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High and Low Credit Risk in SME Portfolios: Evidence from Regulatory Risk Grade Dissemination

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ABSTRACT

Purpose:
SME sector credit risk has received attention in research from several dimensions of the financial system. SME sector's funding is mainly supplied by financial institutions and SME sector is both diversified and large sector in both well developed and less developed economies. Specific research on assessing SME as Financial Institution's (FI's) individual counterparties and SMEs as portfolios have developed from a theoretical and empirical perspective. To supplement current research on the area, we approach SME risk from perspective of FIs own risk assessments and compare it to how SME risk rating and measurement compares to other counterparties.

Design/methodology/approach:
We use published risk rating data from large financial institutions in Europe including globally operating FIs and compare shares of credits in different risk grades and overall portfolio risks within an institution's own risk classification system and risk measurement system. The data consists of 89 comparable portfolios with over 25 million credits.

Findings:
Our results show that comparison to households and large corporates originates from higher default rate estimates for SME, which shows as smaller share of credits in the investment grade. SME risk is further raised as even within speculative grades SME's receives higher default estimates in comparison to households and large corporates. An equally notable finding is that the other relevant parameter for risk calculation, loss given default (LGD), does not differ between SME's and other counterparties. A part of SME credits is found to be in a low-risk regime in portfolio credit risk estimation.

Research limitations/implications:
Coverage and detail of data restricts to a specified geographical coverage and aggregated data on SME-companies is not as exact as unit level data. The data represents mostly European institutions as it is collected from institutions which have a head quarter in Europe and are applying Basel regulation in a single rule book environment for banking regulation. In a global scope there may be differences between jurisdictions or between geographical areas. Data published by institutions is an aggregated data on a rating grade level a and not on a unit level data that institutions have for their exact calculations. Comparison methods for SME sector are selected accordingly so that methods apply to class level instead of unit level data.

Originality/value:
Higher capital requirements for SME's may restrict the price and availability of finance. According to our results there can be separated a low-risk SME finance without higher capital requirements compared to peers. Results may also be used to support counterparty level default risk model results showing higher risk for SME's which can be seen in smaller shares of investment grade credits and in a higher default rate for speculative grade credits.

1. Introduction

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To what extend do the financial institutions (FIs) separate Small and Medium-size Enterprise (SME) risk from risks in households and corporates and how FIs differentiate between low and high credit risk within SME has high impact in a regulatory environment. There has been suggestion of high excess in capital requirement for small business, and the excess has been evaluated to be 45% by Bams et al. (2019). Risk classification and parameter estimation of SME in comparison to other counterparties is an important link in assessing the SME finance in the economy as it is connected to the prices of credits and the capitalization of banks. A coherent approach from risk parameters to capital requirements also serves IFRS 9 expected credit loss analysis which have similarities with capital requirement calculation models for larger institutions as noted for example by Frykström et al. (2018).

SME sector's credit risk has received attention in research of several sides of financial system. A counter sector to SME corporates on financing is to a large extend the financial sector. SME sector's funding is mainly supplied by financial institutions and the sector is both diversified and a large sector in both well developed and less developed economies. Specific research on assessing SMEs both as (FI) individual counterparties and SMEs as portfolios has developed from a theoretical and empirical perspective. To supplement current research on the area we approach SME risk from the perspective of FIs own risk assessments and compare how SME risk rating and risk parameter estimates compares to other counterparties.

A question that rises from FI specific risk measurement and risk classification is that how SME credits are rated in comparison to other counterparties. This question is relevant primarily for FIs with internal rating based (IRB) approach where ratings and risk parameters are part of prudential calculation. FI's own risk assessments for various portfolios are combined with regulatory defined portfolio risk factors in a capital requirement calculation for IRB institutions.

We use published risk rating data from 25 large European financial institutions including globally operating FIs and compare shares of credits in different risk grades and overall portfolio risks within institution's own risk classification system and risk measurement system. The division of SME credit risk to banks and the division within bank to portfolios are considered. The sizes of SME portfolios in banks reflect bank's differentiating position to serve SME sectors need for finance. Instead of sectoral or systemic view, regional aspect may be more important in the financing decisions made by smaller banks.

The paper proceeds as follows. Chapter 2 presents a literature review and chapter 3 derives the credit portfolio risk measurement methodology in Basel regulation and describes the data. In chapter 4 results are presented and discussed. Conclusions are in chapter 5.

2. Literature review

Research on SME counterparties of FI's have a large literature both on the portfolio level risk and on the counterparty level of risk. On portfolio level, the capital requirement of SMEs in comparison to predicted portfolio risk has been studied intensively.

