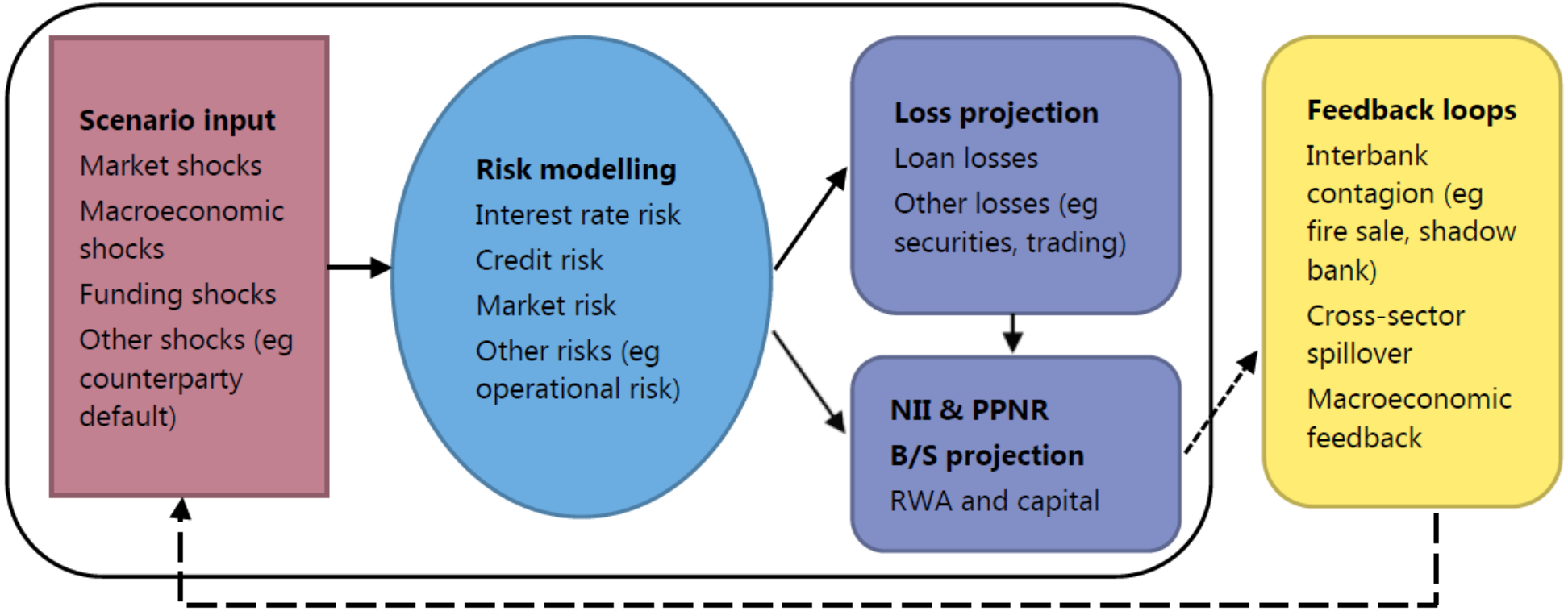
- **Dynamic balance sheet (DBS):** an assumption that the size, composition or risk profile of a bank's balance sheet are allowed to vary over the stress test horizon.

- **Static balance sheet (SBS):** an assumption that the size, composition and risk profile of a bank's balance sheet are invariant throughout the stress testing time horizon.


Project income (9 quarters into the future)
Project balance sheets (9 quarters into the future)
Project Loan Loss (9 quarters into the future for 15 loan types)
Project capital
Project operational risk
Stress Testing must produce information that will:

Modelling approaches and methodologies

In general, a stress test is composed of various modelling blocks, which interact with one another to produce the overall results. Key modelling aspects include risk coverage, granularity of data input and risk representation, translation of macro shocks to micro risk drivers, extent of dynamic projections, inclusion of behavioural reactions, as well as consideration of system-wide interactions and endogenous contagion



NII = net interest income; PPNR = pre-provision net revenue; B/S = balance sheet; RWA = risk-weighted asset.

Source: FSI staff.

Modelling blocks and their interaction have evolved over time, becoming increasingly more numerous and sophisticated

Modelling and Market Factors

Leading Examples techniques

- Swaps and Sovereign Curves (term structure models for interest rates): **Principle component approach**

- Stock Market Returns, Historical and Implied Volatilities: **Time series model with conditional heteroskedasticity and Global Equity Factor (GEF) related to global economic conditions**

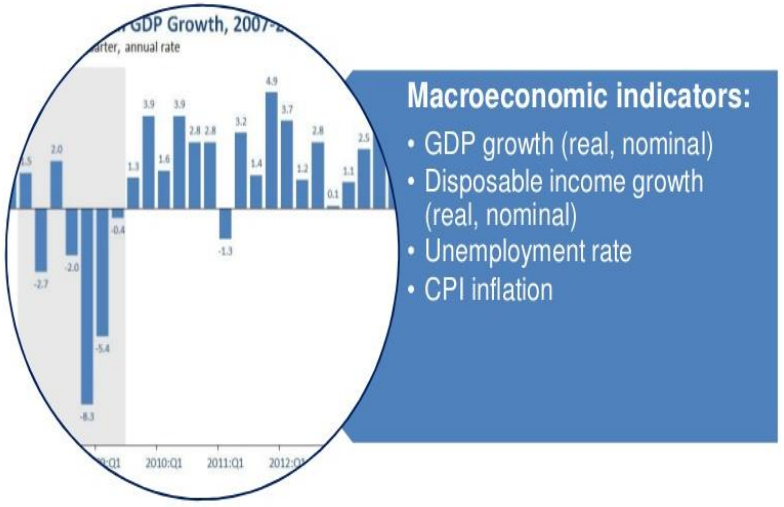
- Mortgage-backed Securities: Agency and Non-agency: Term structure models with GEF and prepayment factor
- Corporate CDS and Corporate Bond Spreads by Sector and Rating Category: **Time series model with Global Credit Factors, combined with principal component analysis**

