

Models Broken

May 2021

ALVAREZ & MARSAL
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Sailing through Covid-19 towards a Model Strategic Plan

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Executive summary (1/2)

Covid-19 has broken the relationship between macroeconomic indicators and bank loan defaults. Are credit models broken?

① **Sharp decline in GDP and employment not materialized yet in bank loan defaults**

② **Loan Loss models have failed to capture the offsetting effect of public support measures** (moratoria, public guarantee schemes, solvency aid, etc.)

A&M View

③ **Models also failed to capture the idiosyncratic impacts** of Covid-19 across the most sensitive industries (CORAL¹)

④ **Banks used large subjective overlays and adjustments** to overcome model shortcomings

⑤ **The impacts of Covid-19 and the associated policy responses are complex and fast moving. Against this backdrop, the limitations of bank's credit models has led to inconsistencies in credit forecasting and provisioning levels, ultimately fueling investor uncertainty**

Executive summary (2/2)

Ideas going forward

- **Banks are required to rethink their model strategy** in the context of lessons learned from Covid-19, to **improve both the effectiveness and efficiency** of their credit risk model architecture
- Going forward, banks should develop a **Model Strategic Plan**, to cover:
 1. **Update/ improve existing models to incorporate Covid-19 lessons learned:** A&M analyses 5 different modelling approaches/ solutions, that should be considered across asset classes and geographies:
 - 1) Do nothing / model sabbatical until 2022
 - 2) Adjustment via expert judgements
 - 3) Recalibrate models based on implicit defaults – top-down and bottom-up views
 - 4) Recalibrate including dummy variables
 - 5) Model redevelopment – applying bottom-up models for material portfolios
 2. **Optimize credit risk modelling:** Defining a model optimization framework that allows banks to identify efficiencies and synergies across models

How A&M can Help

- A&M can help banks to **design and implement a strategic reset** of their credit risk model architecture
- A&M has extensive experience in **credit risk modelling**, with a track record in practical solutions. We have **already developed credit risk management tools tailored for Covid-19 and using a sector approach**
- A&M has strong **benchmarking tools** that provide credit risk peer analysis by country, asset class, sector and risk model

Covid-19 has broken the relationship between macroeconomic indicators and bank loan defaults.

Are credit models broken?

1

Sharp decline in GDP and employment not materialized yet in bank loan defaults

Unexpected correlation between GDP and S3 ratio, which has changed significantly compared to 2018-19

In terms of model alignment with macro: ■ Observable Discrepancies

Countries 4Q20	Macro	IFRS9			Correl. GDP / S3 Ratio	
	GDP YoY Growth	S2 Ratio YoY var. (bps)	S3 Ratio YoY var. (bps)	CoR YoY var. (bps)	18-19	20Y
ES	-8%	130	-17	29	-79%	20%
IT	-5%	496	-186	34	-66%	-18%
PT	-4%	126	-109	17	-84%	4%
IE	2%	966	165	148	-83%	12%
GR	-7%	116	-767	181	-46%	9%
FR	-3%	157	-6	15	-85%	-41%
GB	-9%	561	21	34	-66%	-71%
DE	-2%	422	15	20	-89%	-31%
NL	0%	270	24	30	-62%	-42%
BE	-4%	229	29	27	-55%	-22%
AT	-5%	780	11	41	-80%	76%
SE	3%	10	-3	9	-33%	-79%
DK	0%	45	54	49	-75%	3%
FI	0%	39	8	5	64%	-75%
NO	-9%	251	39	42	3%	-93%
EU/EEA	-3%	318	-15	26	-87%	-15%

Source: EBA Risk Dashboard, Eurostat, A&M Analysis
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2

Loan Loss models have failed to capture offsetting effect of public support measures

Unexpected behavior between public support measures and S2 & S3 ratios. Although S2 ratio has increased YoY for all countries, S3 shows mixed results, and S2&S3 variation not always aligned with level of public support measures

 Most help received
 Highest decrease
 Highest increase

Countries 4Q20	Public Guarantee Scheme			Moratoria		S2 / S3 Ratio	
	PGS Given (€ Bn)	Amount Guarantee %	% EAD	Moratoria (€ Bn)	% EAD	S2 Ratio YoY Mult.	S3 Ratio YoY Mult.
ES	102	<div style="width: 78%;">78%</div>	4%	185	8%	1.2	1.0
IT	82	<div style="width: 87%;">87%</div>	4%	174	9%	1.6	0.7
PT	7	<div style="width: 79%;">79%</div>	3%	47	19%	1.1	0.8
IE	1	<div style="width: 87%;">87%</div>	0%	23	10%	2.6	1.4
GR	5	<div style="width: 64%;">64%</div>	2%	28	13%	1.1	0.8
FR	127	<div style="width: 55%;">55%</div>	2%	259	5%	1.2	1.0
DE	10	<div style="width: 78%;">78%</div>	0%	23	1%	1.8	1.1
NL	3	<div style="width: 83%;">83%</div>	0%	49	3%	1.5	1.1
BE	2	<div style="width: 54%;">54%</div>	0%	44	5%	1.3	1.1
AT	3	<div style="width: 74%;">74%</div>	1%	33	6%	1.8	1.0
SE	0	<div style="width: 72%;">72%</div>	0%	28	4%	1.0	0.9
DK	1	<div style="width: 83%;">83%</div>	0%	0	0%	1.1	1.2
FI	1	<div style="width: 76%;">76%</div>	0%	7	1%	1.1	1.0
NO	0	0%	0%	0	0%	1.5	1.3
EU/EEA	343	<div style="width: 71%;">71%</div>	2%	899	5%	1.5	1.0

