Are SME Loans Less Risky than Regulatory Capital Requirements Suggest?*

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EBA Research Workshop, London
14 November 2013

*This paper represents the authors' personal opinions and does not necessarily reflect the views of the Deutsche Bundesbank or its staff.

Motivation and Contribution

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- Higher minimum capital ratios and a tighter capital definition in Basel III have indirectly also affected capital requirements for credit exposures to SMEs

- Do these regulatory adjustments treat SME unfairly given they didn't cause the recent financial crises?

- Empirical literature is inconclusive but tendency towards lower asset correlation estimates than those in the corporate risk weight functions of Basel II

- **Contribution:**

  1. Assess the systematic risk of German SME loans measured by the asset correlation in a common asset value credit risk model
  2. Compare estimation results with capital requirements for SME lending under the CRR / CRD 4 framework
  3. Unique data sample of SME lending by over 400 small and large German banks

Contribution and Overview

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- Step 1: Estimate asset correlations (AC) from historical default rates of selected size and rating buckets
- Step 2: Compare the size-dependence of IRB risk-weights with the size-dependence of empirical risk-weights (i.e. risk weights based on estimates of AC and PD)
- Focus on "relative calibration": Does the regulatory capital for SMEs appropriately reflect the systematic risk relative to other asset classes?
- Use IRB capital requirements (based on the asymptotic single risk factor model) and not asset correlation estimates directly for a comparison because they are the economically relevant measure
- Large corporates serve as benchmark, i.e. we assume that their IRB risk weights are "correctly" calibrated
- Carry out various robustness checks for estimation results

Data

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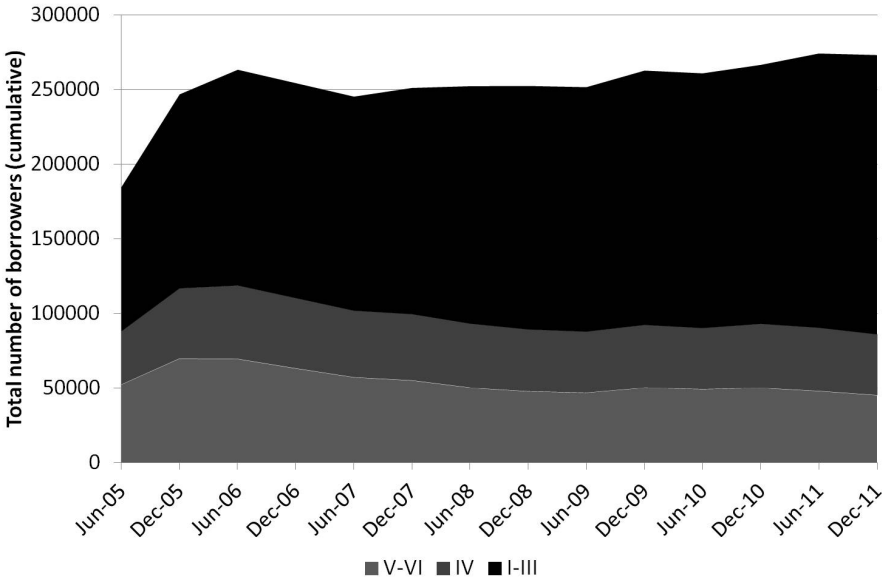
- Data on **more than 400 German banks** (both small and large banks)