- Sovereign CDS by Country and Maturity: **Time series model with long memory, combined with principal component analysis**

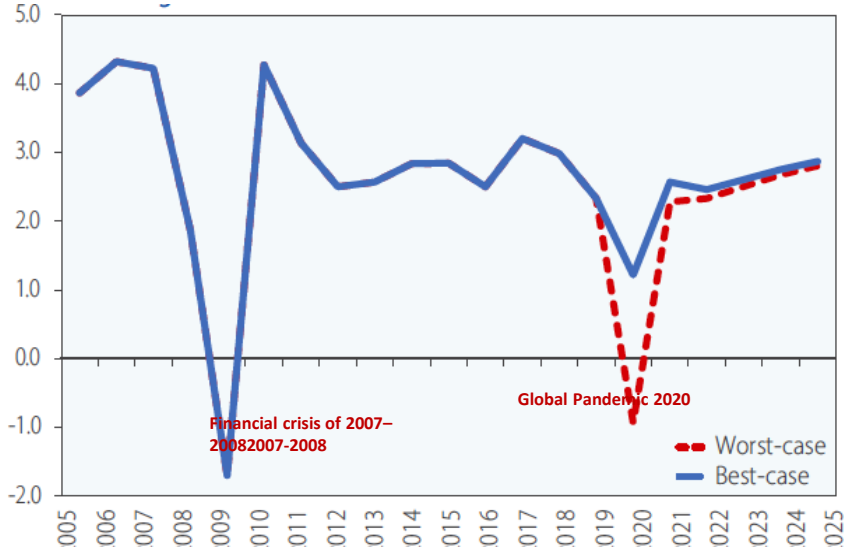
- Credit Migration: Transition matrices for credit portfolios, two-stage approach: **(i) discrete-choice model combined with (ii) quantile and time-series analysis**

- Retail exposures models**: traditional approach (logistic regression) and Machine learning**

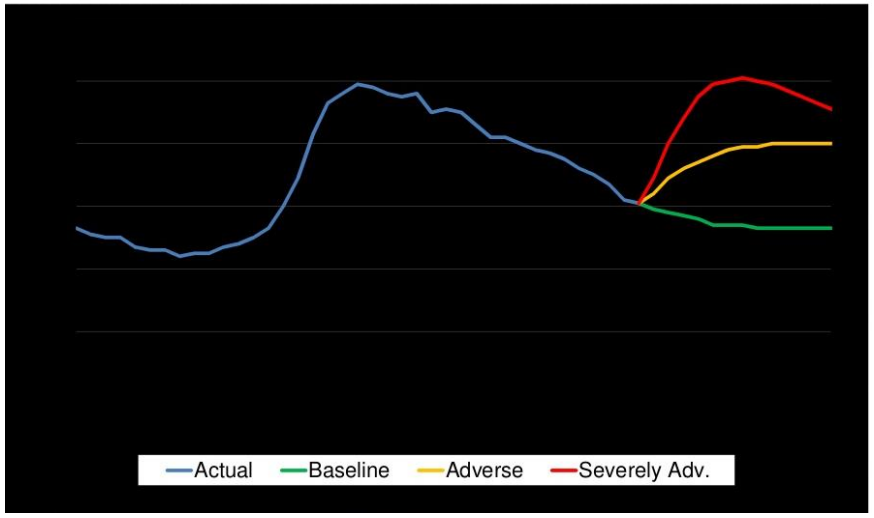
Macro Indicators



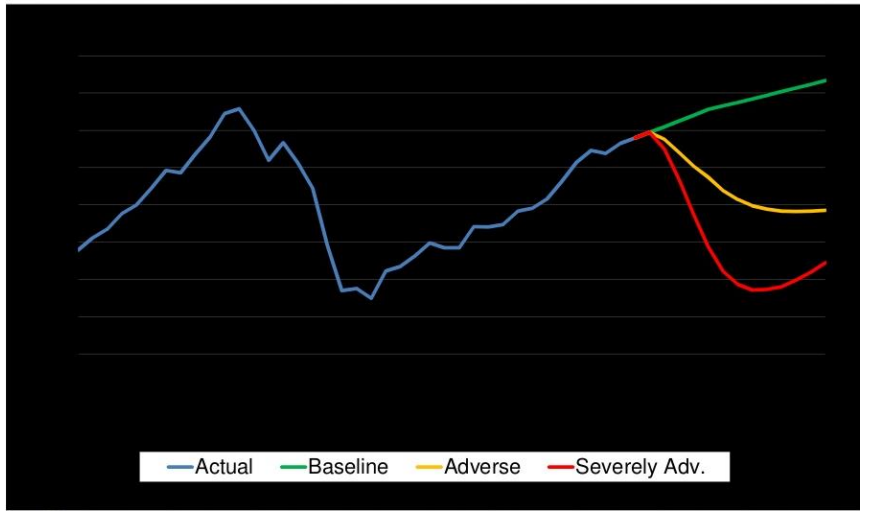
World growth outlook for 2020 in the best and worst-case, as of late of March 2020



