TRIM Project Report

SSM

List of abbreviations

Abbreviations	Meaning	Abbreviations	Meaning
AD	Additional Drawings	IMPOR	Margin Period of Risk
BTB	Business to business	MoC	Margins of Conservatism
CIU	Collective Investment Undertakings	NCAs	National Competent Authorities
CCF	Credit Conversion Factor	PPU	Permanent Partial Use
DR	Default Rate	PD	Probability of Default
DoD	Definition of Default	RR	Recovery Rates
ELBE	Expected Loss Best Estimate	RWAs	Risk Weighted assets
EAD	Exposure at Default	STFs	Securities Financing Transactions
IRC	Incremental Default and Migration RIsk charge	SIs	Significant Institutions
IMA	Internal Models Approach	SSM	Supervisory Mechanism
LRA	Long Run Average	TRIM	Targeted Review of Internal Models
LRA DR	Long-Run Average Default Rate	sVaR	Stressed Value-at-Risk
LGD	Loss Given Default	VaR	Value-at-Risk

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1 Introduction
TRIM Project background

In April 2021 the ECB published the TRIM Project report, which compiles the outcome of the investigations carried out for credit risk models, market risk models and counterparty credit risk models

- Following the financial crisis of 2007-2009, **concerns were raised regarding the unwarranted** (i.e. non-risk-based) **variability of outputs** of some models across banks, alongside criticism from external stakeholders of the complexity of the models and the resulting opaqueness of the modelling approaches.
- These concerns led to **further regulatory work** by the BCBS, supplemented in the EU by initiatives by the EBA, such as the regulatory review of the IRB approach to credit risk.
- In **December 2017** the BCBS published its finalisation of the Basel III reforms, which included restrictions across different risk types on the use of internal models in the areas considered to contribute significantly to excessive variability of risk exposure amounts (or RWA).
- In conjunction with these regulatory initiatives, the ECB's direct supervision of SIs under the SSM has provided a unique opportunity to improve the consistency of internal models across the euro area. **The TRIM was a multi-year project launched by the ECB at the beginning of 2016** in close cooperation with the NCAs that are part of European banking supervision and finalized in **April 2021** with the publication of the **project report**. The project report compiles the outcome of the investigations carried out for **credit risk models**, **market risk** models and **counterparty credit ris**k models.
- TRIM aimed to assess whether the Pillar I internal models used by SIs within the SSM are appropriate in the light of the applicable regulatory requirements and whether their results are reliable and comparable.
- With **200 on-site investigations** conducted in 65 significant banks using internal models, TRIM is the largest project ever carried out by ECB Banking Supervision. The main outcomes are described in this document.

2 Executive Summary of TRIM findings and outcomes (1/2)

General Topics and Models for SME portfolios

The outcomes of the TRIM investigations confirmed that the internal models of SIs can continue to be used for the calculation of own funds requirements. However, for a number of models, limitations were needed to ensure a level of own funds that was appropriate to cover the underlying risk

General Topics

- Most findings related to the **organisation and activities of the internal validation function, roll-out and permanent partial use (PPU), and the management of model changes**.
- **All institutions** in the scope of the general topics review received feedback letters **with recommendations** that indicated that parts of their practices were not in line with the ECB's understanding of applicable regulatory requirements.
- Subset of institutions received a supervisory decision containing obligations to address deviations from the applicable regulatory requirements.

Credit Risk: Retail and SME Portfolios

- 85 investigations have been carried out.
- Institutions generally have the **capabilities to build adequate IRB models**.
- For the **probability of default** (PD) parameter, **more than 70% of investigations ended without severe findings** on the calculation of one-year default rates and the long-run average default rate (LRA DR). However, a significant number of findings were raised **concerning the low risk differentiation of these models**, owing to the low discriminatory power of the scoring/ranking functions.
- **Further improvements in the calibration approaches are still required**, particularly as regards the need for adequate data to ensure that PD estimates reflect long-run average default rates and are sufficiently conservative.
- For LGD models, the calculation of realised LGD was a frequent cause of compliance issues.
- **42% of investigations** contained severe findings on **risk differentiation**. In 95% of the investigations where the LGD parameter was reviewed at least one high-severity finding was raised in relation to this parameter. For the PD parameter, at least one high-severity finding was raised in 67% of investigations.

2 Executive Summary of TRIM findings and outcomes (2/2)

Models for low default portfolios, Market Risk and Counterparty Credit Risk

The outcomes of the TRIM investigations confirmed that the internal models of SIs can continue to be used for the calculation of own funds requirements. However, for a number of models, limitations were needed to ensure a level of own funds that was appropriate to cover the underlying risk

Credit Risk: LDP

- 76 investigations have been carried out.
- Large number of findings were raised in relation to the **rating assignment process and risk quantification**. These mainly concerned the calibration methodology and the calculation of long-run average default rates.
- One of the reasons for these deficiencies is that there are **considerably fewer internal observations available for this type of portfolio**.
- For the LGD parameter, most of the findings raised concerned the **calculation of the realised LGD and long-run average LGD**. Some institutions had difficulties in finding representative data for these portfolios, which led to cases where the LGD estimation was not based on realised LGD or representative data. As a result, there was an **increased use of limitations** to avoid an underestimation of capital requirements.
- In 96% of the investigations at least one high-severity finding was raised in relation to the PD and LGD parameters.

Market Risk

- 31 Investigations have been carried out.
- The greatest number of findings were related to the **VaR, and sVaR methodology, regulatory back-testing and the scope of the IMA**.
- About 60% of the TRIM investigations resulted in at least one high-severity finding on the VaR and sVaR methodology.
- Over 80% of SIs that used IRC models received at least one high-severity finding in relation to those models.

Counterparty Credit Risk

- 8 investigations have been carried out.
- **Validation and governance** were the topics with the highest number of findings. There were also findings on specific modelling topics such as trade coverage, the margin period of risk, collateral, initial margin, and risk factors and calibration.

3 General topics (1/3)
Summary of findings (1/3)

Overall, the outcomes of the TRIM investigations indicate that the internal models of SIs can generally continue to be used for the calculation of own funds requirements. However, the most frequent deviations and findings are summarised below

1 **Overarching principles for internal models**	▪ **Model risk management framework**: Few institutions have a comprehensive framework, and in the cases where there is one, it often requires improvement. ▪ **Documentation of internal models**: Overarching principles or guidelines on model documentation are missing or incomplete for almost half of the institutions.
2 **Roll-out and permanent partial use**	▪ **Compliance with PPU provisions**: A majority of institutions did not have proper monitoring procedures for PPU exposures. Practices in this regard varied across institutions, but in most cases there were no quantitative or qualitative thresholds in place to confirm the continued appropriateness of PPU.
3 **Internal governance**	▪ **Decision-making responsibilities**: Institutions need to better formalise their decision-making process as well as the involvement of the management body/designated committee and senior management in the approval of material changes or other relevant aspects of the rating systems. ▪ **Understanding of the rating systems**: A dedicated process was often not in place to ensure, maintain and improve the management body's and senior management's understanding of the rating systems.

3 General topics (2/3)
Summary of findings (2/3)

Overall, the outcomes of the TRIM investigations indicate that the internal models of SIs can generally continue to be used for the calculation of own funds requirements. However, the most frequent deviations and findings are summarised below

4 **Internal validation**	▪ **Content of tasks of the validation function**: Institutions often did not ensure that all appropriate validation analyses and adequate quantitative thresholds were in place, in particular for the back-testing, discriminatory power and stability tests and analyses of overrides. ▪ **Effective independence of the validation function**: In some cases, institutions did not present an adequate organisational choice that ensured the independent allocation of the validation function within the institution**.**
5 **Internal audit**	▪ **Scope and frequency of review**: Some institutions did not perform an appropriate or sufficiently frequent assessment or review of the rating systems and their operations to determine which rating systems required a more in-depth review. ▪ **Internal audit function**: Some institutions lacked sufficient resources and/or staff with the necessary level of knowledge or skills.
6 **Model use**	▪ **Use test requirements**: With regard to the role of the risk parameters in the relevant risk management processes, for two-thirds of the institutions, IRB parameters were not considered in certain internal processes for which institutions are encouraged to take them into account. ▪ **Assignment of exposures**: Several institutions did not present an appropriate process for treating unrated exposures or outdated ratings. In addition, the processes to define the maximum extent of overrides lacked completeness or were insufficient.