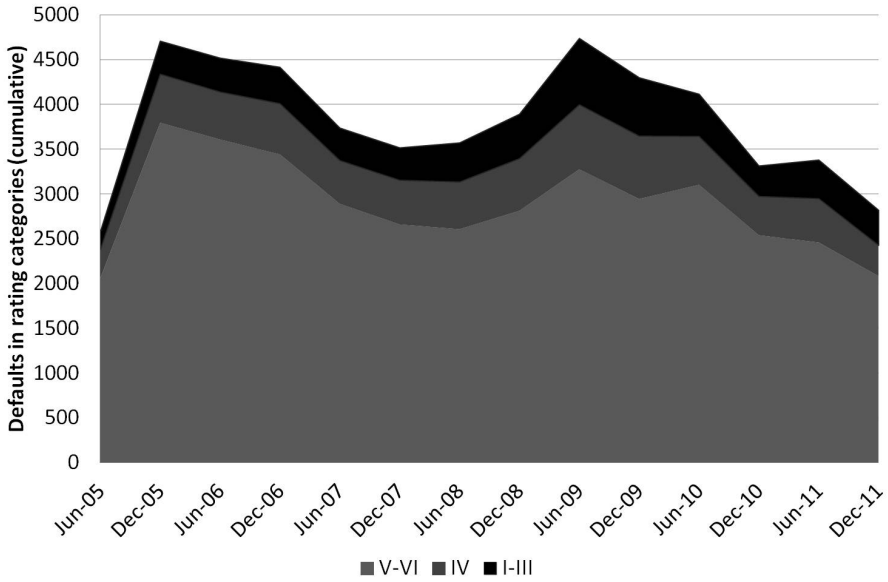
- **Default rates** in the credit portfolio
  - Borrowers: domestic firms except for credit institutions with available IRB PDs (no retail and specialized lending)
  - Number of borrowers as of the beginning of each period
  - Number of defaults occurring during the period under consideration

- **Data clustering** of default rates along three dimensions:
  1. **Time period**: 14 semi-annual periods, 1 June 2005 to 31 December 2011 (7 years), seasonally adjusted
  2. **Rating category**: Six rating classes based on IFD master scale
     $\Rightarrow$ aggregated: I–III, IV, V–VI
  3. **Size**: Measured by yearly turnover (in m €):
     $\Rightarrow$ [0, 0.3], (0.3, 1], (1, 2.5], (2.5, 5], (5, 50], $>$ 50