Unemployment Rate



Commercial Real Estate Price Index

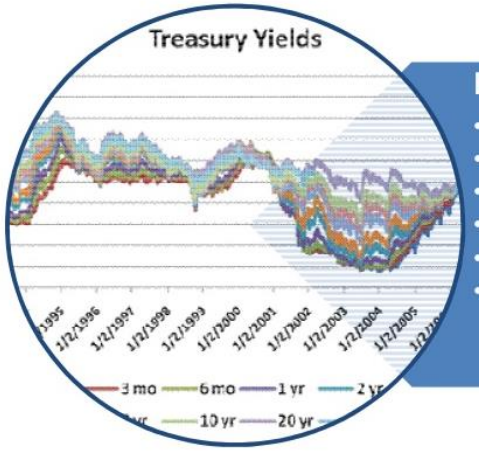


Market volatility Indices

Market Volatility Indices

- Dow Jones Total Stock Market Index
- Market Volatility Index (VIX)
- Home Price Index
- Commercial Real Estate Price Index

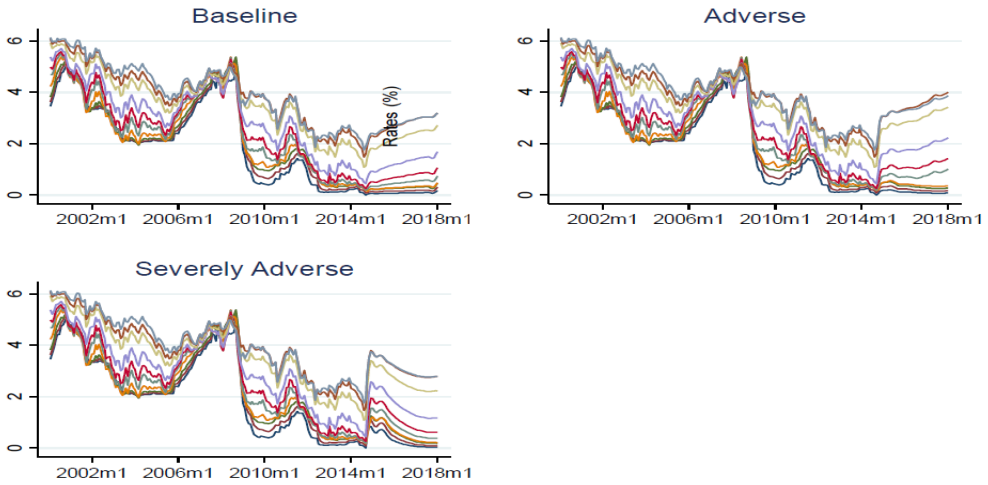
Yields



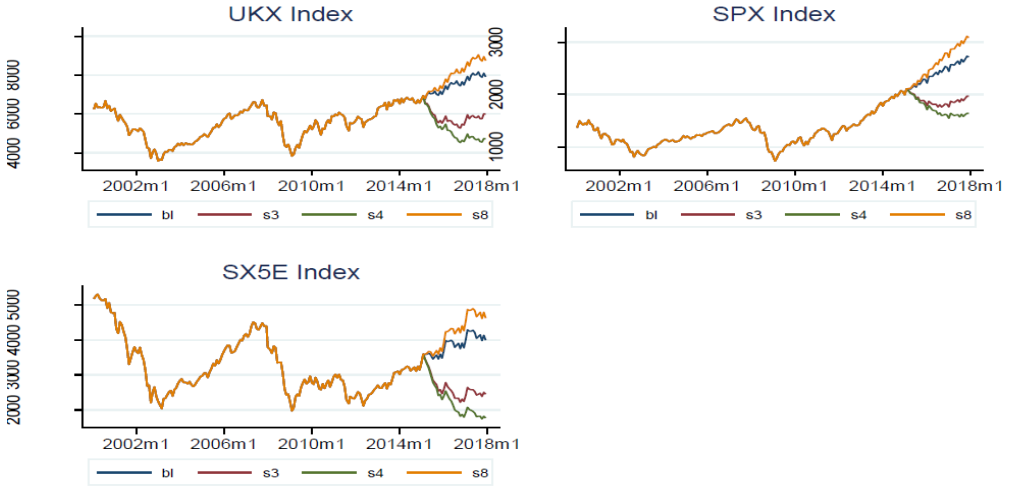
Benchmark Yields

- 3-month Treasury Yield
- 5-year Treasury Yield
- 10-year Treasury Yield
- BBB Corporate Yield
- Mortgage Rate
- Prime Rate

