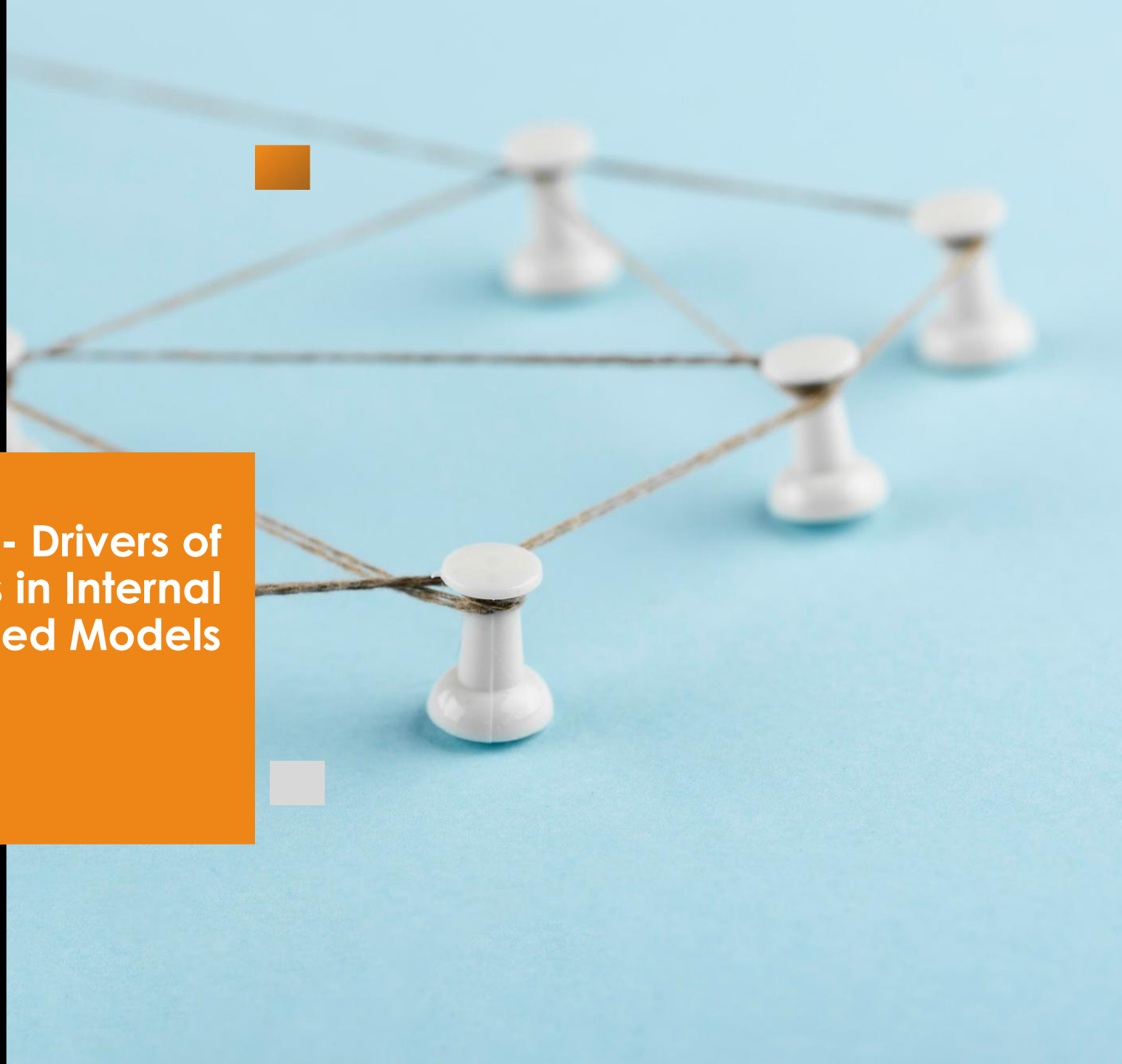
Just in Time

ECB: Severity over Quantity - Drivers of Supervisory Capital Add-ons in Internal Ratings-Based Models

September 2026



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Executive Summary

- This working paper examines **model risk** in **Internal Ratings-Based** (IRB) **models** used by European banks to calculate **credit-risk capital requirements**. Using a confidential dataset of 267 ECB and National Competent Authority Internal Model Inspections conducted between 2014 and 2020, it studies which supervisory findings lead to capital add-ons through temporary limitations on banks' risk-weighted assets.
- The central question is whether supervisory capital add-ons are driven mainly by the number of model deficiencies or by their severity. The evidence is clear: the quantity of findings is not statistically significant. Only findings classified as very high severity (F4) consistently explain the size of supervisory limitations.
- The paper also identifies a **practical early warning signal**: severe findings are disproportionately linked to data governance weaknesses, including problems in data quality, completeness, consistency and management processes used for model development and calibration. The main implication is that supervisors and banks should focus less on the accumulation of minor issues and more on material weaknesses, especially those affecting model inputs.
- Overall, the paper reframes model risk as a question of supervisory materiality. It shows that prudential intervention is not the mechanical outcome of finding more defects, but the result of identifying weaknesses that affect the reliability of capital estimates. This distinction is important for both policy and bank management, because it clarifies where attention and remediation resources should be concentrated.