Data – number of ratings and defaults

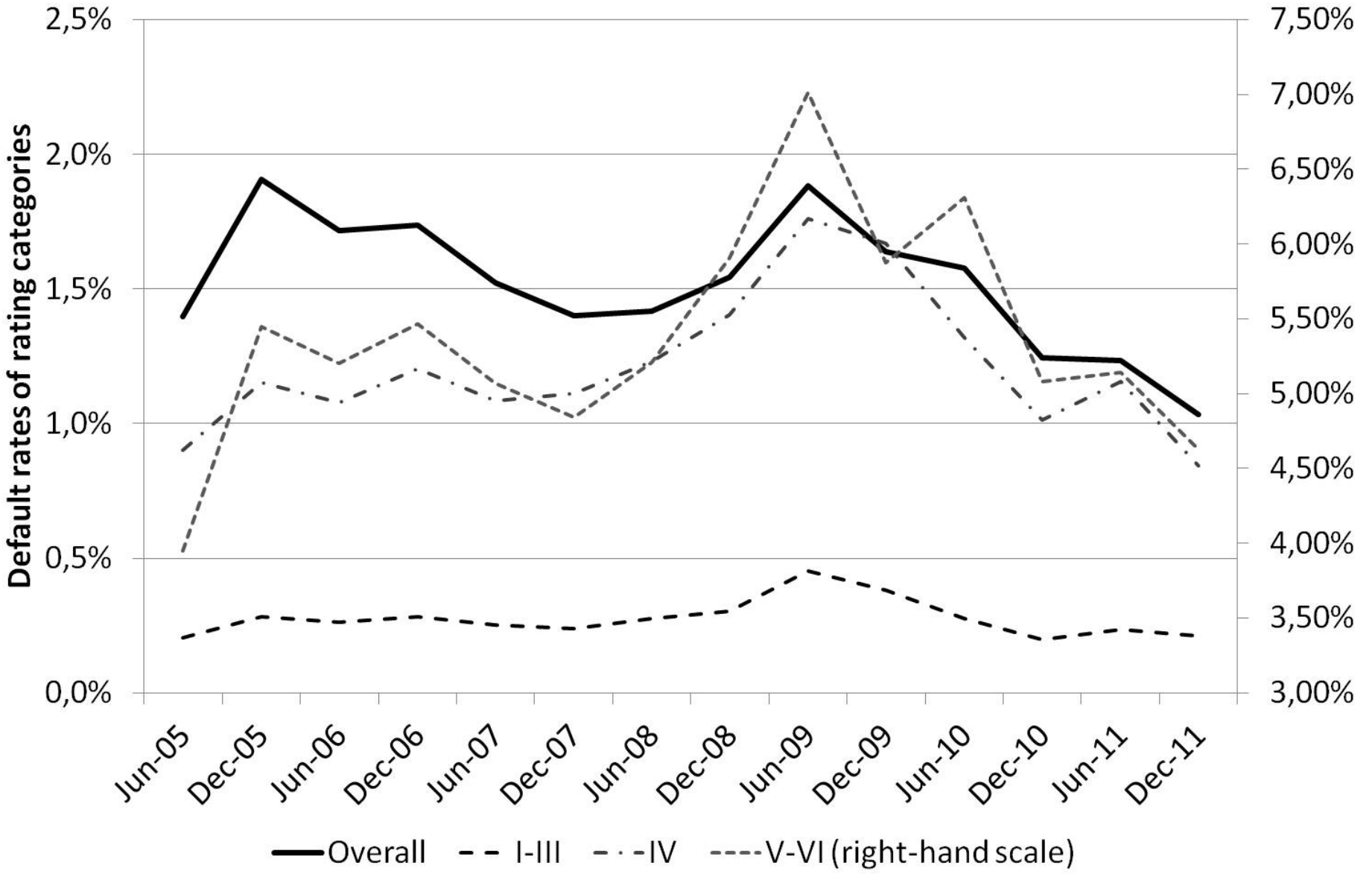


(a) # Ratings by rating category

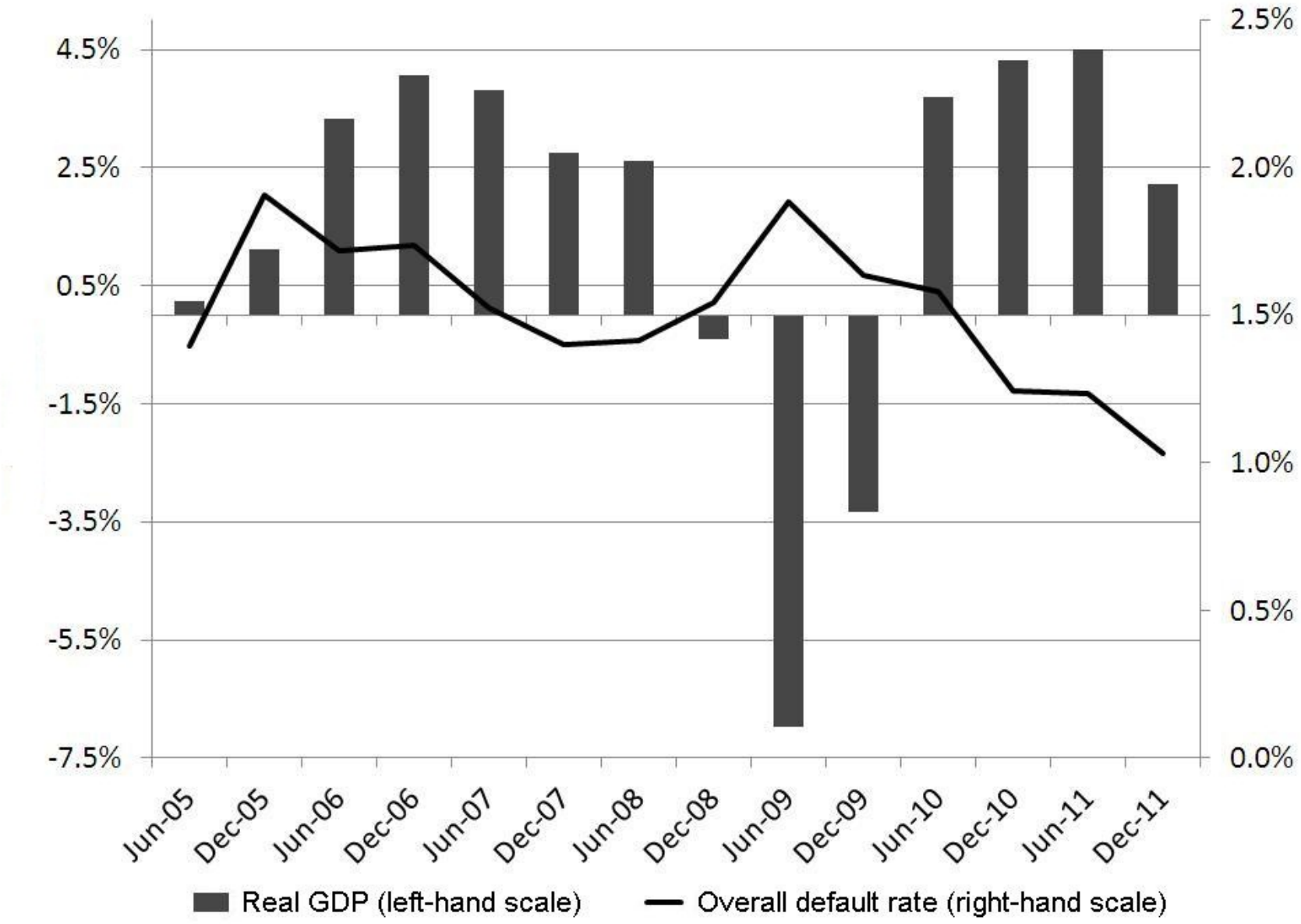


(b) # Defaults by rating category

Data – default rates



Data – default rates



Model and estimation methodology

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- Ability-to-pay process of firm i:

$$Y_i = \sqrt{\rho}X + \sqrt{1-\rho}\varepsilon_i$$

  systematic risk-factor $X \sim N(0,1)$, idiosyncratic risk-factor $\varepsilon_i \sim N(0,1)$, asset correlation ρ

- Conditional default probability: $P(L=1|X=x) = \Phi\left(\frac{\gamma - \sqrt{\rho}\cdot x}{\sqrt{1-\rho}}\right)$

- Estimation technique:
  - Maximum-Likelihood (ML) estimator by Gordy & Heitfield (2002), used for Basel II calibration, downward bias for small samples