3 Models also failed to capture idiosyncratic impacts in industries most impacted by Covid-19

Unexpected behavior of NPL ratio evolution in high-risk segments (CORAL¹). NPL Ratio for CORAL sectors has increased much less than non-CORAL sectors YoY

In terms of credit losses: ■ Best standing ■ Worst standing ■ Unexpected behavior

Countries 4Q20	Non-Financial Corporations				NPL Coverage		NPL Ratio YoY Variation (bps)		
	Size (€ Bn)	%EAD	of which: CORAL	YoY var. (bps)	%	YoY var (bps)	CORAL	No CORAL	Dif.
ES	688	29%	11%	+8	49%	-49	-50	+14	-63
IT	715	39%	13%	-135	56%	+12	-631	-281	-350
PT	78	31%	13%	-6	56%	+35	-329	-291	-38
IE	65	29%	7%	-75	34%	+31	+334	+346	-12
GR	90	43%	23%	-172	48%	-116	-808	-766	-42
FR	1,670	31%	8%	-19	49%	-220	+8	-12	+20
GB	855	19%	6%	-34	44%	-157	+92	+73	+20
DE	700	27%	5%	-142	39%	-420	-114	+51	-165
NL	536	29%	8%	-89	31%	+235	+74	+38	+36
BE	247	27%	9%	-170	48%	-31	+61	+31	+30
AT	198	35%	10%	-145	51%	-108	+20	+9	+11
SE	273	34%	4%	-92	46%	+599	+15	-5	+19
DK	82	13%	2%	-18	29%	-812	+231	-10	+240
FI	161	31%	6%	-55	43%	+294	+57	-36	+93
NO	82	34%	10%	-23	39%	+427	+138	+87	+51
EU/EEA	5,479	30%	8%	-15	47%	-146	-59	-7	-52

Source: EBA Risk Dashboard, A&M Analysis

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(1) CORAL sectors: Construction, Oil and gas, Retail, Accommodation and food services, and Leisure and recreation activities

4

Banks used subjective overlays and adjustments to overcome model shortcomings

Implicit PD based on Cost of Risk and LGDs show an **implicit overlay needed in models of €83Bn for EU**, which has been applied in CoR as overlays but needs to be included in credit risk models

In terms of PD alignment: ■ Best standing ■ Worst standing

Countries 4Q20	Risk Parameters		PD study		Mult. Implicit PD vs PD	Delta Implicit PD vs PD (bps)	Additional est. Defaults (€ Bn)
	CoR EoY20	LG ¹ EoY20	Implicit PD CoR/LGD	PD ² EoY 20			
ES	1.4%	33.6%	4.1%	2.3%	1.8	176	32.9
IT	0.9%	34.3%	2.8%	3.8%	0.7	-101	-12.6
PT	1.1%	32.5%	3.3%	2.2%	1.5	107	2.1
IE	1.7%	28.4%	6.1%	2.3%	2.7	379	5.8
GR	3.1%	35.8%	8.7%	8.1%	1.1	60	1.0
FR	0.5%	26.2%	2.1%	1.6%	1.3	44	15.4
GB	0.8%	25.1%	3.1%	1.5%	2.0	158	41.5
DE	0.5%	34.0%	1.4%	1.0%	1.4	38	4.9
NL	0.6%	21.6%	2.5%	1.0%	2.4	151	19.6
BE	0.5%	23.7%	2.1%	1.7%	1.3	45	2.5
AT	0.7%	30.6%	2.4%	1.2%	2.0	119	4.4
SE	0.2%	19.5%	1.1%	0.5%	2.2	59	3.6
DK	0.8%	20.7%	4.1%	1.0%	4.0	307	4.7
FI	0.3%	25.2%	1.3%	1.1%	1.1	14	0.5
NO	0.6%	37.8%	1.6%	1.3%	1.3	35	0.6
EU/EEA	0.7%	29.0%	2.6%	2.0%	1.3	55	82.7