Research on the default prediction on counterparty portfolio have been classified by Ciampiet al. (2021). They found five major lines of research: one that focuses on cause-and-effect relationships between default prediction modelling, bank lending activities, and firm-bank relationships, mainly by analysing SME default prediction from the bank perspective. The second class focuses on the exploration of the prediction potential of numerous quantitative and qualitative variables and the third class explores the potential of innovation-related variables in predicting SME default. The fourth class analyses the critical variables for small company success and the fifth class focuses on the empirical validation of the seminal theoretical failure prediction model of Argenti (1976) and the development of SME default prediction models based on longitudinal data. Figini et al. (2011) have studied a model selection between different model classes. The need to specify separate default models to SME and large corporates was noted by Altman et al. (2013). In a large study for SME firms in Europe by Filipe et al. (2016) support was found for the use of financial indicators and firm size as a default prediction factor.

The main features of capital requirement calculations for IRB institutions are parameter estimation for credit risk parameters, use of asset correlations with sensitivities to parameters and exposure class and in case of SME, application of support factor in the end. While there is a high regulatory capital requirement perspective in IRB calculation, also the use in economic capital framework of an institution also has an important role as described by Elizade & Repullo (2007). Introduction to IRB parameters and formulas are given for example by Hibbeln (2010). An analytical treatment of defaults in credit portfolio is based on three parameters: probability of default (PD), a loss given default (LGD) and a credit exposure at default (EAD). In PD estimation for firms, accounting variables have an important role, and a firm's size has recognized effects. Gupta et al. (2018) show that micro firms differ in default risk by having higher default rates. Properties of portfolio losses can be described with expected loss (EL) = PD x LGD x EAD and unexpected loss (UL) that considers default correlations. Calculation of UL requires an additional factor in calculation, that is an asset correlation ρ. Asset correlation could be classified also as a portfolio specific risk parameter or exposure specific risk parameter.

Higher capital requirement's connection to the capital costs and supply of finance has several aspects as evaluated by Baker et al. (2015) and increasing capital requirement decisions have been noted to have reducing effects in supply of higher risk corporate credits as shown by De Jongheet al. (2020). There are various elements of risk sensitivity in capital requirements. The capital requirements on level of FI are composed of several requirements. Requirements build through different risk areas, where credit risk is one of the areas and SME credit portfolios are part of credit risk. The resulting capital requirements have been studied and reservations to preparation VaR 99,9% loss scenario has been questioned right from the start of Basel II period as Varsanyi Z (2006) and in conjunction with a financial crisis peaking in 2008 for example by Kiema et al. (2013). A high cumulation of non-performing loans after a financial

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crisis have been studied in detail, for the Spain Gila-Gourgoura et al. (2017) identified both institution-based and macroeconomic factors explaining the level of cumulation. In a level of SME lending, a proportional or an absolute excess in capital requirements compared to through tail risk have been suggested in several studies.

Often research on capital requirement for SME firms captures asset correlations as the part of capital requirements which results in overestimation of risk. Bams et al. (2019) argue that there is a disproportionality in asset correlations favouring large corporates in the cost of SME funding price. Asset correlation does not affect the expected loss of a portfolio and order of portfolio risks could differ in EL and UL. Dietsch et al. (2016) suggests that 0,7169 SME supporting factor generally corrects the disproportionality. Only the credit size limit for support, that is a credit size not exceeding 1,5 M€, leaves out some balancing effects so that without this limit the UL would be in line with loss data. Filipe et al (2016) evaluate co-movements and sensitivity to systematic factors for SME firms in several countries and with several firm features. They find that within SME the smaller companies are more exposed to systematic factors than the larger ones as was suggested by Filipe et al. (2016).

3. Methodology

3.1. Asymptotic single risk factor framework for IRB model

In the Basel regime UL is estimated though asymptotic single risk factor (ASRF) framework. Loss estimation is based on 99,9% Value-at-Risk. ASRF formulas treatment of defaults has its foundation in the limit where the value of a firm's liabilities exceeds value of the firm's assets. In the default model of Merton, a default of a firm occurs if value of liabilities exceeds value of assets of a firm. Asset prices are drivers for defaults with given loan sizes and in case of two firms, dependence can be modeled through asset correlations. Further assumption is that assets are correlated though one or several systematic risk factors. A single systematic risk factor assumption on defaults gives an asymptotic formula

$$UL = VaR_{0.999}^{(ASRF)}(\bar{L}) =$$

$$\sum_{i=1}^{n} \mathrm{w_i E}\left(\widetilde{\mathrm{LGD_i}}|\tilde{x} = \Phi^{-1}(0.999)\right)\Phi\left(-\frac{\Phi^{-1}(\mathrm{PD}) + \sqrt{\rho}\Phi^{-1}(0.999)}{\sqrt{1-\rho}}\right) \times 1.06$$

In IRB modifications EL is subtracted from (2), LGD is downturn estimate, PD reflects one year default horizon and as there is a maturity correction. Scaling factor of 1.06 is included to maintain overall level of capital requirements as equal to preceding Basel 1 regulation (Hibbeln, 2010).

