Stress Testing the Credit Risk of Mortgage Loans

The Relationship between Portfolio-LGD and the Loan-to-Value Distribution

3rd EBA Policy Research Workshop “How to measure the riskiness of banks”

WGZ BANK
Die Initiativbank

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Agenda

1. **Background and motivation**
2. Some general remarks on LTV and on LTV-distributions
3. LGD framework
4. A simple two-bank example
5. Approximation of portfolio LGD assuming Beta-distributed LTVs
6. Conclusions and outlook

Background and motivation (1/3)

- WGZ BANK is part of the German cooperative banking sector with around 190 member banks in Western Germany.
- The bank participates in the stress test exercises at EU level since 2010.
- About 20% (21 bln €) of WGZ BANK group‘s total assets (92 bln €) stem from its mortgage lending business with mainly German residential and commercial real estate serving as collateral.
- In line with current industry practice, a set of LGD models is in place for ICAAP/Pillar II and for Pillar I capital requirements.
- These LGD models also provide the basis for stress testing under the various macroeconomic scenarios given by the regulators.

Background and motivation (2/3)

- In the 2011 EBA stress test, some of WGZ BANK‘s LGD estimates for mortgage loans led to further discussions with NCA/EBA.
- It became evident that the communication between banks and regulators within the process of regulatory benchmarking (“comply or explain”) is aggravated by a fundamental **information asymmetry**:

Banks can argue on the basis of **loan-level data** for loan-to-value (LTV) ratios, which the regulators do not have access to within the stress test process.

Regulators can argue on the basis of **aggregated portfolio data** for LGDs from a **peer group**, whose comparability is not transparent to banks.

Background and motivation (3/3)

- Research question:

  How can the impact of a pre-specified drop in collateral values on average portfolio LGD be properly assessed for banks' portfolios of mortgage loans that differ in their loan-to-value (LTV) distributions?

- Aims of the paper:
  - clarify the predominant role of the LTV distribution in modelling stressed LGDs
  - find a way to resolve the information asymmetry between banks and regulators
  - contribute to a sound benchmarking framework for mortgage loan LGDs that
    - "compares apples with apples, but not with pears"
    - can be used by regulators, rating agencies and banks
  - *and thereby hopefully boost the progress in measuring the riskiness of banks…*

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Some general remarks on LTV and on LTV-distributions

- LTV ratio
  - defined as “loan exposure / collateral value” on single-loan level
  - key figure in banks‘ underwriting standards and regulation
  - identified as primary driver of realized loss rates in empirical literature
  - predominant input variable in mortgage loan LGD models

- About the exposure distribution of LTV ratios within banks‘ portfolios there is almost no empirical evidence publicly available:
  - EBA : only portfolio average LTV figures requested and published at bank level
  - discrete LTV distributions with around 10 data point (“LTV buckets”) are regularly published only for the underlying loan pools of mortgage backed securities (RMBS & CMBS) and for certain covered bond issues
  - rating agencies seem to use a similar “bucket approach” every now and then for their own stresstests

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LGD framework (1/2)

	Loan-to-Value	Loss Given Default
loan-level	$LTV_i := \frac{L_i}{C_i} \in (0,1]$ (current exposure / collateral value)	$LGD_i := \max\left[0, \frac{L_i - C_i \cdot RR_i}{L_i}\right]$ (recovery rate)
portfolio-level	$LTV_P := \sum_{i=1}^{n} \frac{L_i}{\sum_{i=1}^{n} L_i} \cdot LTV_i$	$LGD_P := \sum_{i=1}^{n} \frac{L_i}{\sum_{i=1}^{n} L_i} \cdot LGD_i$