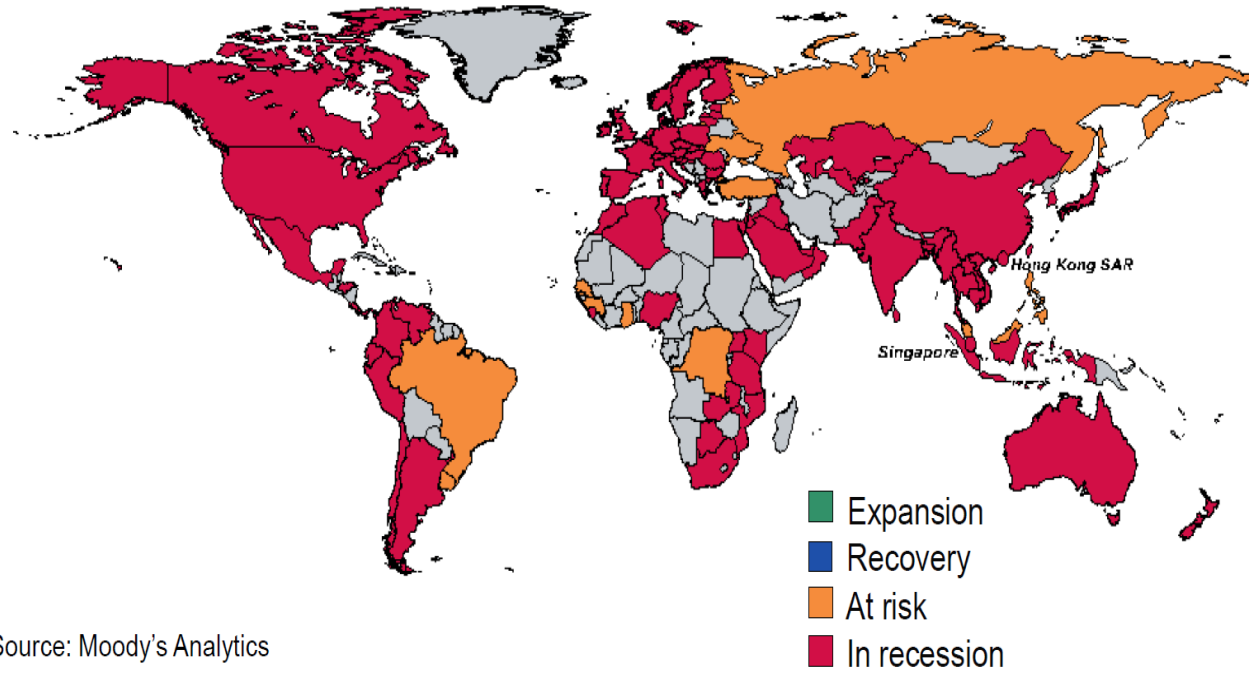
Swap Rates
Euro term structure history and forecasts