Under Basel internal model regulation, risk parameters are linked with capital requirements. If a financial institution applies IRB method in calculation of capital requirements. In IRB method financial institution uses its own estimates of PD, EAD and LGD while EL and UL are calculated with given formulas. One form of IRB uses a standard LGD instead of own estimate.

FIs publish results on parameters, results of prudential calculation as risk weighted assets (RWA) that is a combining calculation factor for banks using IRB method and banks using standardized method. In standardized method RWA is predefined number separating the required capital so that for example exposures in retail secured with real estate are given RWA of 35% and unsecured corporates receive a 100% RWA. In IRB method RWA is calculated by multiplying the UL by 1250. The basis of 1250 multiplier is an initial Basel regulation rule of reserving 8% capital on FIs exposures to cover the losses. SME exposures are given a support factor to RWA to compensate higher capital requirements otherwise calculated to SME's.

3.2. Asset correlations

Correlation formulas in regulation are specific for exposure classes. For large corporates, SME and part of the retail exposures the increase of PD decreases the correlation, which reflects an assumption that with higher PD levels idiosyncratic risk is given more weight and systematic risk, dependence on other counterparties, is given less weight. In the literature main alternative methods for using IRB formula are portfolio models. In portfolio models all parameters can in principle be estimated from internal data and results can be very different to IRB formula where structure is specified and only EAD, and LGD are based on internal estimates. The regulatory models are calibrated to well diversified portfolios with two parameters: a level of confidence and a set of asset correlations. the portfolios used in IRB calibration were not published and distribution is unknown. Calibration refers to data on large international banks Calibration of IRB formula was introduced in BIS (2004) and calibration has not changed since.

3.3. Basel III regulation changes to parameters and loss estimation

Basel II regulation that largely started in 2005, introduced a risk sensitive capital requirement calculation. Capital requirements were aimed to be risk sensitive and at the centre of this aim was the option to use institutions internal credit ratings along with own risk estimates and new regulation, which replaced the first Basel accord that had started at 1981. Basel II regulation was modified with packages increasing preparations for liquidity risk and with targeted rules for securitizations and certain parts of market risk between 2010 and 2013. Preparations for Basel III started in 2015 (Vousinas, 2015) and the enhanced framework was published in 2018. Implementation varies by region, in the European Union regulation started in phases during period 2019 and 2025. In credit risk area regulation aims at increasing sensitivity of standardized method of credit risk and to selectively restricts use of results from internal model approach to reduce variability between FIs model outputs (Durango-Gutiérrez et al., 2021). The use of external ratings will have more detailed rules and use is complemented by the new approach to counterparties without

external rating. Standardized method will for the first time make direct use of loan-to-value (LTV) for real estate secured loans as risk weight vary according to LTV classes. For portfolios of large corporates and institutions advanced IRB approach will no longer be available. PD floors are introduced as a new floor for corporates and for two groups in retail. The use of LGD floors within retail will be extended. Output floor for internal models will be applied to the ratio of results from a new standardized approach.

Initial calibrations of asset correlations will not be changed, and the only exception comes from an increase of asset correlations between financial institutions as a consequence of financial turbulence starting in 2008. Some features of Basel III implementation in the EU do reflect that reliance on the model is limited as some floors that were planned to be temporary in the start of Basel II regime will be continued even in Basel III.