Source: EBA Risk Dashboard, A&M Analysis Models Broken | May 2021

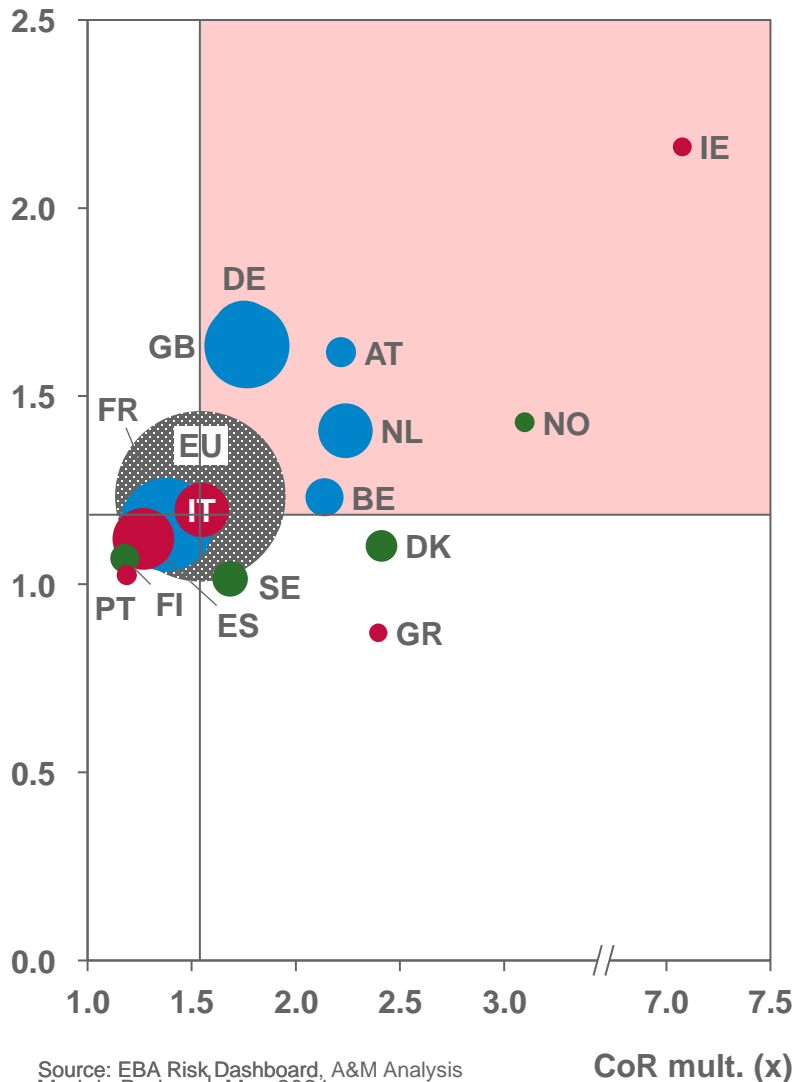
1. LGD weighted average Corporates + Retail

2. PD weighted average Corporates + Retail

5 Inconsistent Bank Provisioning & Staging

Higher proportion of aids (PGS and Moratoria) softens immediate impact, but increases pending recognition of credit deteriorations in P&L

S2 + S3
var. (x)



In terms of recognized credit losses: ■ Worst standing

Countries 4Q20	S2 + S3 % EAD	YoY var. Mult (x)	CoR %	YoY var. Mult (x)
ES	10%	x1.1	1.4%	x1.3
IT	19%	x1.2	0.9%	x1.5
PT	17%	x1.0	1.1%	x1.2
IE	21%	x2.2	1.7%	x7.1
GR	44%	x0.9	3.1%	x2.4
FR	11%	x1.2	0.5%	x1.4
GB	15%	x1.6	0.8%	x1.8
DE	11%	x1.7	0.5%	x1.8
NL	10%	x1.4	0.6%	x2.2
BE	14%	x1.2	0.5%	x2.1
AT	21%	x1.6	0.7%	x2.2
SE	5%	x1.0	0.2%	x1.7
DK	11%	x1.1	0.8%	x2.4
FI	7%	x1.1	0.3%	x1.2
NO	10%	x1.4	0.6%	x3.1
EU	12%	x1.2	0.7%	x1.5

Source: EBA Risk Dashboard, A&M Analysis
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Conclusions & Banks' Response

Conclusions & Bank's Response

Banks are required to rethink their model strategy in the context of lessons learned from Covid-19, to improve both the effectiveness and efficiency of their credit risk model architecture