Equity Returns and Volatilities
Stock indexes history and forecasts

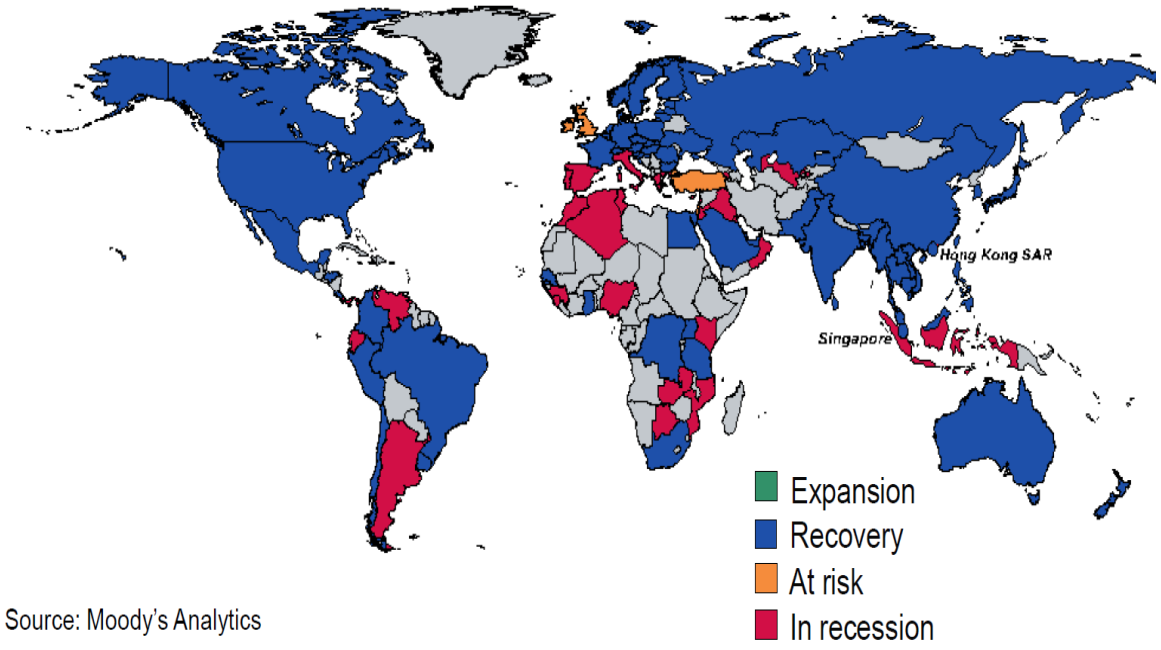


Global Pandemic Impact



Source: Moody's Analytics

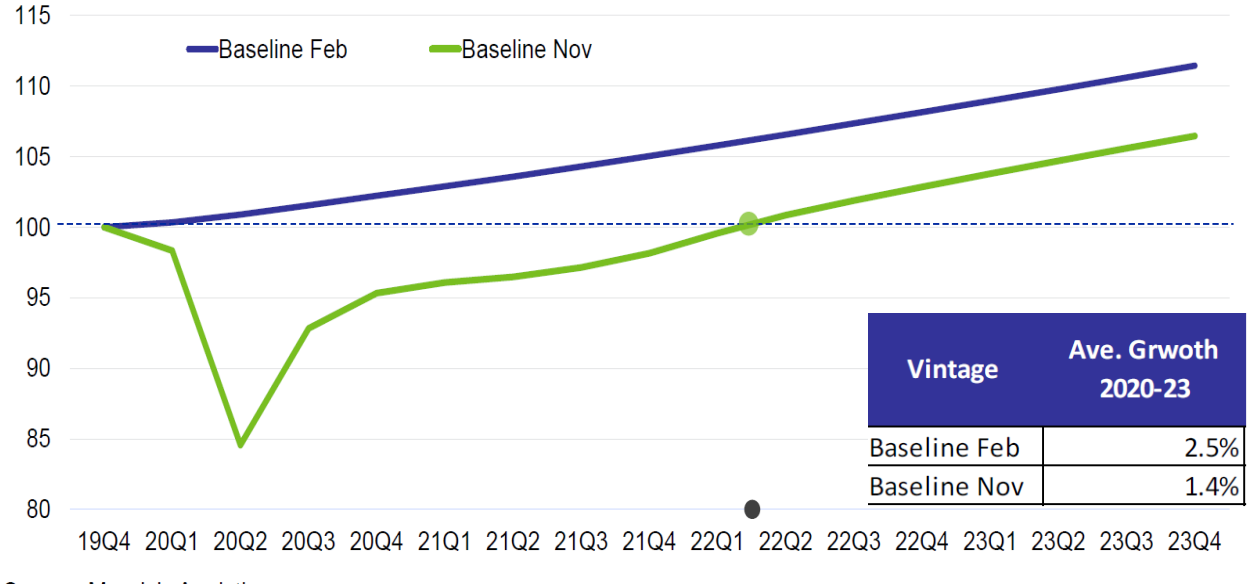
March 2020



Source: Moody's Analytics

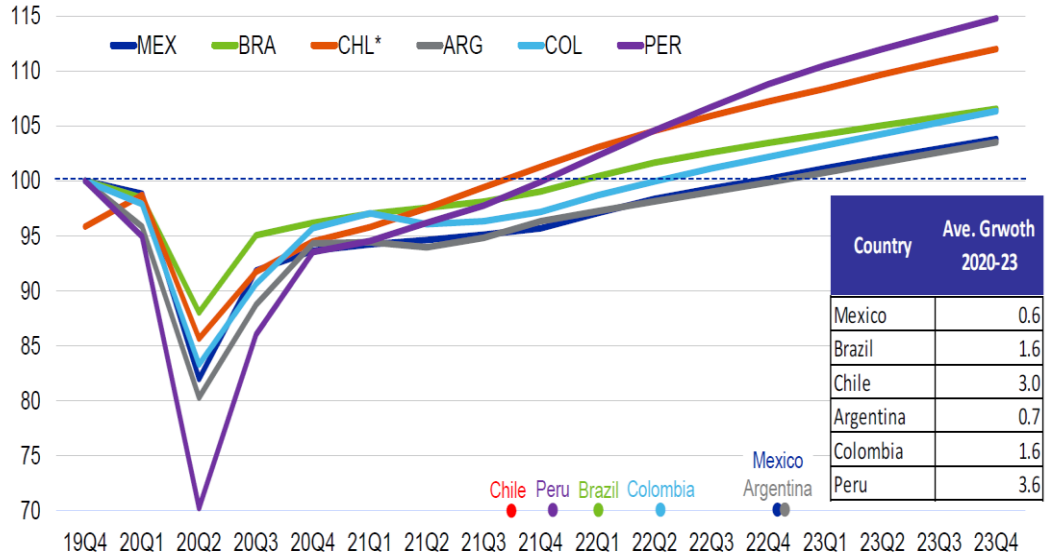
November 2020

LatAm Outlook Deteriorates
Real GDP, LatAm, six largest economies, 2019Q4 =100



Vintage	Ave. Grwoth 2020-23
Baseline Feb	2.5%
Baseline Nov	1.4%

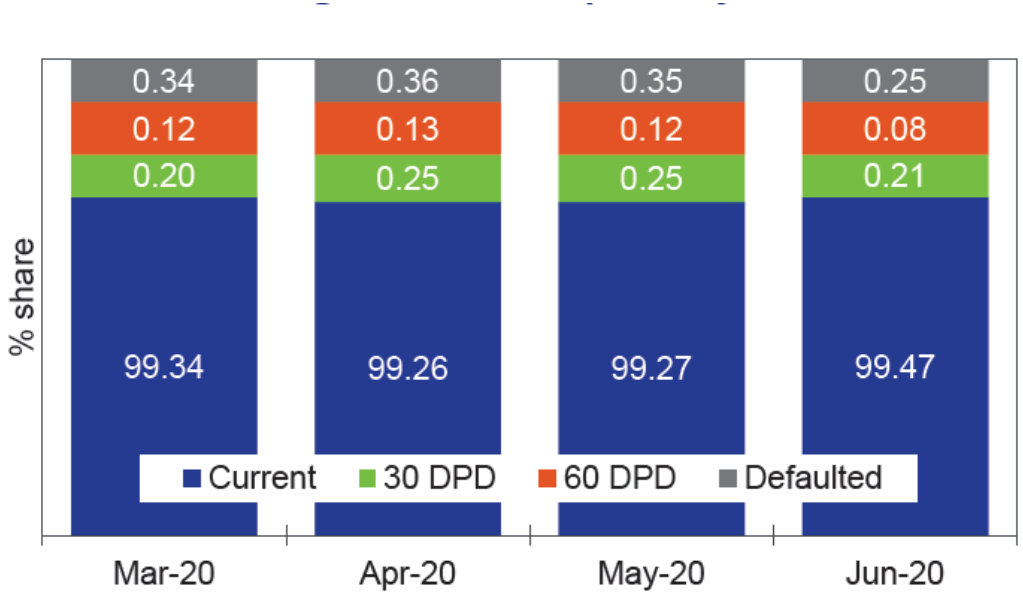
LatAm Outlook: A Long Road Back
Real GDP, LatAm, six largest economies, 2019Q4 =100, November Baseline