3.4 Regulatory portfolio size limits: SME retail threshold

The SME limit applied in regulation is based on a turnover limit of 50 million euros of a firm and on credit size. SME supporting factor has an upper limit of 1,5 million euros in exposures. SME retail threshold is a concept of regulation which aims at dividing exposures to firms into two segments: retail and corporates. Corporates as regulatory defined portfolio is again split into two: one including large number of diversified and small exposures (corporate SME portfolio) and other one including the largest ones (Large Corporate Portfolio). Emphasis in this research is in the SME retail threshold for which banks using IRB are required to define. Regulation requires retail exposures to be smaller than 1 million euros and that banks should genuinely treat these firms less individually. Therefore, if the bank for example has more detailed credit evaluation or decision process for firm exposures above 100 000 euros, this might be a candidate for banks specific SME retail limit. In all cases the limit can be 1 million euros at highest. The exposures with immovable property as collateral (later, IP secured) may be decreased from exposure, and IP secured is its own portfolio with its own asset correlation. This exception is purely a prudential calculation rule for individual exposures and defines cases where firms with exposures above the bank specific retail SME threshold may have exposures in retail that are above the threshold. In corporate exposures, non-SME practically means large corporates, and in retail non-SME practically means households.

3.5 Grade level data from Pillar 3 reports

The data was collected from reports of 25 European institutions published in 2019 and 2020 and referring to end of year date previous year, so that end of year 2018 and 2019 data was used. Each institution is represented only once. There are total of 89 portfolios as summarized in table 1. In terms of the number of credits covered, the data has a macro level view to banking, while a number of institutions and portfolios are smaller and the analysis requires a micro level view with relatively small sample data.

Table 1: Summary of the portfolios in the data

Exposure class	Number of exposures	Number of portfolios
Corporate Large	189 474	21
Corporate SME	564 953	25
IP Secured non-SME	7 655 354	10
IP Secured SME	452 578	11
Retail Other non-SME	15 475 249	10
Retail Other SME	2 453 125	12
Sum	26 790 733	89

The publications of Pillar 3 data follow a standard content as in BCBS (2015) but are not in standard format. FIs follow requirements on minimum information to be reported, but the format is not specified, and requirements also leave room for interpretations. Some reports are in Excel spreadsheets and the accuracy of reported numbers varies. Regulation requires that observed default rates used as data for PD estimates "must have a meaningful distribution of exposures across its credit risk rating grades with no excessive concentrations on either its obligor grades" and that these default rates "must have a minimum of seven obligor grades for non-defaulted obligors and one for defaulted obligors". Estimates presented at given year in Pillar 3 report are based on long run data. Parameters are representative of long run history based on the banks own data and possibly external data. Especially the EL in lower risk grades is reported with relative low accuracy. Maturity has very little variation from 2,5 years in reports, which is a standard estimate for retail.

At least two approaches would enable increased time coverage on portfolio risk but from different perspectives. One option is to consider the time-varying features of the risk parameters and the other is to increase number of years where Pillar 3 reports are collected. First one is methodologically straightforward to approach as in bank sector time-variability of parameters is well recognized and unified methods may be applied. The other one, increasing years of Pillar 3 reports, would be complex due to model changes, exposure roll-outs and bank specific risk level changes. Time-varying features are evident only in PD parameter.

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4. Research Results and Discussion

There are two main approaches to PD estimation. One is a two-phased approach starting from risk assessment of a credit to a grade and in the second phase being an estimation of PD to this grade considering all the aspects of PD estimation including long-term estimation and cyclicality considerations. The other approach is a direct estimation approach where individual credit's PD is estimated, and the grade consists of all credits having a PD in the range of a grade. Grade level inferences on input of grades to the UL estimate is equally applicable to both approaches. However, in the description of how, for example the credits to highest risk grade, end up to this grade term could either be that credits are classified to the grade or that credits receive an estimate of this class. We use the term classification to grade describing both two-phased and direct PD -estimation.

All EL and UL calculations are based on grade level PD and LGD data and UL uses the asset correlation of class. The trace from risk estimation to end results stays as straightforward and is based on portfolio risk parametrization. The UL is primarily presented without SME supporting factors reflecting the result of credit portfolio risk estimation. In picture a comparisons of risk measures between SME and non-SME in three comparable exposure classes shows that the SME unexpected loss level is higher than loss for the peer counterparties in corporate exposures and in IP secured. A deviation to smaller risk in SME is observed in other retail for some institutions while some institutions have even multiple SME risks compared to households.