Update/ improve existing models to incorporate Covid-19 lessons learned

✓ Short-term view



Optimize credit risk modelling

✓ Short/ medium-term view

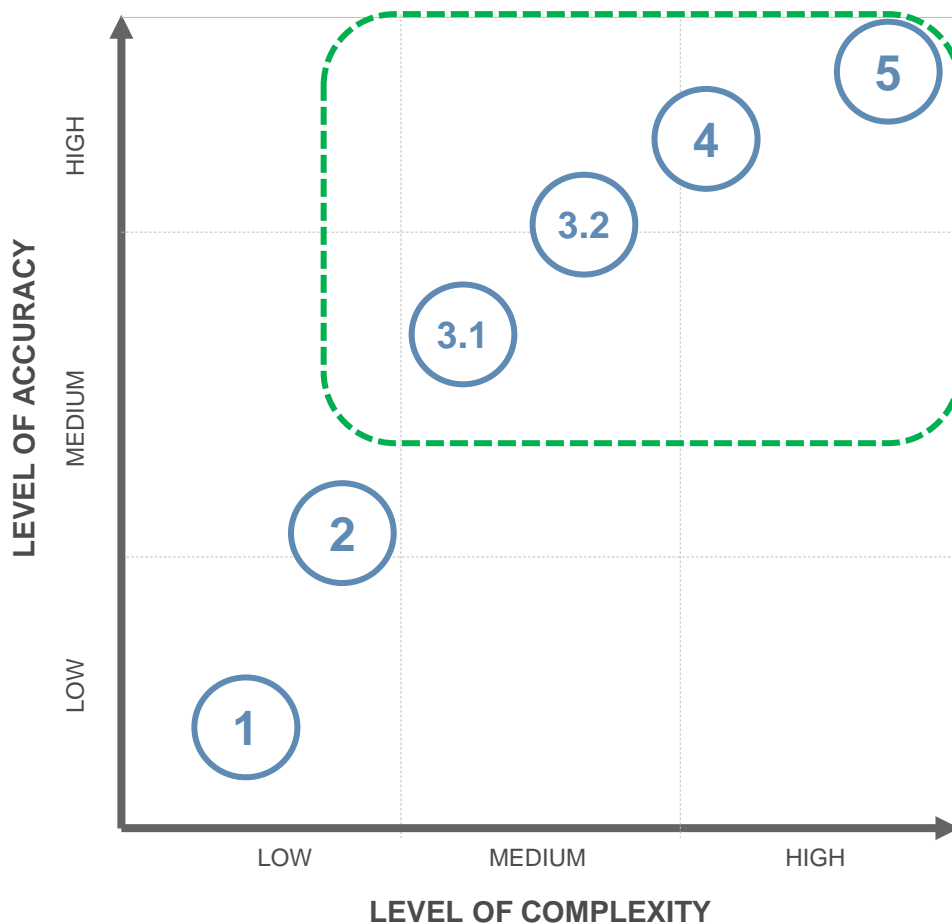
Model approaches to account for Covid-19 period

Going forward, banks will be required to analyse alternative solutions, that may be different by model (IFRS9, IRB, Pricing), portfolio, geography, segment, or industry

APPROACH	DESCRIPTION	COMMENTS
1 Do nothing / model sabbatical until 2022	<ul style="list-style-type: none"> Do not change the model, or wait to include 2020/21 as an average to smooth the results No recalibration done yet 	<ul style="list-style-type: none"> Easiest to implement, but lacks anticipation
2 Adjustment via expert judgments	<ul style="list-style-type: none"> Adjustment of model by including expert judgement add-ons No recalibration done yet 	<ul style="list-style-type: none"> Flexibility depending on model purpose, but lacks anticipation and requires higher MRM
3 Recalibrate models based on implicit defaults	<ul style="list-style-type: none"> Recalibrate the models applying: <ul style="list-style-type: none"> (3.1) top-down view or (3.2.) bottom-up + backtesting 	<ul style="list-style-type: none"> Models get recalibrated with real provisions Bottom-up approach will allow for backtesting comparison
4 Recalibrate including dummy variables	<ul style="list-style-type: none"> Recalibrate the models including dummies to model: 2020 year, ICO vs. No ICO or specific sectors (e.g. CORALs¹) 	<ul style="list-style-type: none"> It can capture idiosyncratic peaks and industry sensitivity, but lacks anticipation and requires higher MRM
5 Model redevelopment	<ul style="list-style-type: none"> Redevelopment of models using a bottom-up approach to include, among others: view by sector, government aids, speed of recovery, climate risk factors, alternative databases and AI 	<ul style="list-style-type: none"> Provides specific results as it is a bottom-up model, by it has higher complexity requires higher MRM

Model approaches to account for Covid-19 period

Going forward, banks will be required to analyse alternative solutions, that may be different by model (IFRS9, IRB, Pricing), portfolio, geography, segment, or industry



Approaches / Solutions

- 1 Do nothing / model sabbatical until 2022
- 2 Adjustment via expert judgments
- 3 Recalibrate models based on implicit defaults
(3.1.) top-down view or
(3.2.) bottom-up + backtesting
- 4 Recalibrate including dummy variables
- 5 Model redevelopment

A&M Recommendation



Update/ improve existing models to incorporate Covid-19 lessons learned

3.1 Recalibrate based on implicit defaults – Top-down view

Implicit PD and additional estimated defaults are calculated in the table below, from Cost of Risk and LGD information