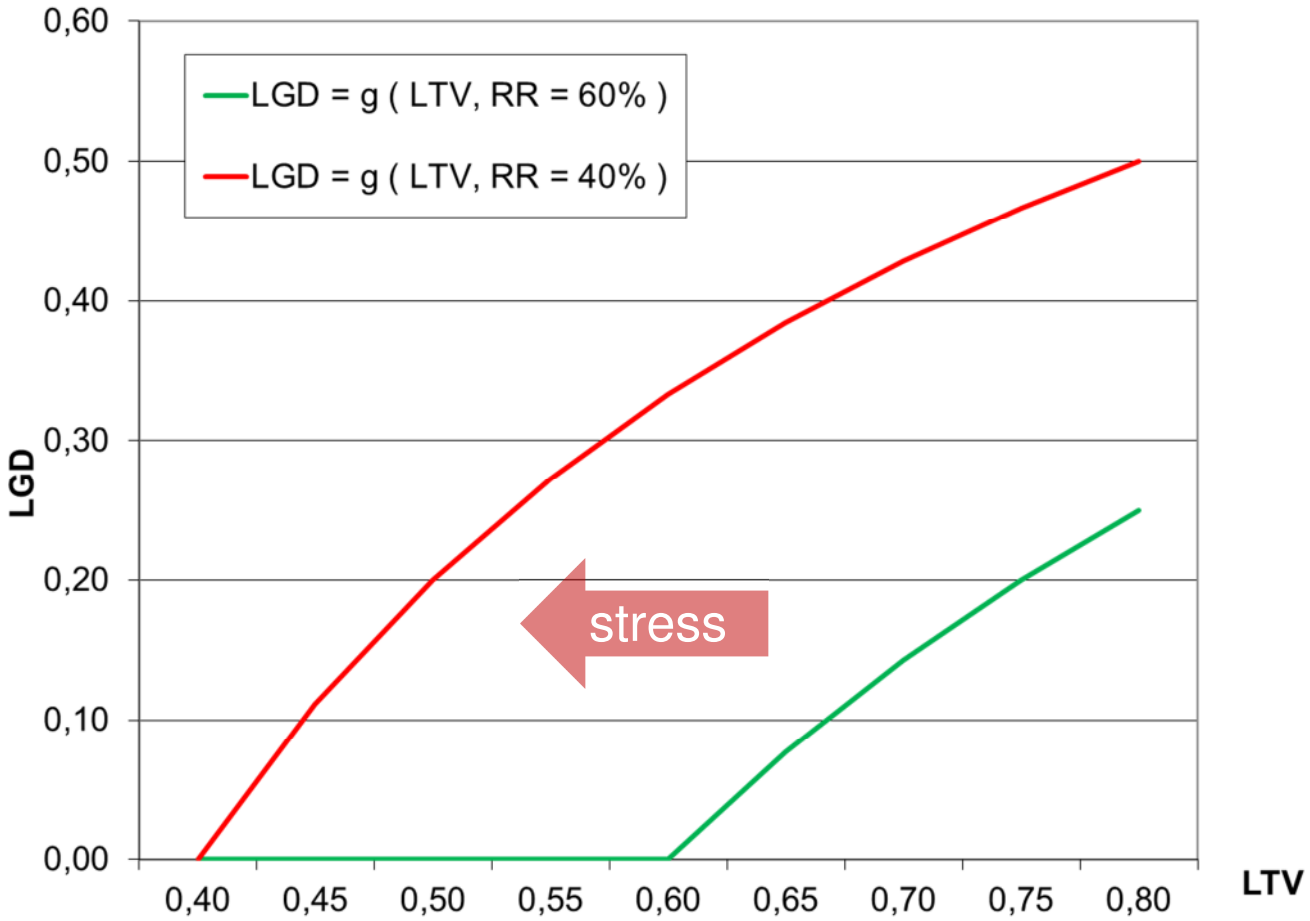
LGD framework (2/2)