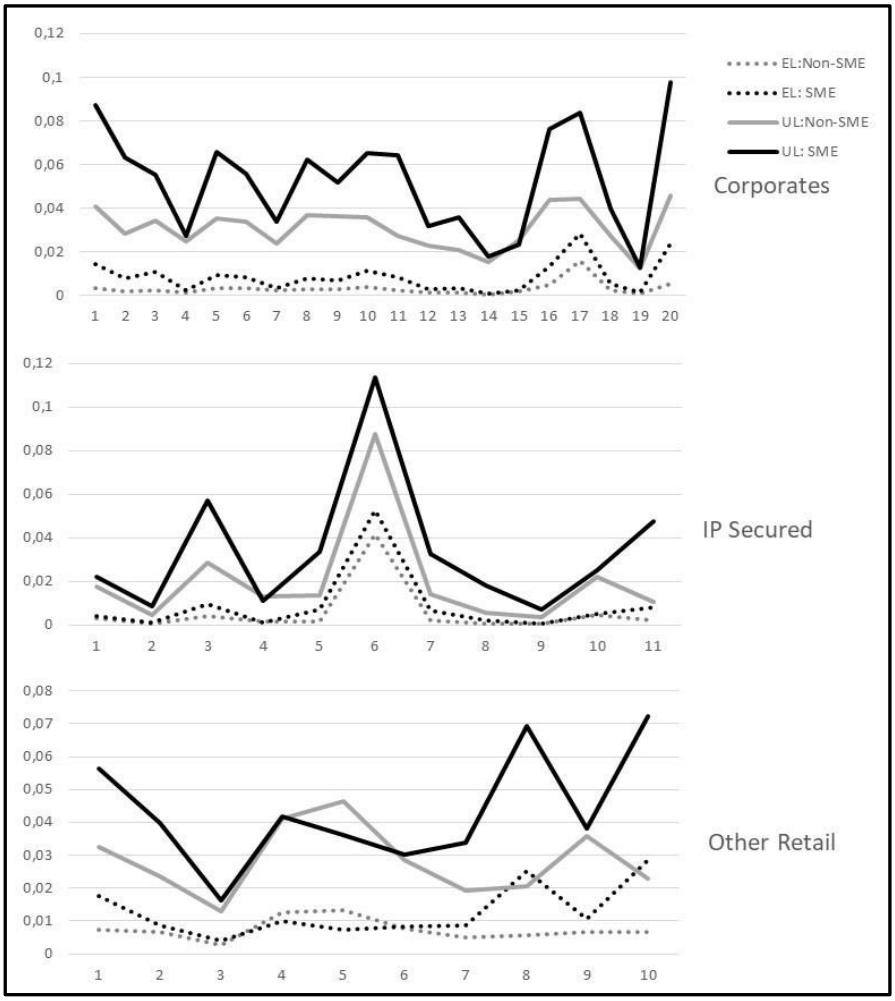

Figure 1 Comparison of unexpected and expected loss between SME and non-SME in banks

The deciles in table 2 show that the first two grade levels constitute the majority for large corporates with 60% accumulation and in IP secured with 58% accumulation. In parentheses is a credit count weighted average decile, which shows that specially for corporates the average credit size is higher in lowest risk grades. This shows clearly in grade one. In grade one, the non-SME large corporates have the highest difference in average deciles: + 0,15. Higher risk class estimations for SME are justified based on research as corporate size and accounting measures have impact on the default risk for companies. For large corporates the higher average credit size in low default risk grades indicates also that credit size is at its highest in lower risk grades.

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Table 2: Average deciles of credit exposure (credit count) for six exposure classes						
Grade	**Corporate Large**	**Corporate SME**	**IP Secured non-SME**	**IP Secured SME**	**Retail Other non-SME**	**Retail Other SME**
1	0.46 (0.31)	0.26 (0.23)	0.47 (0.49)	0.25 (0.26)	0.39 (0.34)	0.17 (0.16)
2	0.58 (0.41)	0.34 (0.3)	0.60 (0.63)	0.37 (0.38)	0.47 (0.42)	0.25 (0.24)
3	0.79 (0.58)	0.54 (0.45)	0.72 (0.72)	0.48 (0.5)	0.51 (0.48)	0.39 (0.37)
4	0.87 (0.66)	0.61 (0.54)	0.78 (0.79)	0.58 (0.59)	0.62 (0.54)	0.52 (0.5)
5	0.98 (0.84)	0.87 (0.81)	0.93 (0.93)	0.72 (0.73)	0.86 (0.81)	0.8 (0.74)
6	1,00 (0.96)	0.99 (0.97)	0.97 (0.97)	0.89 (0.89)	0.96 (0.95)	0.99 (0.96)
7	1,00 (1.00)	1,00 (1.00)	1,00 (1.00)	1,00 (1.00)	1,00 (1.00)	1,00 (1.00)

Tests in table 3 verify that pairwise differences are significant for PD, EL and UL for corporates and IP Secured credits both in t-test and Wilcoxon rank test. For other credits the difference in PD and UL are significant at 0.05 level. for LGD parameters the differences are not significant in any of the three exposure classes.