1. Implicit PD are calculated using CoR and LGD, by asset class
2. Implicit PD are then compared to modelled PD, getting differences by model / by asset class
3. Additional estimated defaults are obtained by model / asset class
4. Peer analysis can be done vs. peers using public information

Bank 4Q20	Risk Parameters		PD Analysis		Mult. Implicit PD vs PD	Delta Implicit PD vs PD (bps)	Additional est. Defaults (€ Bn)
	CoR EoY20	LGD ¹ EoY20	Implicit PD CoR/LGD	PD ² EoY 20			
SMEs	1.4%	33.6%	4.1%	2.3%	1.8	176	3.2
Large Corp.	1.1%	32.5%	3.3%	2.2%	1.5	107	0.5
Mid Corp.	1.7%	28.4%	6.1%	2.3%	2.7	379	0.8
Mortgages	0.9%	34.3%	2.8%	3.8%	0.7	-101	-2.1
Consumer	3.1%	35.8%	8.7%	8.1%	1.1	60	1.0
TOTAL	1.7%	39.0%	4.3%	3.3%	1.3	102	3.4

Illustrative

Portfolios at higher risk

3.2 Recalibrate based on implicit defaults – Bottom-up view

In addition to the top-down view, banks can apply the additional defaults into specific exposures, backtesting the results vs. aggregated view

1. Implicit PD are calculated using CoR and LGD, for each exposure
2. Implicit PD are then compared to modelled PD, getting differences by exposure
3. Additional estimated defaults are obtained by exposure and for total segment / asset class
4. Results are backtested vs. top-down view to analyse main differences

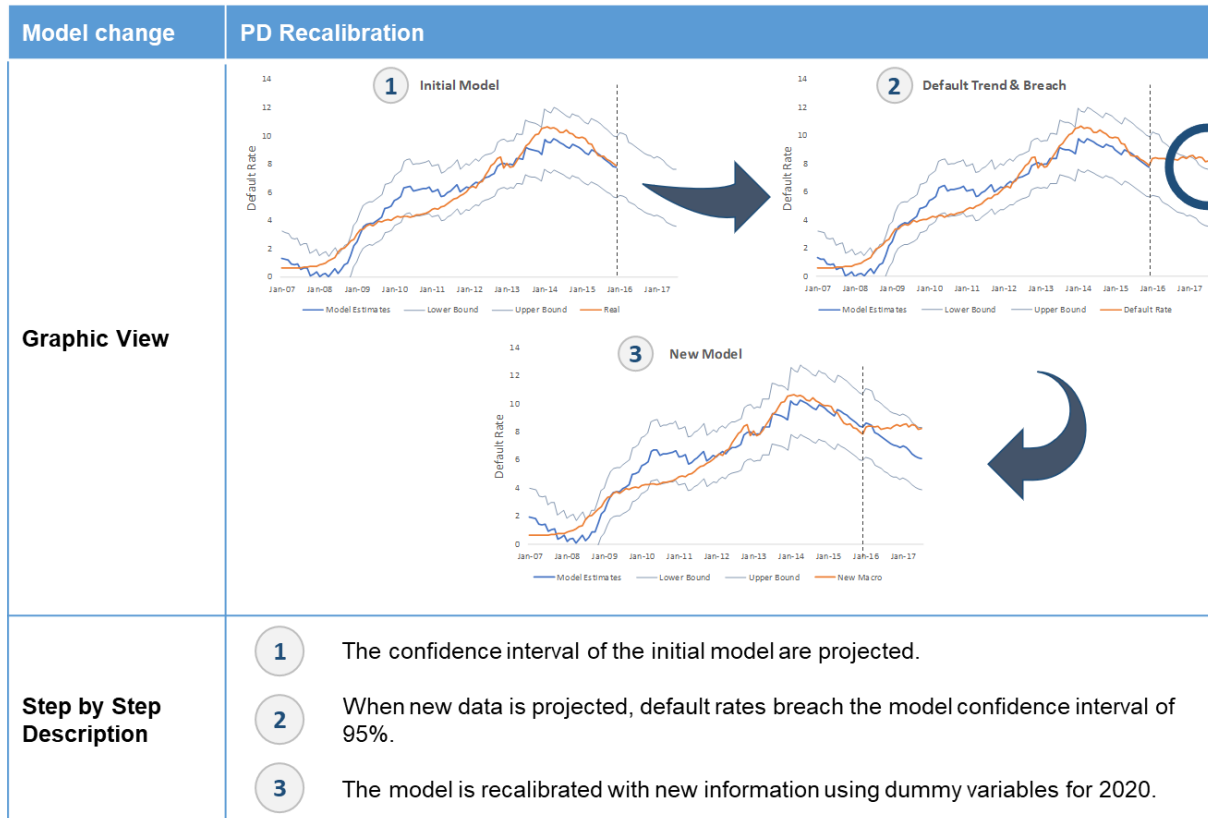
BOTTOM-UP VIEW	SMES 4Q20	Risk Parameters		PD study		Mult. Implicit PD vs PD	Delta Implicit PD vs PD (bps)	Additional est. Defaults (€ Bn)
		CoR EoY20	LGD ¹ EoY20	Implicit PD CoR/LGD	PD ² EoY 20			
	Exposure #1	1.4%	33.6%	4.1%	2.3%	1.8	176	0.12
	Exposure #2	1.1%	32.5%	3.3%	2.2%	1.5	107	0.11