3 General topics (3/3)
Summary of findings (3/3)

Overall, the outcomes of the TRIM investigations indicate that the internal models of SIs can generally continue to be used for the calculation of own funds requirements. However, the most frequent deviations and findings are summarised below.

7 **Management of changes to the IRB approach**	▪ **Re-rating process**: In most of the institutions, the re-rating process after a material model change or model extension was neither properly formalised nor covered in the relevant policy on the management of changes. ▪ **Classification**: Some institutions lacked a formalised classification process to ensure that model changes and extensions were classified in a consistent way.
8 **Third-party involvement**	▪ **Independent performance monitoring**: In some cases, institutions did not ensure proper monitoring of third-party performance in connection with outsourced tasks and/or the use of external data.

4 Credit Risk – models for retail and SME portfolios (1/10)

PD Modelling Landscape: Key points (1/2)

An overview of the observed features of PD models in these areas (the "modelling landscape") is provided below

1 **General modelling approaches**	▪ **11%** of the PD models were based on a continuous granularity with **continuous direct estimates**. For the remaining, **33**% mapped continuous PD to a **discrete grade scale** (either masterclass or portfolio specific), and **56**% of the PD used for capital requirements was based on the **LRA DR at grade level**.
2 **Risk differentiation**	▪ Different practices were observed regarding the **risk drivers** considered in the model, most institutions used **internal behavioural information** (including **past delinquency**, which over 90% of the investigated internal models used as a driver in the scoring function), **financial information** and **contract/obligor** characteristics in their PD models. ▪ **Homogeneity** within grades and **heterogeneity** across grades was one of the areas targeted during the TRIM investigations. In a majority of cases, no specific analyses were conducted by institutions, or the analyses were not considered appropriate
3 **Grade assignment dynamics**	▪ A wide range of practices were observed, with methods being on different combinations of either **short or long term exclusively**. In light of this, **additional clarifications have been included in the ECB guide to internal model**. Although PD's time horizon is one year, the rating/grade assignment should adequately anticipate and reflect risk over a longer time horizon.
4 **Calculation of one-year default rates**	▪ More than **70% of investigations ended without severe findings** on the calculation of one-year default rates and the LRA DR. Additionally, the level of PD assignment and the counting unit for the DR was consistent for the vast majority of institutions.

4 Credit Risk – models for retail and SME portfolios (2/10)

PD Modelling Landscape: Key points (2/2)

An overview of the observed features of PD models in these areas (the "modelling landscape") is provided below

5 Long-run average default rate and calibration methodology

- Different **observation periods** were used for the computation of the LRA: 86% used at least 5 years, meanwhile 29% used at least 10 years. Years 2008 (70% of cases) and 2009 (90%) were considered downturn periods. Only 34% of institutions used data before 2006.
- **Half of the institutions used the average observed DR**, while the other half applied adjustments. The most common adjustments when institutions did not have observed default data on the **LRoV period**: extrapolation, weighting schemes and a combination of historical observation, forward looking and expert judgment.
- For the retail exposure class is possible to increase the weigh of the recent periods if it leads to a better prediction. **66% of institutions did not modified the weighting scheme**, 5% used higher weighting in recent periods, 20% used weights base on observation and the remaining 9% used another weighting scheme.
- **44%** of the institutions calibrated at **segment level**, meanwhile **56**% did at **grade level**.

6 Margin of Conservatism

- **40%** of institutions were already applying an **explicit MoC**, while near **50%** stated that a **MoC was implicitly considered** through conservative assumptions. In the remaining, no MoC was considered.
- For institutions with an explicit MoC, margins were applied mostly to account for **data and methodological deficiencies** (**MoC A - 62**%) and the **general estimation error** (**MoC C - 71%**), while in **26%** of cases they were applied to account for **representativeness issues** (**Moc B**).

4 Credit Risk – models for retail and SME portfolios (3/10)

LGD Modelling Landscape: Key points (1/3)

An overview of the observed features of LGD models in these areas (the "modelling landscape") is provided below

1 **General modelling approaches**	▪ **80% of the LGD models** employed a component-based approach, generally consisting of **differences between secured and unsecured** exposure, on the termination scenario, or on the use of intermediate phases in the recovery process. ▪ In approximately **45%** of cases, the LGD estimates result from a **continuous scale**. In the remaining **55**% of cases a **discrete scale** was used (45% of cases, the aggregation of several components resulted in a discrete scale; in the remaining, the LGD estimates resulted from the LR average calculated at grade level).
2 **Calculation of realised LGD**	▪ **78%** of the institutions computed the **realised LGD at facility level**, **11**% did at **obligor level** and the remaining was a mix of approaches or the assignment level was to a group of connected obligors. ▪ In around **40%, recovery flows were not directly observed** but calculated as the difference between exposures on two consecutive dates or derived from another treatment. ▪ About **33%** of institutions **were not able to connect the new facility after restructuring** to the facility prior to restructuring. 71% of the LGD models did not consider in the definition of loss the diminished financial obligations that result from the restructuring. ▪ Although EBA is prescriptive on the discount rate at **3M Euribor plus 5%** a wide variety of practices were observed. **30%** used a **fixed rate**, **19%** the **contractual rate**, **19%** the **base rate with an additional premium** and **10%** the **base rate without such premium**. ▪ **40**% of retail models **followed an adequate treatment of additional drawings** (AD), meanwhile 40% did not ensure alignment between EAD and CCF (the reaming 20% is for specific exposures that do not allow AD). On the other hand, **85% of the non-retail exposures there was an inappropriate treatment**, since none of them considered the AD at the same time both in the numerator and denominator and in the definition of the CCF (the remaining 15% is for specific exposures that do not allow AD). ▪ As for the treatment of reposed but not yet sold collaterals, **42 % of institutions applied a haircut** to the repossession, **11% used it directly**, while the remaining **47% did not consider** the repossession only recognizing **the cash flow once the collateral was sold**.

4 Credit Risk – models for retail and SME portfolios (4/10)

LGD Modelling Landscape: Key points (2/3)

An overview of the observed features of LGD models in these areas (the "modelling landscape") is provided below

3 **Risk differentiation**	▪ Most institutions used **contract characteristics** (including collateral type). Around **35% used obligor characteristics** and **20% used internal behavioral** information. ▪ When an LGD scale is used, 47% of the cases used statistical analysis to ensure homogeneity/heterogeneity, 35% used solely expert judgment, while the remaining 18% no analysis was conducted. ▪ **74%** of the institution's **monitoring exercises did not have a process** in place to **check homogeneity/heterogeneity**.
4 **Treatment of incomplete recovery processes**	▪ In **59%** of institutions already had a definition of time-to-workout. The **length** of this period varied from **3 to 15 years**, depending on the country, the exposure class and the recovery processes. ▪ **32% of the institutions** did **not explicitly considered incomplete recovery files**, while almost **68%** of the institutions **did consider incomplete files**, either by **extrapolating** cash flows (**47%**) or by assuming **no further recoveries** (**21%**).
5 **Long-run average LGD**	▪ **40%** of institutions **calculated de LRA LGD at portfolio/calibration segment**, **24**% did at **grade level**. However, the reaming 36% had an inappropriate approach. Of those, **14% did not compute the LRA** and 22% only computed at component level. ▪ Although there were differences in the **observation period**, a common period used by most institutions **was between 2008 and 2013** (78% used all six years) ▪ Near **60% used a default weighted averages**, nevertheless around 40% used inappropriate approaches as EAD weighting (20%) or not computing LRA (14%).