Table 3: Comparison tests on risk measures - all risk grades included				
Exposure class	**Risk measure**	**t-test**	**Wicoxon**	**Correlation**
Corporates	UL	-6.14 [0.0000]	2 [0.0000]	0.91 [0.0000]
	EL	-4.97 [0.0001]	0 [0.0000]	0.84 [0.0000]
	PD	-5.14 [0.0001]	0 [0.0000]	0.82 [0.0000]
	LGD	0.64 [0.527]	123 [0.5217]	0.83 [0.0000]
IP Secured	UL	-3.71 [0.004]	1 [0.002]	0.92 [0.0000]
	EL	-3.1 [0.0112]	1 [0.002]	0.98 [0.0000]
	PD	-2.21 [0.051]	1 [0.002]	0.99 [0.0000]
	LGD	-1.44 [0.1789]	15 [0.2213]	0.48 [0.1326]
Other	UL	-2.34 [0.0437]	5 [0.0195]	0.01 [0.9749]
	EL	-1.92 [0.0866]	11 [0.1055]	-0.09 [0.7969]
	PD	-2.31 [0.0457]	10 [0.084]	0.2 [0.5737]
	LGD	-0.71 [0.4906]	20 [0.4922]	0.36 [0.302]

SME portfolios are not among the low-risk portfolios of banks. Rank of SME portfolios is presented in table 4. Corporate SME was in 11 cases the portfolio with highest UL and in most cases among the three portfolios with highest risk. The immovable property secured SME portfolios were also in few cases among the highest risk portfolios while also in having in some banks a relatively low portfolio risk. Other SME within retail was again a higher risk portfolio as it had highest portfolio risk for some banks in most cases it was classified at least to highest half of portfolio risks.

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Table 4: Rank of portfolio UL lowest to highest			
Number of reported portfolios in institution	**of which Corporate SME**	**of which IP Secured SME**	**of which Retail Other SME**
4	4	-	-
5	2,4,5,5,5,5,5,5	4,5	-
6	5,5,6	6	4,6
7	5,5	2,7	6
8	6,7,8,8	4,4,5	4,6,7,8
9	8,9,9	4,5,6	6,9
10	8,8	2,5	9,10

To focus on a low risk in SME, a more general risk definitions to risk grades may be applied to data. Terminology and default levels for rating agencies give several options for the reclassification of grades. An interesting part of the rating grades are the two lowest risk grades, which may be mapped to term "Investment grade" based on observed default levels in Moody's data. Moody's and Standard and Poors definitions are those applied by Livingston et al. (2021) and mapping is reported in table 5.

Table 5: Mapping of PD grades of portfolios to rating definitions				
Grade	**PD**	**Moody's and S&P**		
1	0.00 to <0.15	A	Investment grade	Highest quality
2	0.15 to <0.25	BBB	Investment grade	High quality
3	0.25 to <0.50	BBB-	Speculative grade	Likely to fulfil obligations
4	0.50 to <0.75	BB	Speculative grade	Likely to fulfil obligations
5	0.75 to <2.50	BB-	Speculative grade	High risk
6	2.50 to <10.00	B	Speculative grade	High risk
7	10.00 to <100.00	CCC	Speculative grade	Vulnerability to default

The contributions of the investment grade and the speculative grade to RWA are in table 6. Lowest UL and RWA is in IP secures non-SME credits while the share of investment grade is higher in other exposure classes. Lowest risk weight in IP secured are due to the lowest asset correlation of all exposure classes. For SME the contribution to RWA from investment grade to does not exceed 7% in any exposure class.

Table 6: Contribution to portfolio RWA from investment and speculative grades						
	Corporate Large	**Corporate SME**	**IP Secured non-SME**	**IP Secured SME**	**Retail Other non-SME**	**Retail Other SME**
Portfolio RWA	36.7	62.6	25.1	42.9	35.5	54.3
- incl. SME support factor		47.7		32.7		41.4
of which investment grade	23.3%	7,0 %	7.4%	3.3%	13.2%	4.1%
of which speculative grade	76.7%	93,0 %	92.6%	96.7%	86.8%	95.9%

Within the investment grade there are mainly differences to higher in risk in SME in comparison to other exposures according to comparisons in table 7. In corporate exposures the difference, especially in EL is very small, partly balanced by lower LGD in SME. In speculative grade for corporate exposures the EL ratio of 58% is narrowed to 77% through asset correlation that decreases though PD.