	TOTAL SMES	1.7%	39.0%	4.3%	3.3%	1.3	102	2.8
TOP-DOWN VIEW	SMEs 4Q20	Risk Parameters		PD study		Mult. Implicit PD vs PD	Delta Implicit PD vs PD (bps)	Additional est. Defaults (€ Bn)
		CoR EoY20	LGD ¹ EoY20	Implicit PD CoR/LGD	PD ² EoY 20			
	Total SMEs	1.4%	33.6%	4.1%	2.3%	1.8	176	3.2
DIFFERENCE				0.2%	0.9%	0.5	76	0.4

4 Recalibrate including dummy variables

Dummy variables are commonly used to represent subgroups of the sample that should be treated differently when compared to the remaining sample, which is the case for 2020 data due to Covid-19

1. Statistical thresholds of initial model have been breached due to the idiosyncrasies of 2020 data and macro variables
2. Model is recalibrated using dummy variables to account for 2020 data
3. Model can then be projected using the new recalibration and 2020 information with dummy variables



 Update/ improve existing models to incorporate Covid-19 lessons learned

⑤ Model redevelopment

Model redevelopments allow banks to rethink the model methodology approach needed for each asset class. Bottom-up approaches, sector view, inclusion of climate risk drivers and new databases/AI will be the tendency going forward



Bottom-Up Models

A&M view is that **bottom-up models** will be deployed going forward for all material portfolios, in contrast of top-down models



Sector View

Bottom-up models will be used broadly to include **additional drivers**, such as **sector drill-down**. Sector view will be essential to capture different recovery paths from Covid-19 crisis



Climate Risk

Climate risk is here to stay, and climate specific drivers will be required in credit risk modelling going forward to capture transition and physical events



Alternative Databases and AI

Alternative databases (such as high-frequency information) together with the use of **AI** will be essential to model credit risks






Role of Model Risk Management




Role of MRM / validation will be reinforced, due to the inclusion of new and more complex models or the refinement of the existing ones

Model complexity increase – Drivers & Implications

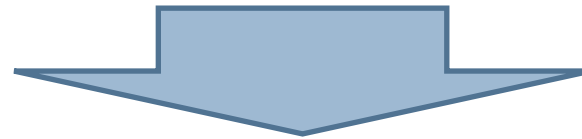
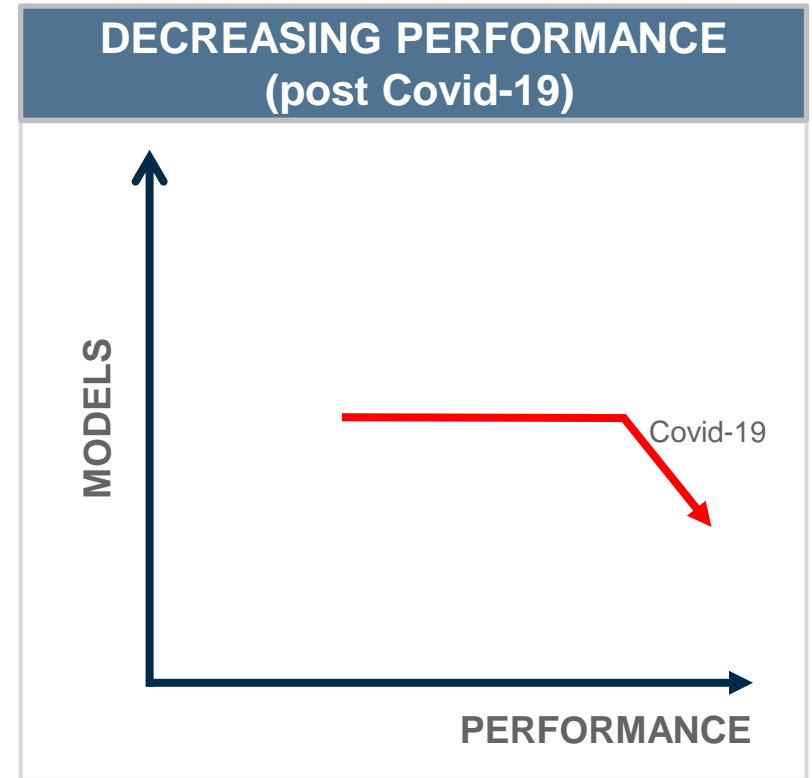
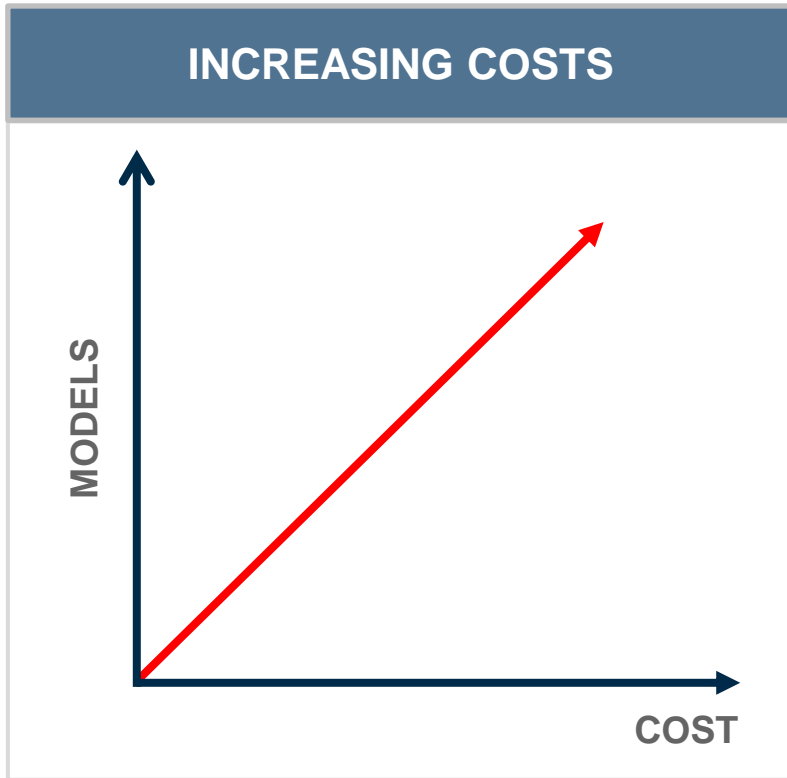
Drivers