  - Robustness checks through Method-of-Moments (MM) and Asymptotic Maximum Likelihood (AML) without bias correction, yearly estimations...

Model and estimation methodology

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Empirical risk-weight formula:

$$RW(\text{LGD,PD,M},\rho) = 1.06{\cdot}12.5{\cdot}\text{LGD}{\cdot}\left[\Phi\left(\frac{\Phi^{-1}(\text{PD}) + \sqrt{\rho}\Phi^{-1}(0.999)}{\sqrt{1-\rho}}\right) - \text{PD}\right]{\cdot}f(\text{PD,M})$$

Basel II risk-weight formula:

$$RW(\text{LGD,PD,M}) = 1.06{\cdot}12.5{\cdot}\text{LGD}\left[\Phi\left(\frac{\Phi^{-1}(\text{PD}) + \sqrt{\rho(\text{PD,S})}\Phi^{-1}(0.999)}{\sqrt{1-\rho(\text{PD,S})}}\right) - \text{PD}\right] f(\text{PD,M})$$

where

$$\rho(\text{PD,S}) = \frac{1-e^{-50\text{PD}}}{1-e^{-50}}{\cdot}0.12 + \left(1 - \frac{1-e^{-50\text{PD}}}{1-e^{-50}}\right){\cdot}0.24 - 0.04\left(1 - \frac{\min\{50,\max\{S,5\}\}-5}{45}\right)$$