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Table 7: Risk measure comparisons between SME and Non-SME for two ratings classes					
Exposure class	**Risk measure**	**Rating**	**Non-SME**	**SME**	**Ratio to SME**
Corporates	UL	Investment	0.014	0.015	94.8%
		speculative	0.05	0.065	76.9%
	EL	Investment	0,000	0,000	89.9%
		speculative	0.006	0.011	58.4%
	PD %	Investment	0.113	0.130	87.4%
		speculative	1.659	2.803	59.2%
	LGD %	Investment	38.213	36.527	104.6%
		speculative	39.226	38.500	101.9%
IP Secured	UL	Investment	0.003	0.005	72.8%
		speculative	0.028	0.036	76.7%
	EL	Investment	0.000	0.000	69.9%
		speculative	0.008	0.009	80.7%
	PD %	Investment	0.112	0.148	75.8%
		speculative	3.552	4.856	73.1%
	LGD %	Investment	15.455	17.896	86.4%
		speculative	16.913	18.537	91.2%
Other	UL	Investment	0.010	0.013	75.1%
		speculative	0.041	0.049	83.8%
	EL	Investment	0.000	0.001	69.1%
		speculative	0.012	0.015	82.6%
	PD %	Investment	0.109	0.138	78.6%
		speculative	2.946	3.152	93.5%
	LGD %	Investment	47.523	51.011	93.2%
		speculative	40.015	46.025	86.9%

The pairwise tests in table 8 on UL show that for corporates and for other exposures differences are not significant, but for IP Secured there is a 0,0389 significance in the test. The EL of corporates is also significant, but in this case to the direction of lower UL for SME. As the EL figures are very small ratios, this may reflect the varying direction of differences in PD and LGD without having effect on UL.

Table 8: Comparison tests on risk measures - investment grade				
Exposure class	**Risk measure**	**t-test**	**Wilcoxon**	**Correlation**
Corporates	UL	-0.86	83	0.66
		[0.4026]	[0.4304]	[0.0014]
	EL	5.23	203	0.4
		[0.0000]	[0.0000]	[0.0794]
	PD	-2.07	52	0.43
		[0.0518]	[0.0484]	[0.059]
	LGD	1.27	118	0.76
		[0.2211]	[0.3652]	[0.0001]
IP Secured	UL	-2.47	5	0.44
		[0.0389]	[0.0391]	[0.2379]
	EL	-2.56	4	0.45
		[0.0335]	[0.0273]	[0.228]
	PD	-4.16	0	0.75
		[0.0032]	[0.0039]	[0.0188]
	LGD	-1.52	10	0.52
		[0.1661]	[0.2936]	[0.1507]
Other	UL	-1.55	12	0.13
		[0.1561]	[0.1309]	[0.7293]
	EL	-1.74	8	0.08

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		[0.1153]	[0.0488]	[0.822]
	PD	-4.68 [0.0012]	0 [0.002]	0.7 [0.0251]
	LGD	-0.41 [0.6944]	24 [0.7695]	0.14 [0.7096]

As a summary on the results, on a portfolio level, SME portfolios show higher risk in comparison to large companies. In comparison to large companies, SME has a higher share of credits in a weaker category of speculative grades and even within speculative grade the SME risk is higher. In retail exposure classes IP secured and other retail, the SME risk is also higher than for other counterparties in retail, which generally are the households. Interestingly, the presence of collateral in IP secured does not balance out the higher risk of SME counterparties, while the role of the collateral is important as studied by Berger et al. (2011).

5. Conclusions

We find that SME portfolios are among the riskiest portfolios of the banks within all portfolios of institutions and in comparison to similar credit types to households or to bigger companies. Higher risk of SME portfolios supports findings on previous research. The output of SME risk is dampened by the SME supporting factor applied to the result. The higher portfolio loss risk, expected and unexpected, rises from higher PD estimates which leads to classification of SME counterparties and credits to higher risk grades. With findings on PD parameter, results complement the current research by stating the importance of PD estimation as a main factor behind higher capital requirements. For the investment grade credits, the difference in loss estimates is not generally higher for SME and within this lowest credit risk class is also a substantial share of SME counterparties. Risk level comparison identifies a low-risk part of SME credit portfolio and this finding may affect how to measure risk for SME portfolios in comparison to other sectors. Another contribution with this finding is a support for SME rating models which differentiate between low and high-risk SMEs. The speculative grades are the source of portfolio differences both with higher share of SME credits and with higher average risk estimates.