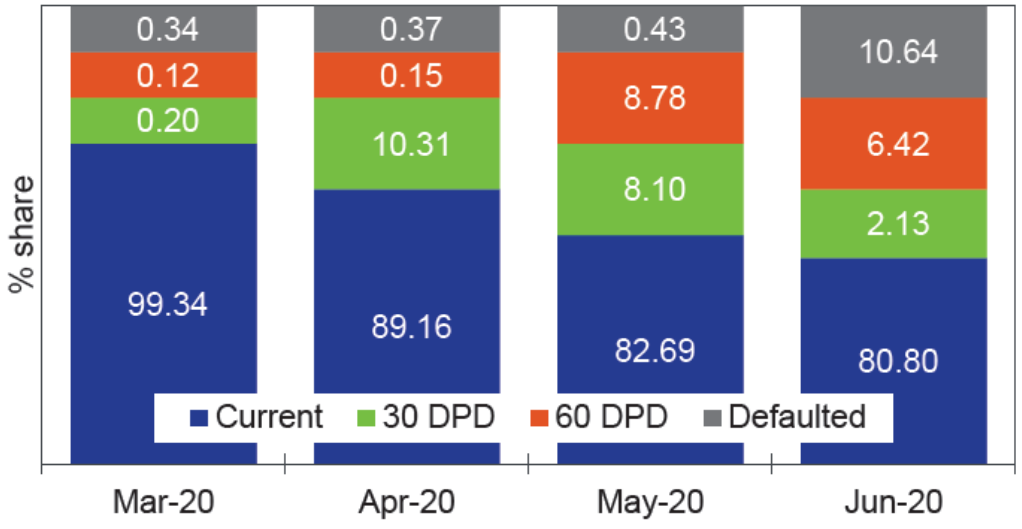
Country	Ave. Grwoth 2020-23
Mexico	0.6
Brazil	1.6
Chile	3.0
Argentina	0.7
Colombia	1.6
Peru	3.6

Source: Moody's Analytics

Original Delinquency Status

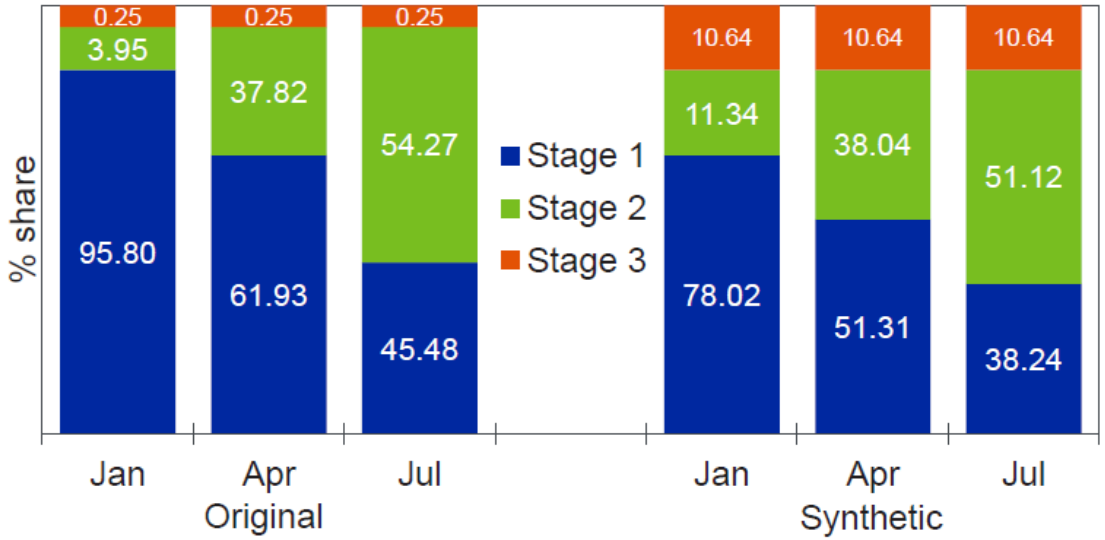


Synthetic Delinquency Status

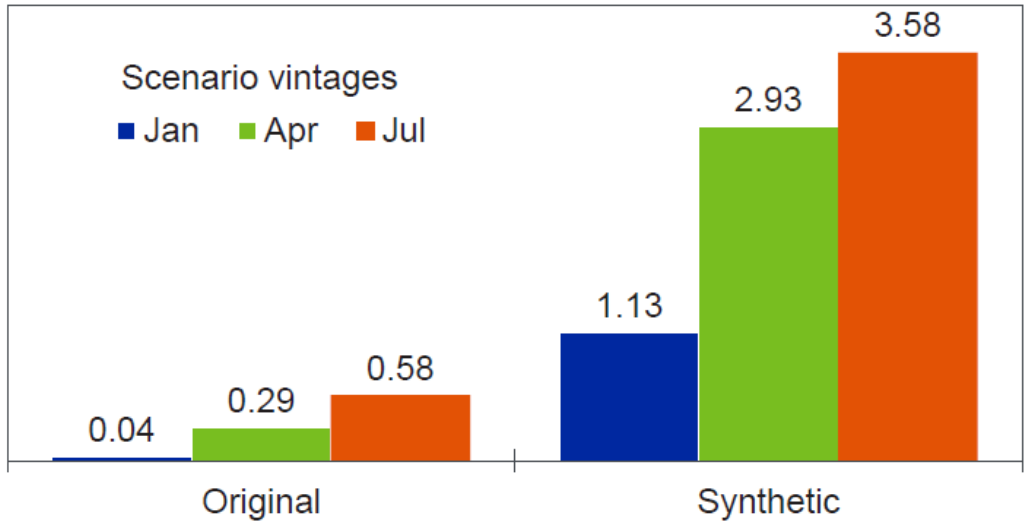


f(PD, LGD,EAD, Stressed Macro Factors)