4 Credit Risk – models for retail and SME portfolios (5/10)

LGD Modelling Landscape: Key points (3/3)

An overview of the observed features of LGD models in these areas (the "modelling landscape") is provided below

6 **Downturn adjustment**	▪ An **explicit period was defined to derive a downturn LGD was used in 53%** of the models, whereas in the rest an adjustment was made without identifying a period or no adjustment was made. ▪ Although similar economic downturn periods for the same country and exposure type were expected, **76%** of the models, the **downturn period included the years 2008 or 2009**, while in **26%**, the period included data from **before 2006**. ▪ In 41%of the models, **the downturn adjustment was based on observed values** during the selected downturn period. In 26%, the d**ownturn adjustment was obtained by stressing model components** (e.g. interest rates, collateral values, etc.), while in **11%, no downturn adjustment** was applied.
7 **Margin of Conservatism**	▪ **40%** of institutions were already applying an **explicit MoC**, while near **50%** stated that a **MoC was implicitly considered** through conservative assumptions. In the remaining, no MoC was considered. ▪ For institutions with an explicit MoC, margins were applied to account for **data and methodological deficiencies (MoC A - 74%) representativeness issues (MoC B -80%)** and **general estimation error (MoC C - 80%).**
8 **ELBE and LGD in-default**	▪ Regarding **ELBE**, **21%** of institutions, **did not had a specific estimation in place**, and in the **25%, the ELBE estimate was based on or equal to the credit risk adjustments**. In the remaining 54% of cases, the ELBE was instead evaluated using a dedicated model. ▪ Regarding the estimation of **LGD in-default, in 29% of the investigations, there was no specific estimation in place**, in other **33%,** the LGD in-default was calculated as the sum of the ELBE plus an add-on, while in 38% there was a "direct" LGD in-default approach.

4 Credit Risk – models for retail and SME portfolios (6/10)
Findings (1/5)

The horizontal analyses carried out in the context of TRIM have enabled the ECB to identify the most common or critical shortcomings of internal models

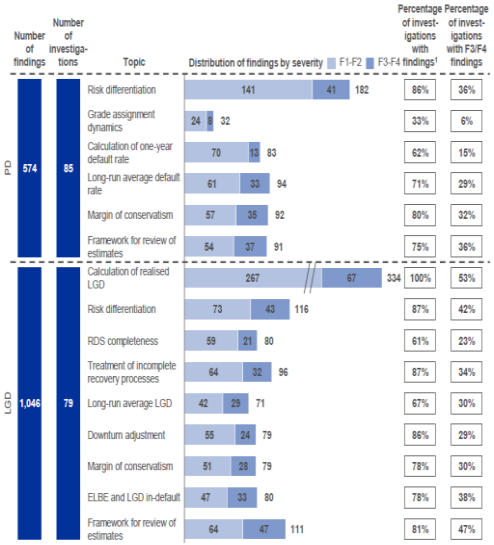
In total, 85 investigations were carried out on the selected credit risk models for retail and SME portfolios, covering 53 SIs

A total of 2,000 findings are reported based on the investigations carried out. According to their severity, the findings are distributed as follows:

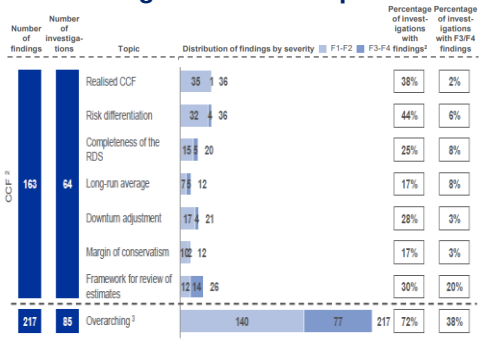
- **F1: 24%**
- **F2: 46%**
- **F3: 25%**
- **F4: 5%**

The average number of findings per investigation was 24

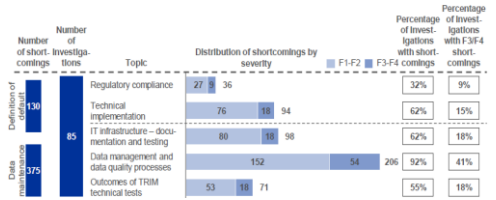
The LGD and PD findings are distributed as showed below



Although not detailed, overarching and CCF findings have been reported.



Data Quality findings are also reported



4 Credit Risk – models for retail and SME portfolios (7/10)
Findings (2/4)

The most frequent findings in each section of the PD parameter are detailed below

1 **Risk differentiation**	▪ In **more than half** of the models reviewed, **findings were raised concerning low risk differentiation** of PD models owing to the low discriminatory power of the scoring/ranking functions and/or **as a result of inappropriate homogeneity/heterogeneity of the grades**. In a significant number of cases, **these findings were assigned a high severity (at least F3)**. ▪ Findings were also frequently triggered by the **inappropriate justification of modelling assumptions** and issues with the **range of application** of the models.
2 **Grade assignment dynamics**	▪ Findings were mainly related to the **lack of analysis of the grade assignment dynamics**, and its implications in terms of risk quantification and parameter estimation.
3 **Calculation of one-year DR**	▪ Findings were raised in relation to **shortcomings in the method used to compute the default rate** and lack of **representativeness of the DoD** across time.

4 Credit Risk – models for retail and SME portfolios (8/10)

Findings (2/5)

The most frequent findings in each section of the PD parameter are detailed below

4 **LR average default rate**	▪ In around **40% of the models** reviewed, findings were raised concerning the **period used to define the long-run average not being properly justified or appropriate**. In a significant number of cases, these findings had a high severity.
5 **Margin of conservatism**	▪ Most of the findings concerned the **inappropriate calculation of the level of conservatism** and the **absence of a framework** for the identification of deficiencies and **quantification of the respective MoC**. In a significant number of cases, and for both reasons, these findings had a high severity.
6 **Framework for the review of estimates**	▪ Many findings were raised in relation to the **framework for the review of estimates**, including cases where **relevant analyses were missing** or not prescribed.

4 Credit Risk – models for retail and SME portfolios (9/10)
Findings (3/5)

The most frequent findings in each section of the LGD parameter are detailed below

1 **Calculation of realised LGD**	▪ Issues regarding the **calculation of realised LGD** were identified in **all of the investigations**. In particular, these findings related to the **lack of** the necessary **information to compute realised LGD**, the definition of **economic loss** not being comprehensive enough and the process of **allocation of recoveries and costs** leading to bias in LGD estimates.
2 **Risk differentiation**	▪ A majority of investigations identified deficiencies with regard to the risk drivers for LGD models, in particular in relation to **missing or irrelevant risk drivers. Poor risk differentiation** of the LGD models was an issue in almost **half of the investigations**, owing to **low discriminatory power** of the scoring/ranking functions and/or **inappropriate homogeneity/heterogeneity** of the grades.
3 **RDS completeness**	▪ **Findings** were raised with regard to **data exclusions not being adequately justified** and cases where the institution did not include in the reference dataset all the information needed to estimate the LGD.
4 **Incomplete recovery processes**	▪ The main findings were related to **non-consideration of incomplete cases** in the LGD estimation and the **inadequate definition of the time-to-workout**.