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At a Glance

Keywords: Credit risk, IRB, model risk

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Introduction

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Introduction

IRB models allow banks to estimate key credit-risk parameters such as Probability of Default, Loss Given Default and Exposure at Default instead of relying solely on standardised risk weights.

This improves risk sensitivity but also creates model risk: errors in design, calibration, data or governance may lead to understated capital requirements.

Because such weaknesses are often invisible outside supervisory inspections, the paper uses confidential ECB evidence to assess their prudential consequences. Its core hypothesis is that capital add-ons are driven by the materiality of deficiencies rather than by their sheer number.

The issue is particularly relevant because IRB models affect the denominator of capital ratios. Even small errors in risk parameters can influence risk-weighted assets and, therefore, the level of capital a bank appears to need. At the same time, model deficiencies differ widely in importance. Some reflect documentation or process weaknesses with limited capital impact, while others affect the data, assumptions or calibration choices that determine the model's output. The paper focuses precisely on this distinction.

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Institutional Background and Literature Review

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Institutional Background and Literature Review

The regulatory framework reflects a persistent trade-off between simplicity, comparability and risk sensitivity.

Basel II permitted internal models to improve risk measurement, while **Basel III** and related reforms introduced safeguards against excessive modelling discretion.

The literature mirrors this **tension**: complex models can improve measurement, but they can also increase opacity, regulatory arbitrage and implementation risk.

Supervisory inspections *therefore play a* ***central role****. They classify findings from F1 to F4 and, when deficiencies may lead to underestimated capital, impose temporary limitations until remediation is complete.*

This institutional setting makes supervisory findings a valuable source of information.
They are not generic audit observations, but ***formal assessments*** *of whether internal models meet regulatory standards and produce* ***reliable capital outcomes****.*

The **severity scale** is therefore central to the analysis: it allows the paper to distinguish between deficiencies that may be relevant for governance or documentation and deficiencies that are sufficiently serious to justify prudential measures.

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Dataset

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Dataset

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The dataset covers banks supervised under the Single Supervisory Mechanism **from 2014 to 2020** and consists of **267 Internal Model Inspections** on **IRB credit-risk models**. For each inspection, the authors manually extract findings, severity classifications, breached CRR provisions and the quantitative impact of supervisory limitations expressed as additional RWA.

The dependent variable is the additional RWA imposed through limitations, scaled by total assets to ensure comparability across banks. The resulting panel follows 50 IRB banks across 24 quarters.

The sample stops in 2020 to avoid distortions from later regulatory changes and pandemic-related measures.

A major strength of the dataset is that it links qualitative supervisory findings to quantitative capital consequences.

The authors do not only observe that a weakness was identified; they also observe whether it resulted in an additional RWA limitation and how large that limitation was.

This makes it possible to study model risk as an economically measurable outcome rather than as a purely descriptive compliance issue.

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Research Questions and Methodology

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Research Questions and Methodology

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The paper addresses **two questions**

whether model risk is better explained by the number or severity of supervisory findings

whether specific categories of non-compliance provide early warning signals of material capital add-ons

The **empirical strategy** uses panel OLS regressions with bank and time fixed effects. The **key explanatory variables** are the number of findings by severity class, lagged by one period.
Controls include profitability, bank size, capital headroom, cost of risk and revenue diversification. Standard errors are clustered at bank level.
A **dedicated indicator** captures **findings** related to **data governance provisions**.

The **lag structure** is important because supervisory limitations typically follow the identification and formalisation of findings rather than appearing simultaneously with them.

Bank fixed effects absorb persistent differences across institutions, such as business mix, internal modelling culture or supervisory history, while time fixed effects control for common shocks and supervisory initiatives.

The model is therefore designed to isolate whether the severity profile of findings contains incremental information about future capital add-ons.

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Empirical Results

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Empirical Results 1/2

The empirical results support a simple and consistent message: supervisory capital add-ons are explained by the materiality of deficiencies, not by their frequency.