Stage Allocation
% of exposure, scenario vintages

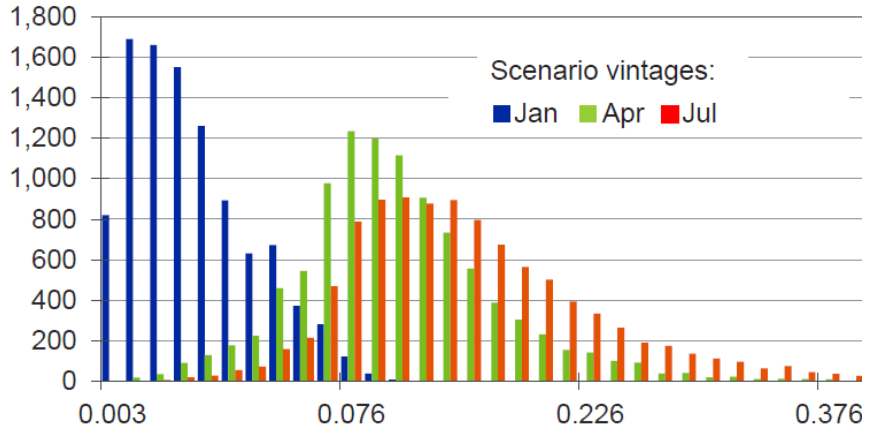


Expected Credit Loss
Coverage ratio, %

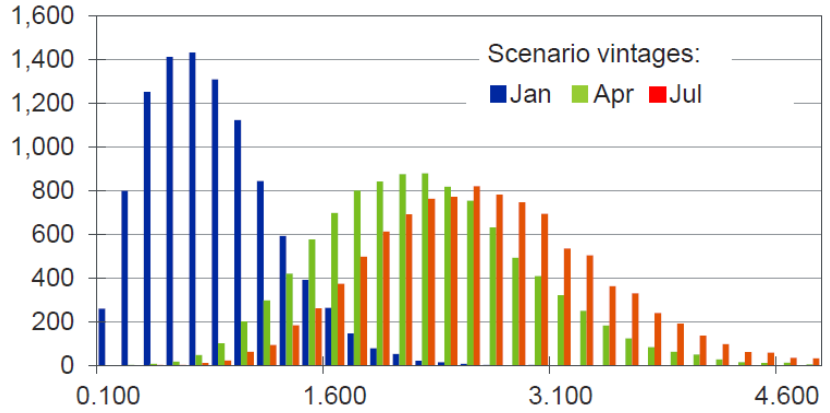


ECL = PD*LGD*EAD

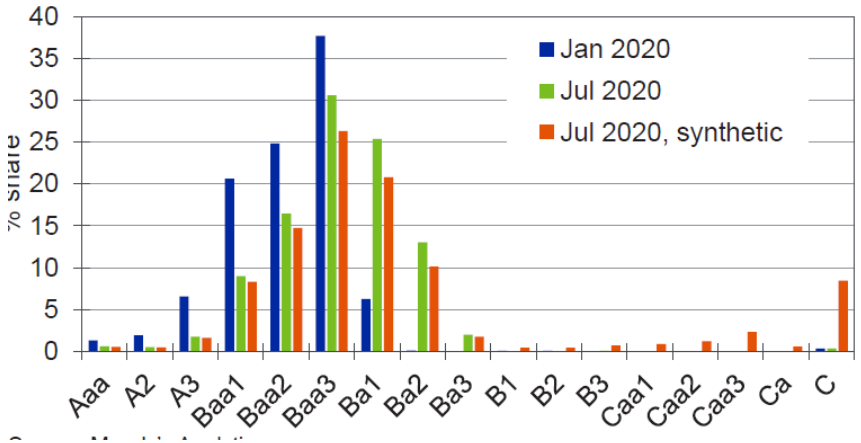
Loss Distribution - Original Portfolio
Baseline forecast, 12-mo expected loss, %



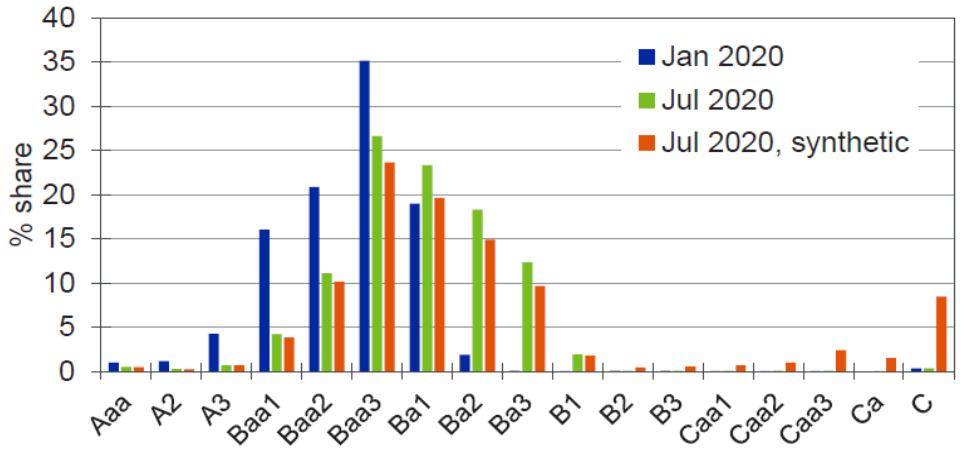
Loss Distribution - Synthetic
Baseline forecast, 12-mo expected losses, %



Loan Ratings Distribution
Based on 12-mo PD, baseline forecast across scenario vintages