4 Credit Risk – models for retail and SME portfolios (10/10)
Findings (5/5)

The most frequent findings in each section of the LGD parameter are detailed below

5 **Long-run average LGD**	▪ The most significant findings were related to the **use of a weighting other than facility-weighted average** and to the **calibration methodology of the long-run average**, including lack of or inappropriate adjustments to ensure a representative long-run average.
6 **Downturn LGD**	▪ A majority of findings with regard to the downturn LGD related to **the identification of the relevant downturn conditions**, or where the institution did not **take into account a sufficiently long historical dataset** of such indicators. In around **one-third** of the models, issues with the **quantification of the downturn adjustment** were identified.
7 **Margin of conservatism**	▪ Most of the findings on this topic concerned the **inappropriate calculation of the level of conservatism** and the **absence of a framework** for the identification of deficiencies and **quantification of the respective MoC**.
8 **ELBE and LGD in-default**	▪ In around 20% of cases, findings were raised concerning the **lack of dedicated ELBE or LGD in-default models**, while in around **one-third** of cases, findings were raised owing to **weaknesses in the modelling approach**.
9 **Framework the for review of estimates**	▪ A majority of findings in this sub-topic related to a **lack of relevant analysis** (affecting almost **half of the models**); for example, the institution **not performing the minimum scope of tests** expected or **not having an appropriate set of metrics** to test model performance.

5 Credit Risk – models for low default portfolios (1/13)

PD modelling landscape (1/2)

An overview of the observed features of PD models in these areas (the "modelling landscape") is provided below

1 **General modelling approaches**	▪ More than **90% of institutions use a discrete scale** in estimating PD. Of these, 60% use a master scale (common to different entity rating systems) and the remaining 40% use a model-specific rating scale.
2 **Risk differentiation**	▪ Entities applied **different approaches** to risk differentiation have been observed (**27%** of cases using **default event as the target variable**, **26% shadow rating** modelling, **In 23% of cases an internal rating** as target variable, **16% expert judgment** and other methods). ▪ Approximately **80% of the models include qualitative and financial information** in the risk assessment, while geographic or external agency information is less used.
3 **Grade assignment dynamics**	▪ Regarding the time **horizon chosen when assigning obligors to grades** or pools, it is required to be greater than 1 year. However, **41% of the institutions took a time horizon of one yea**r, and 24% of the institutions have not defined it.
4 **Use of ratings of third parties**	▪ More than **90% of the entities used external ratings in the rating assignment process**.

5 Credit Risk – models for low default portfolios (2/13)

PD modelling landscape (2/2)

An overview of the observed features of PD models in these areas (the "modelling landscape") is provided below

5 **Treatment of joint credit obligations**	▪ **Overrides** of the model outputs are **mostly used in the final phase** of the rating assignment process. **TRIM recognizes** a number of areas for **improvement in this process** (frameworks, maximum override rates, etc.).
6 **Risk quantification**	▪ **31% of the entities use only internal data in the PD model**, **29% use only external data**, **16% use mixed data and 10% use pooled data**. The remaining 10% of the entities develop expert models that do not use data. ▪ **57% of the entities using external data or pooled data** did not perform a representativeness analysis. **50% of the same entities did not analyze the consistency of the different definitions of default**. ▪ In entities that used internal data, most of them opted to choose as Likely Range of Variability the period from the year 2000 onwards. For the models related to portfolios with very few defaults, the most common practice was to use all available external data at the time of the calibration.
7 **Margin of Conservatism**	▪ **23% of the institutions applied MoCs explicitly**, while **57% of them considered that the MoC was implicit under conservative model** assumptions. The remaining 20% did not consider any MoC. ▪ Among the entities that used MoCs explicitly, 82% calculated a MoC for data/methodological deficiencies, 24% for representativeness and 82% calculated a general estimation MoC.

5 Credit Risk – models for low default portfolios (3/13)

LGD modelling landscape (1/2)

An overview of the observed features of LGD models in these areas (the "modelling landscape") is provided below

1 **General modelling approaches**	▪ 74% of the LGD models employed a component-based approach, generally consisting of differences between secured and unsecured exposure. ▪ In approximately 62% of cases, the LGD estimates result from a continuous scale. In the remaining 38% of cases a discrete scale was used.
2 **Calculation of realised LGD**	▪ 54% of the entities did not incorporate realised LGD in the estimation, although most of them used it in backtesting. ▪ 35% of the institutions were not able to identify recovery cash flows. ▪ Only 4% of the institutions used a discount rate as indicated in the EBA Guidelines. The rest used a variety of non-compliant forms of discounting. ▪ Only 32% of institutions treated multiple defaults in a compliant manner. ▪ Only 26% of institutions considered additional provisions in the calculation of LGDs and CCFs.
3 **Risk differentiation**	▪ More than **60% used the obligor characteristics in the LGD model as a driver**. Collaterals were also used as drivers.
4 **Incomplete recovery processes**	▪ A **Time-to-Workout was defined in only 33%** of the models in which a LRA was calculated. ▪ **30% of the models** did not include a treatment of incomplete recoveries. 13% of the models did not include an estimate of future recoveries.

5 Credit Risk – models for low default portfolios (4/13)

LGD modelling landscape (2/2)

An overview of the observed features of LGD models in these areas (the "modelling landscape") is provided below

5 **Long-run average LGD**	▪ A Time-to-Workout was defined in only 33% of the models in which a LRA was calculated. ▪ 30% of the models did not include a treatment of incomplete recoveries. 13% of the models did not include an estimate of future recoveries.
6 **Downturn adjustment**	▪ 70% of the models have a defined downturn period. About 80% of these include the years 2008-2009. ▪ The most common (45%) approach in calculating the adjustment is inferring it on the basis of the realised LGD of the downturn years.
7 **ELBE and LGD in-default**	▪ In most cases (60%) both ELBE and LGD in-default were being assigned to defaulted exposures. In 13% of cases only ELBE was being calculated and in 5% of cases only an LGD in-default was being calculated.
8 **Margin of Conservatism**	▪ 43% of the institutions applied MoCs explicitly at grade/calibration level, while 35% of them considered that the MoC was implicit under conservative model assumptions. The remaining 22% did not consider any MoC. ▪ Of the entities that employed MoCs explicitly, 71% calculated a MoC for data/methodological deficiencies, 14% for representativeness and 81% calculated a general estimation MoC.

5 Credit Risk – models for low default portfolios (5/13)

Findings (1/5)

The horizontal analyses carried out in the context of TRIM have enabled the ECB to identify the most common or critical shortcomings of internal models

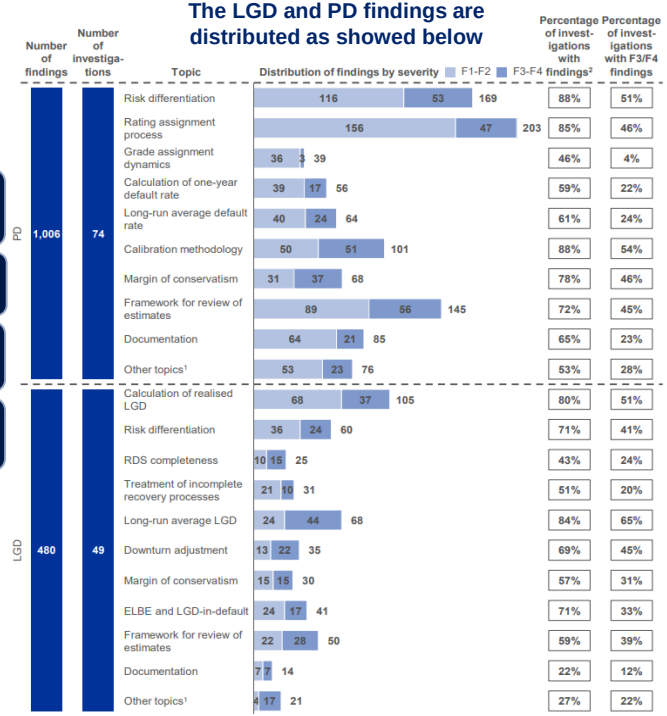
In total, 76 investigations were carried out on the selected credit risk models for LDPs, covering 48 SIs