Severity matters more than quantity

Findings classified as **F1**, **F2** and **F3** do not significantly explain supervisory limitations, whereas **F4 findings** consistently do.
This result is meaningful because it rejects a purely cumulative interpretation of model risk. **A bank may receive several findings without triggering a material capital response if those findings do not affect the core reliability of the model**. Conversely, a smaller number of very severe findings may be sufficient to produce a supervisory limitation. The **relevant question** is therefore not how many issues exist, but whether **they compromise the model's ability to generate prudent capital estimates.**

Interaction effects

Interaction tests confirm this interpretation: **lower-severity findings do not become material simply because they coexist with severe ones.** The decisive signal remains the presence of very high-severity weaknesses.
The interaction analysis also **helps clarify the supervisory logic**. Lower-severity issues may require remediation, but they do not necessarily amplify capital consequences unless they are themselves connected to a material weakness. This supports a risk-based interpretation of supervision: the capital response is targeted at deficiencies that threaten the prudential soundness of the model, not at the administrative burden created by long lists of findings.

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Empirical Results 2/2

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Bank characteristics	The result is also **robust** to bank-level controls for **profitability, size, capital headroom, cost of risk and business model,** suggesting that supervisory limitations are not merely a reflection of observable institutional characteristics. This distinction matters because weak capital ratios, poor profitability or larger balance sheets could otherwise explain why some banks receive larger add-ons. The findings suggest instead that the supervisory limitation is linked to inspected model weaknesses themselves. In other words, **severity adds information beyond general bank risk indicators.**
Data governance as an early warning signal	Data governance provides the paper's main practical insight. It is not merely another category of findings**; it is the channel through which severe model risk often becomes observable.** **Findings linked to data quality, completeness, consistency and governance are disproportionately classified as F3 or F4**, and the data-governance indicator remains statistically and economically significant in the regression model. This turns data governance into a usable early warning signal: weaknesses in model inputs are more likely to translate into material supervisory consequences. The channel is intuitive. IRB models are only as reliable as the data used to estimate and validate them. If default histories are incomplete, collateral information is inconsistent, recovery data are poorly maintained or governance processes do not ensure traceability, model parameters may become biased or unstable. **Supervisors therefore treat data weaknesses not as peripheral control issues, but as potential sources of capital mismeasurement.**

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Robustness Tests

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Robustness Tests

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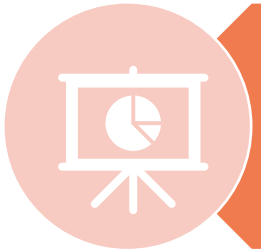
The robustness tests ask whether this message survives alternative specifications. The evidence confirms that it does.

The conclusions remain stable when the analysis accounts for outliers, potential endogeneity of bank characteristics and time effects linked to the ECB's Targeted Review of Internal Models. F4 findings continue to drive capital add-ons, while data-governance weaknesses retain strong explanatory power.



The Targeted Review of Internal Models is particularly relevant because it could have changed the intensity and focus of inspections during the sample period. By showing that the main coefficients remain stable after accounting for this context, the paper strengthens the interpretation that the results reflect a structural relationship between severe findings and prudential consequences rather than a temporary supervisory campaign effect.

Consequently, the relationship between supervisory severity and capital add-ons is not an artefact of one exceptionally large bank.

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Conclusions & Takeaways

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Conclusions & Takeaways

The paper's conclusion is therefore straightforward: supervisory capital add-ons are not triggered by the accumulation of minor model issues, but by a limited set of material weaknesses with clear prudential consequences.

Key takeaways for Supervisors	Key takeaways for Banks
• The implication is to prioritise high-severity findings and weaknesses affecting model inputs, because these are the areas most likely to translate into material prudential consequences.	• **Prioritise remediation by prudential materiality, not by the number of open findings.** The first focus should be on weaknesses that may affect capital outcomes. • **Treat severe model findings as potential capital events.** Each material finding should be linked to expected prudential impact, ownership, timeline and evidence of closure. • **Focus on the drivers of capital sensitivity.** Priority areas include model inputs, calibration choices, validation quality, data lineage and governance accountability. • **Use data governance as a capital-management tool.** Reliable, complete and traceable data reduce the risk of biased parameters and lower the probability of RWA limitations. • **Make remediation evidence-based.** Banks should test whether data-quality gaps change PD, LGD or EAD estimates before treating a finding as closed. • **Use a materiality-based dashboard.** Management should track severity, affected portfolio, model parameter, estimated RWA sensitivity, accountable owner, deadline and validation evidence.

This does not mean that lower-severity findings should be ignored. They remain relevant for supervisory follow-up and sound model governance, but their prudential significance depends on whether they connect to weaknesses that can affect capital estimates.

The paper's contribution lies in linking confidential inspection evidence directly to capital consequences. It shows that effective model supervision depends less on counting deficiencies and more on identifying the weaknesses that are most likely to affect prudential outcomes.

The final message is clear: banks reduce model risk most effectively when they move from a finding-count mindset to a materiality-based remediation strategy focused on the few weaknesses that can affect capital.

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Marco Carminati

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