Loan Ratings Distribution
Based on 12-mo PD, downside forecast across scenario vintages

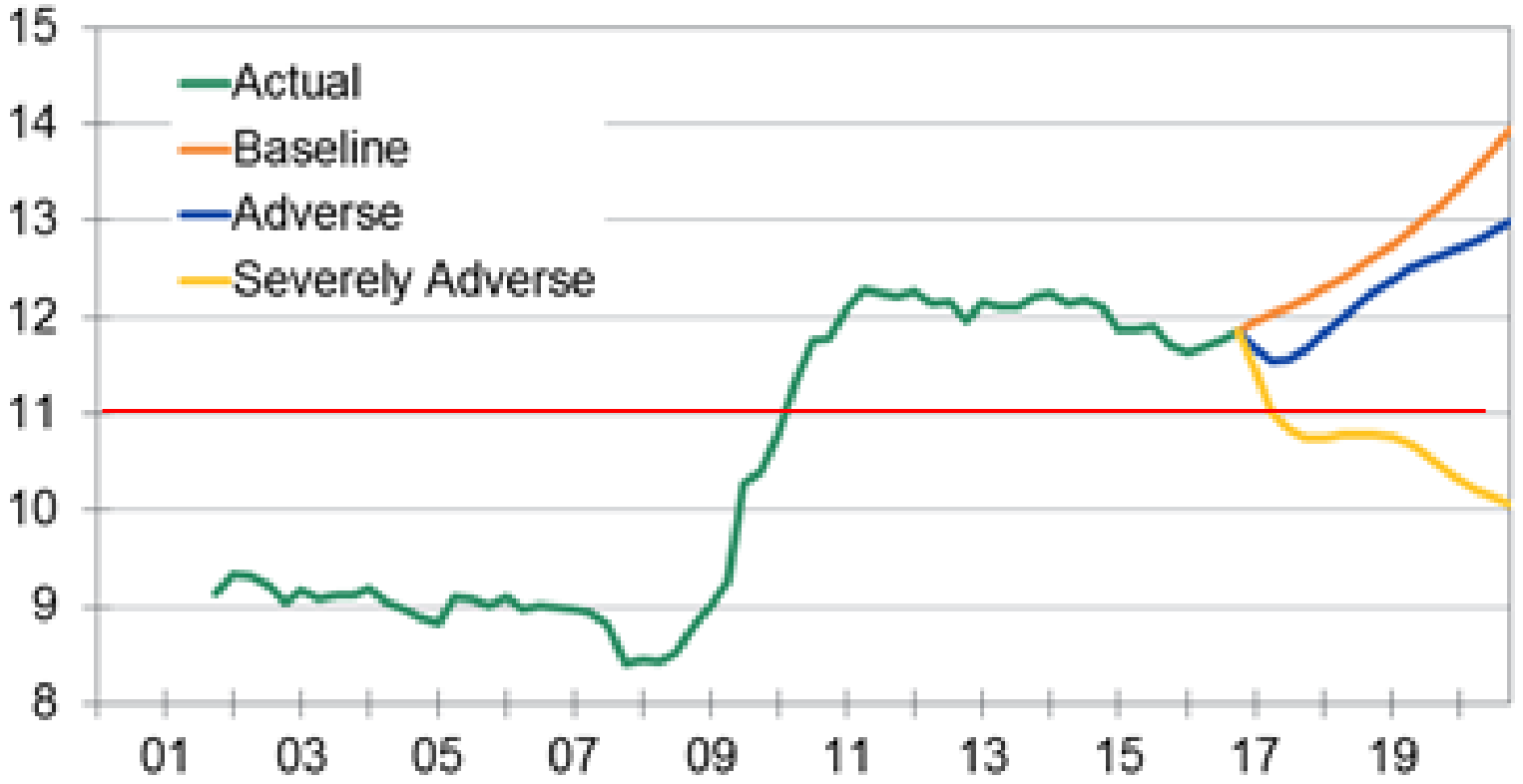


- **The impact of the scenario on banks can be summarised by specific metrics:** In general, in a stress testing model, the scenario translates into changes in bank-level parameters, which are then used to determine the impact on some metric of bank resilience.
- **Modelling approaches range from granular to aggregate models.** For each risk type, it is possible to take a granular approach that reflects the detailed structure of banks' balance sheets, in terms of eg liquidity, maturity or riskiness.

Category	Risk Appetite measure	Metric	Early warning
Regulatory Capital ratios	Tier 1 Capital ratio Total Capital Ratio	>11% >13%	11.10% 13.10%
Earnings	Return on Equity Earnings per Share	20-25% 0-15%	NA
Credit Ratings	At least two of the bank's long-term debt ratings by the major ratings agency	At least AA- or equivalent	
Liquidity	Liquidity coverage ratio	>105%	110%
Credit Risk	Total outstanding balance Loan loss rate	1000 billion Less than .0004%	Business
Market Risk	Trading portfolio total VaR Trading portfolio stressed VaR	Less than 100 million Less than 150 milion	80 million 130 million
Operational Risk	Total Annual loss	Less than 100 million	80% of annual total loss

Here we focus on the tier-1 risk-based capital ratio,

One of the goals of stress-testing is to determine whether banks have sufficient capital so that depositors and other creditors will not suffer losses if economic conditions deteriorate substantially



- **Authorities run stress tests for macroprudential or microprudential purposes.**
- **There is no single way of designing and conducting stress tests.**
- **A stress test is most effective when its design is closely aligned with the policy objectives**
- **While stress tests can support authorities in reaching their policy objectives, they are no panacea.**
- **As the development of stress tests continues, new features are becoming available and could be incorporated, but challenges remain.**