A total of 1,700 findings are reported based on the investigations carried out. According to their severity, the findings are distributed as follows:

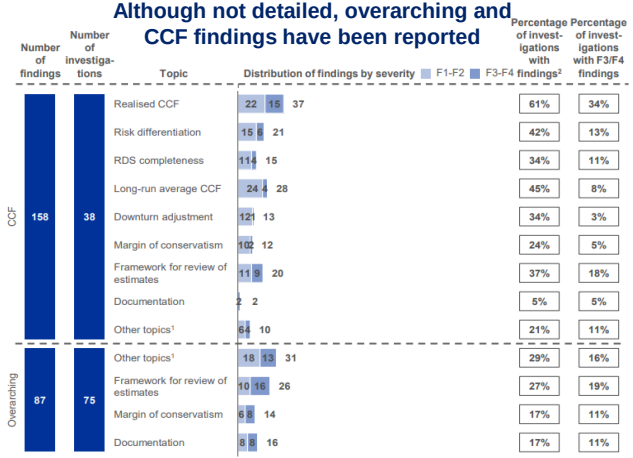
- **F1: 14%**
- **F2: 49%**
- **F3: 30%**
- **F4: 8%**

The average number of findings per investigation was 22

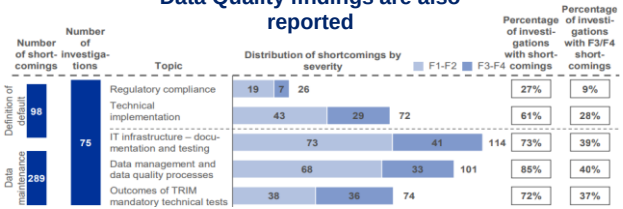
The LGD and PD findings are distributed as showed below



Although not detailed, overarching and CCF findings have been reported



Data Quality findings are also reported



5 Credit Risk – models for low default portfolios (6/13)
Findings (2/5)

The most frequent findings in each section of the PD parameter are detailed below

1 **Rating assignment process**	▪ Findings were raised concerning flaws in the **rating assignment process and inconsistent application of the assignment process**. ▪ In addition, a significant number of findings were raised in relation to the **improper use of overrides**
2 **Risk differentiation**	▪ A significant number of findings were raised in relation to the **selection of risk drivers** ▪ Multiple findings were raised in relation to the **homogeneity/heterogeneity of obligors or exposures**
3 **Grade assignment dynamics**	▪ Findings were mainly related to the **lack of analysis of the grade assignment dynamics**, and its implications in terms of risk quantification and parameter estimation.
4 **Calculation of one-year default rates**	▪ Findings were raised in relation to the **incorrect calculation of one-year default rates**, **unjustified exclusions** from the one-year default rate calculation and cases where there was an inappropriate treatment of multiple defaults.
5 **Long-run average default rate**	▪ **Shortcomings** were observed in relation to the **calculation of the long-run average** default rate and in relation to the appropriateness on the **period covering the likely range of variability of default** rates.

5 Credit Risk – models for low default portfolios (7/13)
Findings (3/5)

The most frequent findings in each section of the PD parameter are detailed below

6 **Calibration methodology**	▪ The most frequent **type of finding related to calibration assumptions** that were **not properly justified** and deficiencies in the calibration analyses
7 **Margin of conservatism**	▪ Findings were raised in relation to the **lack of robust processes for identifying deficiencies that should be accounted for in the MoC** or the lack of processes to quantify the impact of such deficiencies. Several findings were raised concerning the absence of an appropriate MoC framework.
8 **Framework for the review of estimates**	▪ Many findings were raised in relation to the **framework for the review of estimates**, including cases where **relevant analyses were missing** or not prescribed.
9 **Documentation**	▪ Findings were raised when the **documentation on a topic was incomplete** or missing.
10 **Other topics**	▪ The areas with the most **shortcomings concerned the robustness of the validation function** and the range of application of the model not being appropriately defined and/or respected in practice.

5 Credit Risk – models for low default portfolios (8/13)
Findings (4/5)

The most frequent findings in each section of the LGD parameter are detailed below

1 **Calculation of realised LGD**	▪ A number of findings were raised in relation to the calculation of realised LGD, including cases where **recovery flows were not appropriately allocated**, **discounts rates were not being or not appropriately applied** or cases where multiple default had an inappropriate treatment.
2 **Risk differentiation**	▪ Over **half of the investigations** identified **deficiencies with regard to the risk drivers** for LGD models.
3 **RDS completeness**	▪ **Findings** were raised with regard to **data exclusions not being adequately justified** and cases where the institution did not include in the reference dataset all the information needed to estimate the LGD.
4 **Incomplete recovery processes**	▪ In **20%** of investigations, findings were raised in relation to the **non-consideration of incomplete recovery processes** in the LRA calculation. ▪ In around **60% of investigations**, a finding was raised in relation to the **estimation of future recoveries**.
5 **Long-run average LGD**	▪ Just under **half of the investigations** identified **shortcomings in relation to the representativeness** of the calibration sample. ▪ Also common were issues relating to predictive ability and cases where the **LGD estimation was not based on realised LGD**.
6 **Downturn LGD**	▪ Findings were raised across a number of areas, including **weaknesses in the quantification of the downturn impact**, the **identification of the downturn period** and insufficient consideration of macroeconomic indicators. Some institutions did not define an economic downturn adjustment.

5 Credit Risk – models for low default portfolios (9/13)
Findings (5/5)

The most frequent findings in each section of the LGD parameter are detailed below

7 **Margin of conservatism**	▪ Most of the findings on this topic concerned the **lack of a MoC framework** or the absence of robust processes for identifying and quantifying deficiencies which should be accounted for in the MoC.
8 **ELBE and LGD in-default**	▪ Issues included institutions **not having ELBE or LGD in-default estimates**, a lack of justification for assumptions in the estimation, and institutions not having clear documentation on the breakdown of ELBE and LGD in-default or the breakdown of the unexpected loss add-on component,.
9 **Framework the for review of estimates**	▪ Framework for the review of estimates not prescribing any predictive ability/back-testing/homogeneity/heterogeneity analyses, or where a regular cycle for full review of the rating systems was not defined or implemented. .
10 **Documentation**	▪ In 40% of cases, **documentation was either incomplete or missing**, particularly in relation to the calculation of realised LGD and of LRA LGD.
11 **Other topics**	▪ Other findings related to the **robustness of the validation function** and the range of application of the LGD model not being appropriately defined and/or respected in practice.

5 Credit Risk – models for low default portfolios (10/13)

Supervisory follow-up: Limitations, obligations or recommendations

The supervisory decisions issued as a follow-up to TRIM investigations contain limitations, obligations or recommendations depending on the basis for the finding

An obligation is therefore the primary means of setting out how a finding needs to be addressed. Obligations can be further categorized as follows:

- To make a change
- To provide further analysis or justification, or to better document or report on an aspect of the internal models.
- To make a change, unless further evidence can be provided which clarifies that no further action is required

The obligation remains in force until full compliance therewith, as the specific case of non-compliance with regulatory requirement must be remediated

In some cases a finding might warrant immediate action

- In this case, a Limitation is used in addition to an Obligation
- Limitations restrict or modify the use of a model.
- Limitations only applies for the period up until the corresponding obligations are fulfilled.