Other retail: turnover $<$ 2.5 m €; S:= turnover; M:= maturity

Results – Risk weights per rating and size class

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		Other Retail		Corporate			
Estimates	Turnover	[0, 0.3]	(0.3, 1]	(1, 2.5]	(2.5, 5]	(5, 50]	> 50
	Rating						
	I-III	4.0	3.9	4.0	4.2	4.3	6.4
	IV	9.6	9.4	12.6	14.6	13.2	23.9
	V-VI	30.3	22.6	30.2	33.9	**36.3**	**50.8**
		Other Retail		Corporate			
Basel II	Turnover	[0, 0.3]	(0.3, 1]	(1, 2.5]	(2.5, 5]	(5, 50]	> 50
	Rating						
	I-III	39.8	36.6	36.6	61.2	62.4	67.8
	IV	62.3	63.6	64.8	100.9	107.7	130.3
	V-VI	80.3	81.4	83.6	159.7	**167.1**	**196.5**

Relative difference for estimated RW: $\Delta_{5-50}^{Est,V-VI} = \frac{36.3-50.8}{50.8} = -28.5$

Relative difference for Basel II RW: $\Delta_{5-50}^{BII,V-VI} = \frac{167.1-196.5}{196.5} = -15.0$

Results – Relative differences by rating and turnover class

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		Other Retail		Corporate			
Estimates	Turnover	[0, 0.3]	(0.3, 1]	(1, 2.5]	(2.5, 5]	(5, 50]	> 50
	Rating						
	I-III	-37.3	-0.39	-39.1	-34.6	-32.8	0.00
	IV	-59.9	-60.6	-47.5	-38.9	-45.0	0.00
	V-VI	-40.4	-55.5	-40.5	-33.3	-28.5	0.00
		Other Retail		Corporate			
Basel II	Turnover	[0, 0.3]	(0.3, 1]	(1, 2.5]	(2.5, 5]	(5, 50]	> 50
	Rating						
	I-III	-41.3	-46.0	-46.0	-9.8	-8.0	0.00
	IV	-52.2	-51.2	-50.3	-22.6	-17.4	0.00
	V-VI	-59.1	-0.58.6	-57.5	-18.7	-15.0	0.00

Reductions are calculated as a weighted average with respect to the number of loans per rating class

Results – analysis of IRB and RSA risk weights

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IRBA		Other Retail			Corporate		
	Turnover	[0, 0.3]	(0.3, 1]	(1, 2.5]	(2.5, 5]	(5, 50]	> 50
	Differences						
	Basel II IRBA	-49.3%	-50.2%	-48.9%	-13.3%	-10.3%	0.0%
	Estimated	-42.7%	-47.4%	-39.7 %	-35.1%	-33.9%	0.0%
	Total Difference	**6.6%**	**2.8%**	**9.2%**	**-21.8%**	**-23.6%**	0.0%

RSA		Other Retail			Corporate		
	Turnover	[0, 0.3]	(0.3, 1]	(1, 2.5]	(2.5, 5]	(5, 50]	> 50
	Differences						
	Basel II RSA	-25.0%	-25.0%	-25.0%	0.0%	0.0%	0.0%
	Estimated	-42.7%	-47.4%	-39.7%	-35.1%	-33.9%	0.0%
	Total Difference	**-17.7%**	**-22.4%**	**-14.7%**	**-35.1%**	**-33.9%**	0.0%

Total differences are averages over rating categories.

Summary

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- Consider total differences $> 10\%$ between Basel II and estimated risk weights as "economically" significant

- Then total differences are significant for
  - SMEs in the IRB corporate portfolio (annual turnover between 5 and 40 mln EUR)
  - generally under RSA

- Before drawing policy conclusions the following caveats should be considered
  - Basel is an international framework; results for other countries necessary before risk weights functions should be revisited (work in progress).
  - RSA was calibrated more conservatively than the IRBA since it is much less risk sensitive. This can at least partly explain significant total differences.
  - Time series of default rates is till relatively short and may not cover a "representative" economic cycle.