 Covid-19	 Regulatory requirements	 Different uses and owners
<ul style="list-style-type: none"> ❖ Banks used subjective overlays and adjustments to overcome model shortcomings ❖ Covid-19 uncertainty and varying public response across the world has resulted in inconsistent bank provisioning and credit forecasting, which needs to be readjusted 	<ul style="list-style-type: none"> ❖ In recent years several models have been developed to comply with regulatory requirements: <ul style="list-style-type: none"> ❖ IRB / IMA / IFRS9 / IRRBB ❖ While internal models have also increased and become more complex: <ul style="list-style-type: none"> ❖ Approval / Pricing / Behavior / Monitoring / Ec Capital / PPNR / ALM 	<ul style="list-style-type: none"> ❖ Different models were developed for different purposes by different owners <ul style="list-style-type: none"> ❖ Risk: Approval / Monitoring / Collections ❖ Risk & Finance: Capital Ec /Reg / Provisioning / ALM ❖ Now all of them need to be reviewed

Implications

 Δ Cost ,Op & Model Risk	 Misalignment & wrong decisioning	 Less incremental performance
<ul style="list-style-type: none"> ❖ Model Risk Management implies material costs: <ul style="list-style-type: none"> ❖ Modell development / validation / governance / monitoring ❖ For regulatory purposes they also requires regulatory approval (cost and time constrains) ❖ In addition, operational and model risks can increase 	<ul style="list-style-type: none"> ❖ Increasing number of silo models & different uses mean misalignment <ul style="list-style-type: none"> ❖ Segmentation / Variables / Recalibrations ❖ Leading to wrong decisioning <ul style="list-style-type: none"> ❖ Approval / Pricing / Provisioning / Capital / Reporting / Monitoring / Collections / Sales ❖ Regulatory vs Management views can affect alignment 	<ul style="list-style-type: none"> ❖ New granular models add minimum additional predictive power <ul style="list-style-type: none"> ❖ Some granular models are not necessary ❖ Extra factors: No additional impact ❖ Granularity means cost and possible misalignment risk ❖ In some cases, capital additional efforts don't imply savings due to the capital floors