TRIM supervisory decisions on Limitations have an impact on institutions' capital

- Limitations (along with model changes approved) will lead to a 12% increase (275 billions)(1) in the aggregated RWA covered by the models in scope of TRIM.
- At the individual institution level, an average increase of 26%(1) was observed for RWA covered by each TRIM investigation.[1]

Supervisory decisions issued can contain recommendations. A recommendation is an action recommended to the institution. Unlike an obligation it has no legally binding effect or deadline.

1 Aggregated impact of limitations and material model changes approved with TRIM decisions for internal models for credit, market and counterparty credit risk across 65 SIs.

5 Credit Risk – models for low default portfolios (11/13)

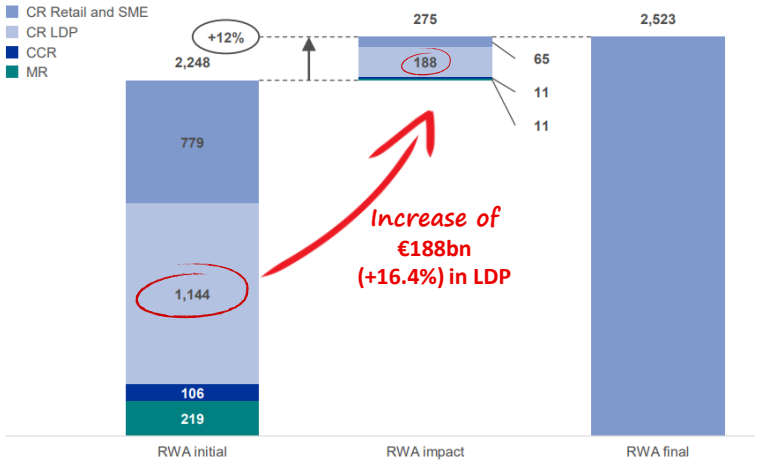
Supervisory follow-up: Impacts on LDP

TRIM supervisory decisions have had the following impact on institutions regarding credit risk in Low Default Portfolios

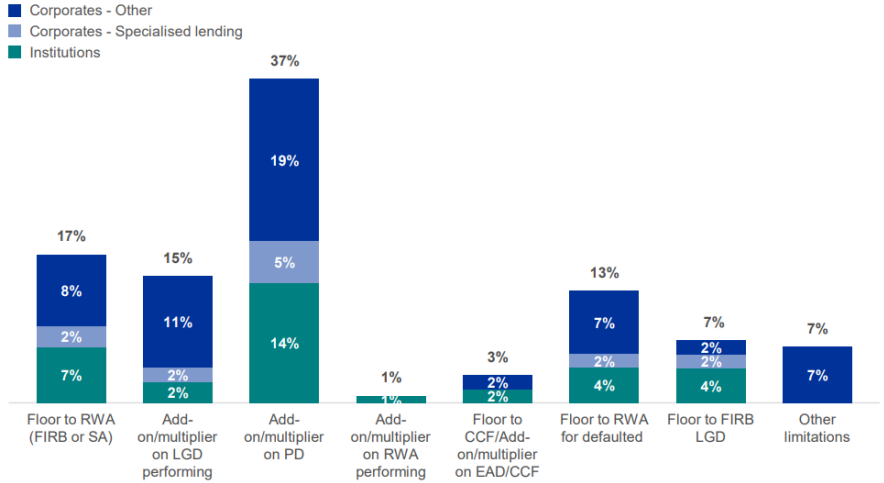
The impact of limitations and material model changes approved with TRIM decisions led to an **increase of €188 billions (16.4% increase) in credit risk LDP** models, representing 68.4% of the aggregate impact of the supervisory decisions all models (€275 billions)

Chart below provide detailed information on the credit risk supervisor measures imposed in connection wit LDP investigations. Almost **70% of the supervisory measures fall into three categories: Add-on/multiplier related to PD, LGD and floor to RWA (FIRB or SA)**

Impact on RWA (EUR billions) of inspected models – SSM level by risk type



Supervisory measures by type – focus on LDP



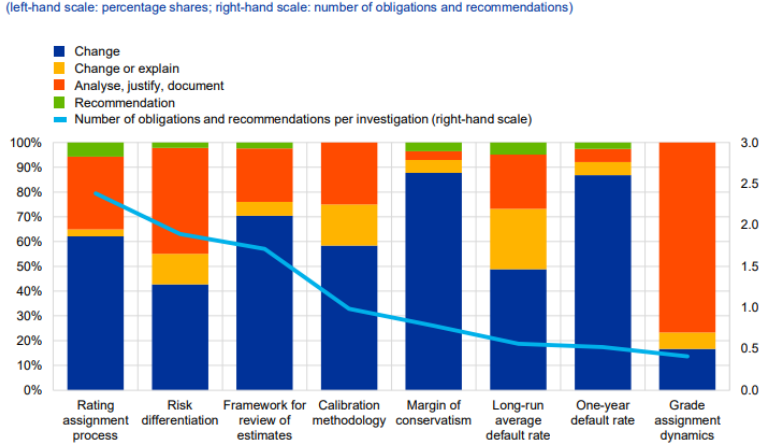
5 Credit Risk – models for low default portfolios (12/13)

Supervisory follow-up: General PD findings (1/2)

When describing how the supervisory follow-up of TRIM has contributed to reducing unwarranted RWA variability for credit risk the main focus will be on obligations and recommendations. In PD case:

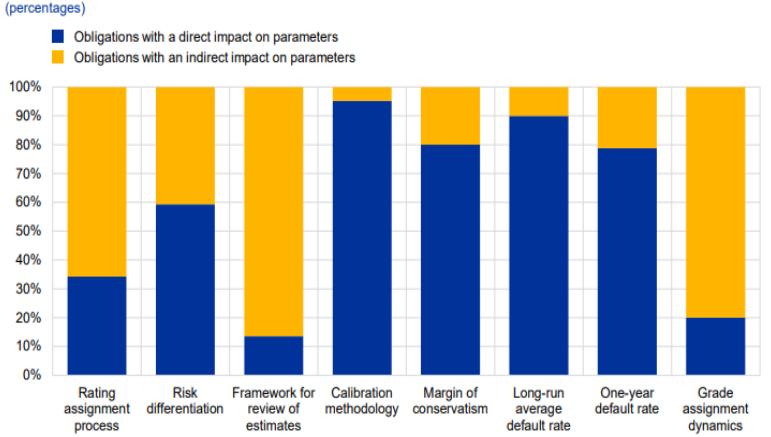
The chart below provides an overview of the supervisory follow-up for PD according to a high-level categorization of the findings raised

PD findings – supervisory follow-up by type



The chart below presents a summary of whether "change" obligations affect risk parameters directly (ie. adding a specific MoC) or indirectly (ie. Improvements to validation activities)

PD findings – impact of "change" obligations on PD risk parameters



Limitations are not included in the charts since they applies for the period up until the corresponding obligations are fulfilled. "Documentation" and "Other topics" categories have been excluded owing to their horizontal nature.