Reforms on Basel regulation may restrict the amount of information available through Pillar 3 as there are floors affecting the result on capital requirement calculation. Even the current data dissemination practice resulted in limited availability of comparable information from institutions. Introduced floors could affect lower risk parts of SME portfolios which were identified within investment risk categories based on data of almost 90 portfolios.

For the research on capital requirements concerning SME's, an important finding is that institutions assess SME as higher default risk counterparties than peers and this results in higher capital requirements. Future research on credit risk of SME firms may enlighten how separation of low-risk and high-risk SME counterparties effects various dimensions of credit risk measurement. For future research these dimensions are potentially in separated estimation of expected loss and unexpected loss estimation for SME credit portfolios. Also, for the research on SME finance, a risk separation may be an important factor defining both access to finance and pricing of finance.

References

Altman, E. I., & Sabato, G. (2013). Modeling credit risk for SMEs: evidence from the US market. *In Managing and Measuring Risk: Emerging Global Standards and Regulations After the Financial Crisis* (pp. 251-279).

Argenti, J. (1976). Corporate collapse. Wiley.

Baker, M., & Wurgler, J. (2015). Do strict capital requirements raise the cost of capital? *Bank regulation, capital structure, and the low-risk anomaly. American Economic Review*, 105(5), 315-20.

Bams D, Pisa M, Wolff CCP (2019) Are Capital Requirements on Small Business Loans Flawed? - *Journal of Empirical Finance, 2019 - Elsevier*

Basel Committee on Banking Supervision, BCBS:(2015). Revised Pillar 3 disclosure requirements. January 2015. URL: https://www.bis.org/bcbs/publ/d309.pdf.

Berger, A. N., Espinosa-Vega, M. A., Frame, W. S., & Miller, N. H. (2011). Why do borrowers pledge collateral? New empirical evidence on the role of asymmetric information. *Journal of Financial Intermediation*, 20(1), 55-70.

Ciampi, F., Giannozzi, A., Marzi, G., & Altman, E. I. (2021). Rethinking SME default prediction: a systematic literature review and future perspectives. *Scientometrics, 126(3), 2141-2188.*

Durango-Gutiérrez, M. P., Lara-Rubio, J., & Navarro-Galera, A. (2021). Analysis of default risk in microfinance institutions under the Basel III framework. *International Journal of Finance & Economics.*

Elizalde, A., & Repullo, R. (2007). Economic and regulatory capital in banking: What is the difference?. *Tenth issue (September 2007) of the International Journal of Central Banking.*

De Jonghe, O., Dewachter, H., & Ongena, S. (2020). Bank capital (requirements) and credit supply: Evidence from pillar 2 decisions. *Journal of Corporate Finance, 60, 101518.*

Dietsch, M., Düllmann, K., Fraisse, H., Koziol, P., & Ott, C. (2016). Support for the SME supporting factor: Multi-country empirical evidence on systematic risk factor for SME loans (No. 45/2016). Deutsche Bundesbank.

Filipe SF, Grammatikos T, Michala D (2016). Forecasting distress in European SME portfolios- *Journal of Banking & Finance, 2016 – Elsevier*

Figini S, Giudici P (2011) Statistical merging of rating models - *Journal of the operational research society, 2011* - Springer

DOI: 10.25103/ijbesar.152.03

Frykström, N., & Li, J. (2018). IFRS 9–the new accounting standard for credit loss recognition. *Economic Commentaries*, 3, 1-13.
Gila-Gourgoura, E., & Nikolaidou, E. (2017). Credit risk determinants in the vulnerable economies of Europe: Evidence from the Spanish banking system. *International Journal of Business and Economic Sciences Applied Research*, *1*.
Gupta, J., Barzotto, M., & Khorasgani, A. (2018). Does size matter in predicting SMEs failure?. International Journal of Finance & Economics, *23*(4), 571-605.
Hibbeln Martin (2010): Risk Management in Credit Portfolios: *Concentration Risk and Basel II*, *Springer*
Kiema I, Jokivuolle E (2013): 99.9%-Really? - *Bank of Finland Research Discussion Paper*, 2013
Livingston, M., & Zhou, L. (2020). Credit ratings and rating agencies. *In Oxford Research Encyclopedia of Economics and Finance.*
Varsanyi Z (2006): The Basel II IRB approach revisited: do we use the correct model?. *MPRA Paper No. 1244, posted 23 Dec 2006 UTC*
Vousinas, G. L. (2015). Supervision of financial institutions: The transition from Basel I to Basel III. A critical appraisal of the newly established regulatory framework. *Journal of Financial Regulation and Compliance.*

DOI: 10.25103/ijbesar.152.03