Need model optimization plan



NEED MODEL OPTIMIZATION PLAN

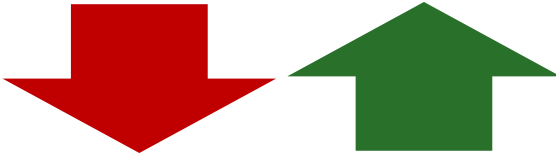
Model Optimization Environment

MACRO

Covid

Observed

Expected

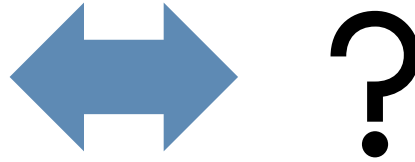


RATINGS

AIDs + Flexibility

Observed

Expected

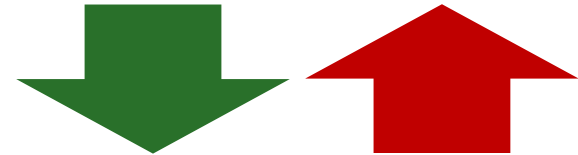


DEFAULTS/LOSSES

AIDs + Flexibility

Observed

Expected



CoR

Buffers+Overlays

Observed

Expected

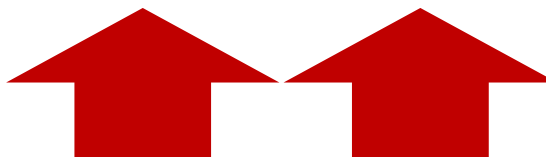


RW

TRIM

Observed

Expected



Spreads

Competition + No Defaults

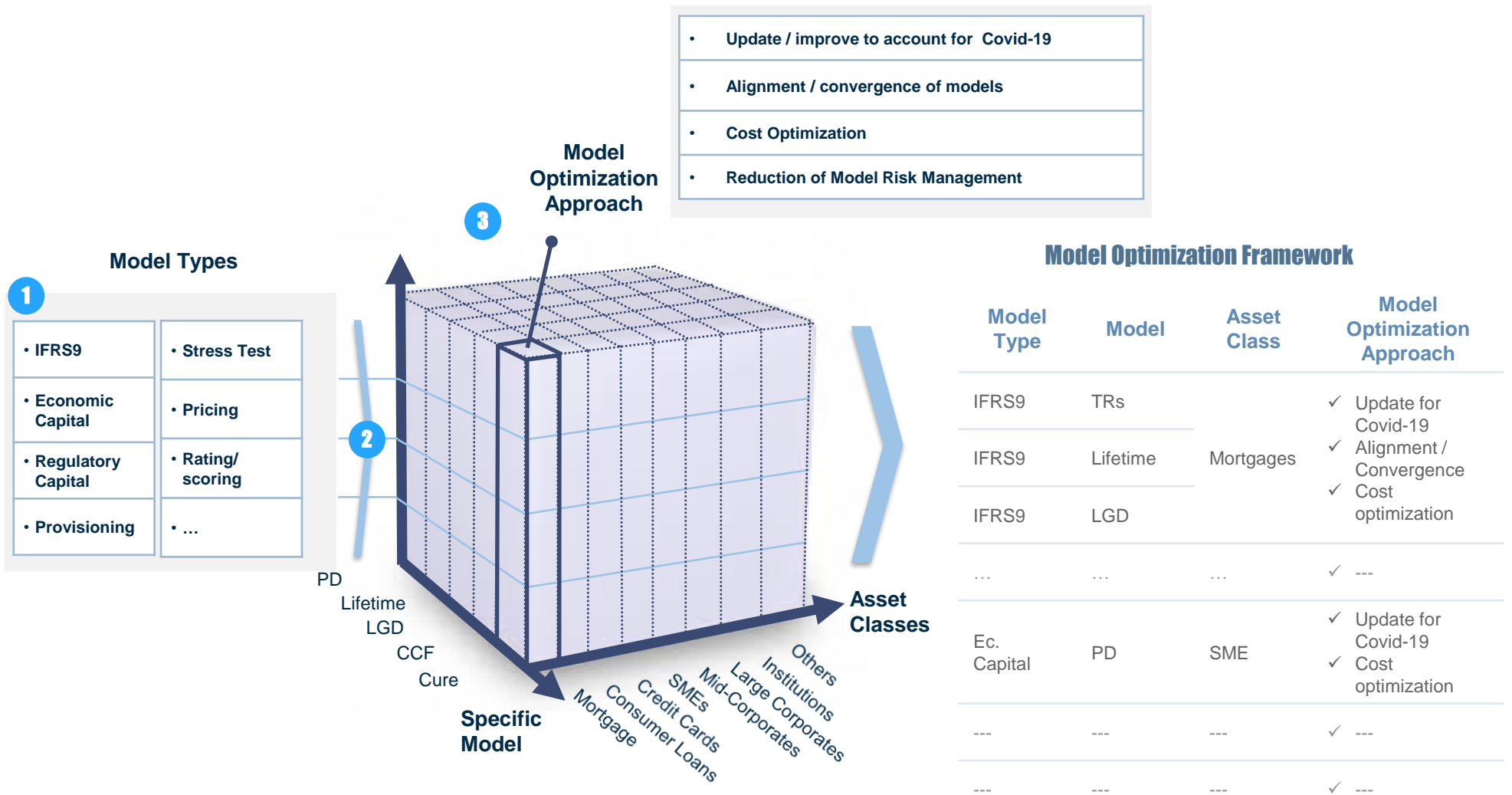
Observed

Expected



Model Optimization Framework

Defining a model optimization framework to identify the correct model optimization approach for each model type, sub-model and asset class.



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