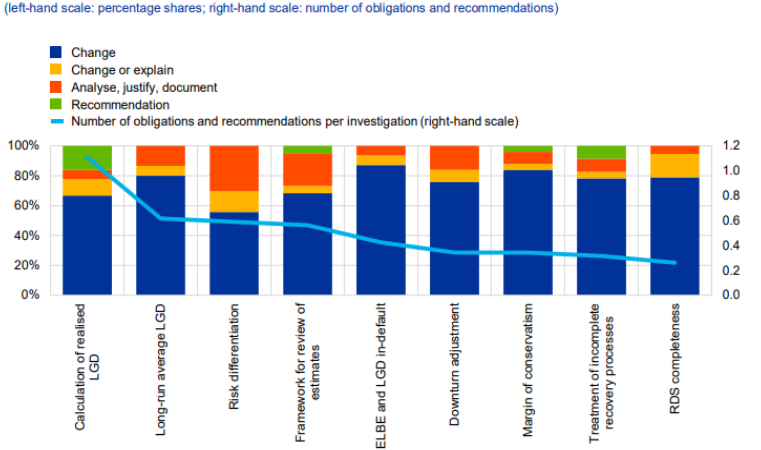
5 Credit Risk – models for low default portfolios (13/13)

Supervisory follow-up: General PD findings (2/2)

When describing how the supervisory follow-up of TRIM has contributed to reducing unwarranted RWA variability for credit risk the main focus will be on obligations and recommendations. In LGD case:

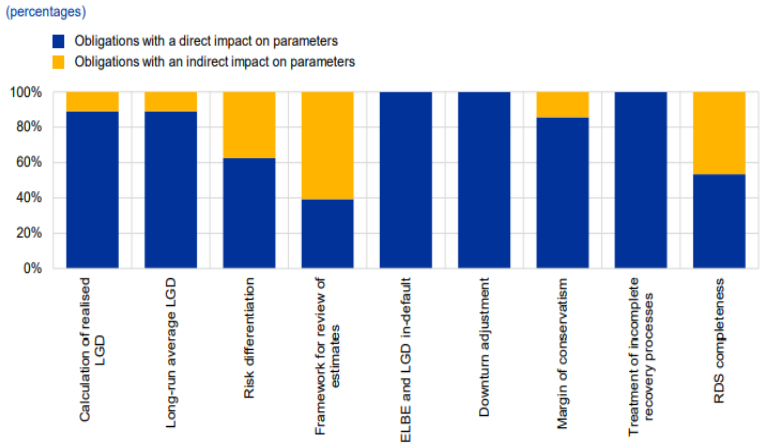
The chart below provides an overview of the supervisory follow-up for LGD according to a high-level categorization of the findings raised

LGD findings – supervisory follow-up by type



The chart below presents a summary of whether "change" obligations affect risk parameters directly (ie. adding a specific MoC) or indirectly (ie. Improvements to validation activities)

LGD findings – impact of "change" obligations on risk parameters



Limitations are not included in the charts since they applies for the period up until the corresponding obligations are fulfilled. "Documentation" and "Other topics" categories have been excluded owing to their horizontal nature.

6 Market risk (1/5)

Var, sVaR and IRC Modelling Landscape (1/2)

31 investigations were carried out for internal market risk models. 19 investigations were carried out for incremental default and migration risk. An overview of the observed features of VaR and sVaR models and IRC models in these areas ("the landscape") is provided below

1 VaR and sVaR Scope

- About **half of the in-scope institutions** have approval to **use the internal models** approach **for all six market risk categories**. The rest has partial use of the model (having all of them been granted IMA approval for general risk of debt instruments)

2 VaR and sVaR modelling

- Most common modelling approach **was historical simulation** (19 cases), with 7 employing MC simulation, and 5 parametric or mixed approach
- All institutions performed **backtesting** at top of the house level, and all but 5 backtested also below top level portfolios
- 22 institutions used a **1-year historical period**, and 9 a 2-year period. The stressed period spanned **2008 and 2009** in all but 5 cases

3 VaR and sVaR Pricing functions

- Three quarters (23) of institutions used **full revaluation** for a majority of financial instruments within the scope of their VaR model.
- For 50% of the institutions VaR pricing methods were aligned with economic P/L pricing methods

6 Market risk (2/5)

Var, sVaR and IRC Modelling Landscape (2/2)

31 investigations were carried out for internal market risk models. 19 investigations were carried out for incremental default and migration risk. An overview of the observed features of VaR and sVaR models and IRC models in these areas ("the landscape") is provided below

4 **VaR and sVaR RNIME**	▪ Two-thirds of institutions had in place a process to **identify risks not in the VaR and sVaR** model engines, and 10 of them applied some type f RNIME add-on
5 **IRC Scope and positions**	▪ **19 IRC models** in use at 17 institutions were reviewed in TRIM, all of them based on a MC simulation ▪ 14 institutions used a **multivariate Gaussian distribution** (vs Sudent's t-distribution or mixed approaches)
6 **IRC Parameters**	▪ The use of **zero or very low PDs** for obligors in the IRC model was identified in a majority of institutions (11/19 assumed PDs < 1BP) ▪ Most institutions used **recovery rates from data provided by external agencies** (vs IRB RRs or Front Office RRs. 2/3 assumed constant RRs

6 Market risk (3/5)
Findings (1/3)

The horizontal analyses carried out in the context of TRIM have enabled the ECB to identify the most common or critical shortcomings of internal models

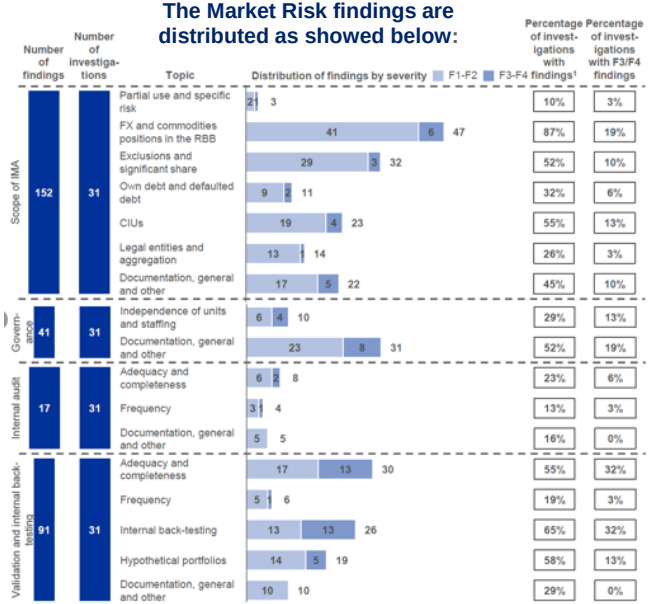
There were 31 TRIM investigations related to market risk models, of which 17 included the assessment of the IRC models of institutions that used the IMA for specific risk of debt instruments.

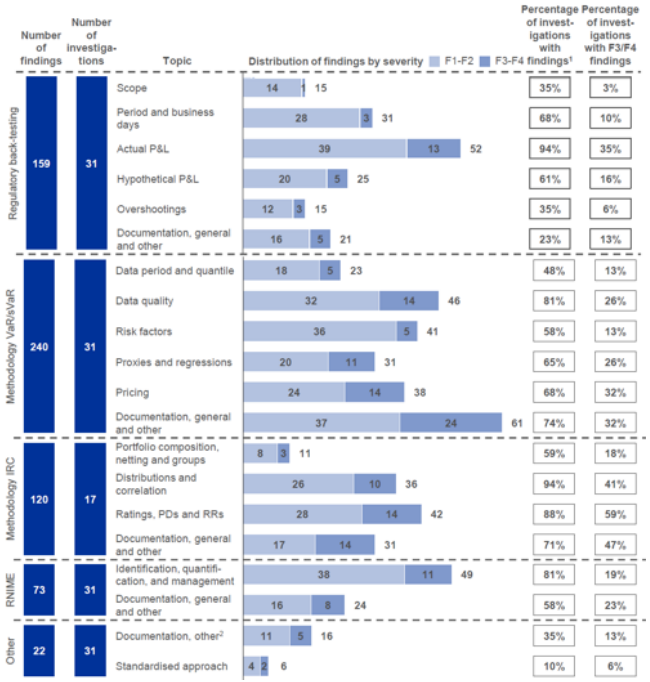
A total of 900 findings are reported based on the investigations carried out. According to their severity, the findings are distributed as follows:

- F1: 26%
- F2: 48%
- F3: 23%
- F4: 3%

The average number of findings per investigation was 29; for institutions without an IRC model the average was 22.

The Market Risk findings are distributed as showed below:





6 Market risk (4/5)
Findings (2/3)

The most frequent findings in each section of the Market Risk are detailed below

1 **Scope of IMA**	▪ A high number of findings were made on the treatment of **FX and commodities** risk from positions in the regulatory **BB**, mainly relative to inadequate definition of internal TB/BB boundary, incorrect calculation, inadequate documentation and lack of monitoring. ▪ Exclusions (such as **BTB** transactions) and treatment of **CIUs** were also found insufficiently substantiated or not-well documented.
2 **Internal validation and internal back-testing**	▪ Deficiencies in the adequacy and completeness of the **internal validation** tests as well as in the **internal back-testing** programme ▪ Findings relative to the required back-testing on **hypothetical portfolios** showed that institutions were not carrying it out, or only to a very limited extent.
3 **Regulatory back-testing**	▪ Findings: lack of specific definition of business and non-business days (trading on local holidays, missing P&L figures for specific dates,…), definition and deficiencies in actual P&L concepts (fees, commissions, fair value adjustments, CVA, theta …), insufficient alignment (pricing functions, market data,..) of economic P&L and the hypothetical P&L, as well as the inconsistent treatment of the **theta effect** in the HPL.

6 Market risk (5/5)
Findings (3/3)

The most frequent findings in each section of the Market Risk are detailed below

4 **VaR and sVaR methodology**	▪ Shortcomings in **data quality assessment**: data cleansing processes, outlier correlation, data filtering, documentation ▪ Missing **risk factors** or inadequately modelled risk factors, as well as insufficient justification with respect to RF modelling ▪ Inadequate **pricing methods** for particular products in the VaR model, insufficient or missing validation of the adequacy of pricing methods.
5 **IRC methodology**	▪ Unjustified or inaccurate **RR or PD values** (inconsistent assignment, set manually, or without proper justification). Special attention to PDs close to zero (typically occurring for sovereign obligors). ▪ **Distributions and correlations**: Insufficient or no justification of modeling choices (copula..), assumptions, as well as bad quality of data set for calibration correlations.
6 **Risks not in the model engines**	▪ **Inadequate** or missing **quantification** of RNIME and, less frequently, **no RNIME framework** in place at all.

7 Counterparty credit risk (1/5)

Key observations on IMM Modelling Landscape (1/2)

The scope of TRIM for IMM in CCR was limited to 8 institutions. An overview of the observed features of CCM models in these areas (the "modelling landscape") is provided below

1 Scope of the IMM

- For **derivatives**, the scope of the IMM covers, in most cases, **all asset classes**, with 2 exceptions for inflation and 1 for commodities
- For **SFTs** most institutions had an IMM that mainly covered bond and equity underlyings

2 Margining

- A majority (6/8) of in-scope institutions use a **backward-looking approach** to MPOR modelling. The length of the MPOR
- All accounted for the variation margin when calculating expected exposures, with 4 assuming current collateral composition would remain
- Limited use of a dynamic initial margin

3 Maturity

- Most institutions usually established an **effective floor** of 1Y for derivatives.

7 Counterparty credit risk (2/5)

Key observations on IMM Modelling Landscape (2/2)

The scope of TRIM for IMM in CCR was limited to 8 institutions. An overview of the observed features of CCM models in these areas (the "modelling landscape") is provided below

4 **Time grid points and scenarios**	▪ The approach used to define the number of **grid points** and their **position** differs significantly across institutions (3 using less than 100 grid points and 2 using more than 300 grid points) ▪ 4 institutions used between 1000-2000 scenarios, and the rest between 3000-5000
5 **Calibration**	▪ Half of the institutions had **monthly or more frequent** calibration. ▪ 5/8 used just **one stress period** (the one at group level). .
6 **Validation**	▪ Progress is being made in implementing effective and independent **validation**, but this remains a challenge (in 4 cases validation was still not considered to provide sufficient effective challenge to certain tasks) ▪ All applied **backtesting** at risk factor level, and half of them also to actual and or hypothetical trades. At portfolio level, 4 used both actual and hypothetical portfolios, and the other 4 just one approach. Unsatisfactory results were obtained in 5 institutions

7 Counterparty credit risk (3/5)
Findings (1/3)

The horizontal analyses carried out in the context of TRIM have enabled the ECB to identify the most common or critical shortcomings of internal models

There were 8 TRIM investigations related to CCR models.

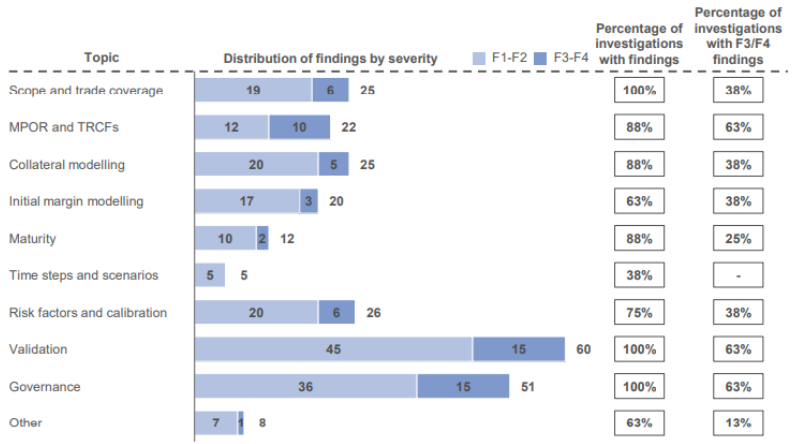
A total of 236 findings are reported based on the investigations carried out. According to their severity, the findings are distributed as follows:

- **F1: 27%**
- **F2: 50%**
- **F3: 22%**
- **F4: 1%**

The average number of findings per investigation was 29.

Figure 10
Overview of findings (CCR investigations)

The Counterparty Credit Risk findings are distributed as showed below:



Source: ECB supervisory information.
Note: Where a finding relates to multiple topics (which applies to 18 findings), the finding is counted under each relevant topic on the chart.

It is worth mentioning that Validation and Governance were the topics that generated the highest number of findings

7 Counterparty credit risk (4/5)
Findings (2/3)

The most frequent findings in each section of the Counterparty Credit Risk are detailed below

1 **Scope and trade coverage**	▪ **Insufficient coverage** of IMM with respect the proportion of transactions, and inadequate exclusion/inclusion of transactions.
2 **MPOR and trade-related cash flows**	▪ MPOR length shorter than regulatory floor, **inconsistencies** in the default management process and coarse time grid due to interpolation/extrapolation methods.
3 **Collateral modelling**	▪ **Overestimation** of collateral value, inappropriate accounting for the collateral composition, and **divergences** between actual and modelled collateral.
4 **Initial margin modelling**	▪ **Divergences** between actual and modelled initial margin, and insufficient accounting for contractual terms.
5 **Maturity**	▪ **Wrong formula** for M parameter in IMM exposures.

7 Counterparty credit risk (5/5)
Findings (3/3)

The most frequent findings in each section of the Counterparty Credit Risk are detailed below

6 **Time steps and scenarios**	▪ Related with impact of granularity of the time grid and number of scenarios on the accuracy of exposure calculation.
7 **Risk factor modelling and calibration**	▪ **Weaknesses in the assumptions** of the stochastic processes used and calibration of their parameters (in particular volatilities), and the length of the stress period and the corresponding stress calibration.
8 **Validation**	▪ Weaknesses in the scope and depth of validation. Deficient back-testing owing to **inappropriate coverage**, **missing levels** or risk measures and a **lack of follow-up** action.
9 **Governance**	▪ Inadequate or **missing documentation**, insufficient staffing and **unclear responsibilities**.