- LGD as a function g of LTV and recovery rate (loan-level)

$$LGD_i = g(LTV_i, RR_i)$$

$$= \max\left[0, \frac{LTV_i - RR_i}{LTV_i}\right]$$

$$= 1 - \frac{RR_i}{\max[RR_i, LTV_i]}$$



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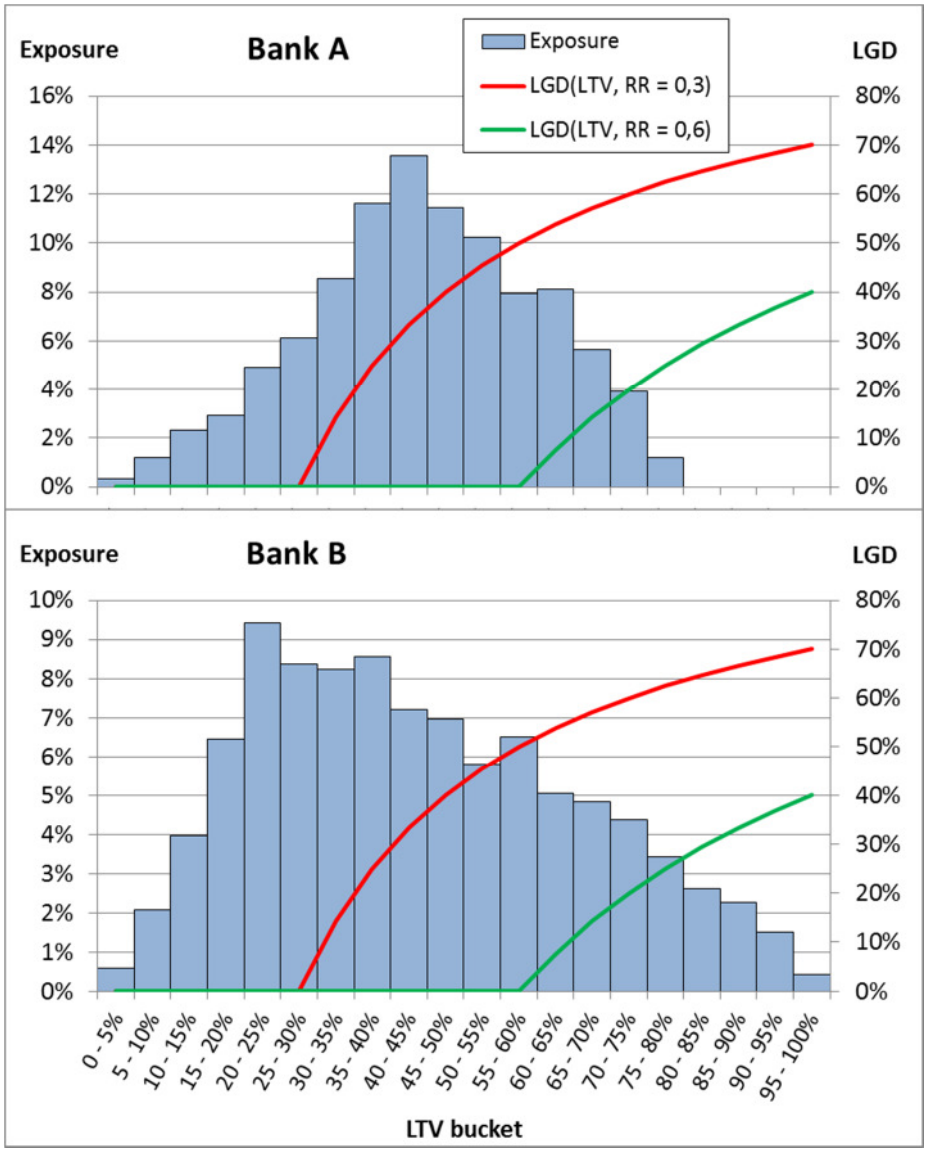
Simple example: two hypothetical banks with similar LTV_P



	LTV_P	LGD_P		stress factor
		$RR = 60\%$	$RR = 30\%$	
Bank A	44,6%	1,9%	29,7%	16
Bank B	44,1%	4,4%	27,4%	6

- Although LTV_P is almost identical for banks A and B, the stress sensitivity of LGD_P is completely different.
- The more dispersed LTV-distribution of bank B acts as an additional risk buffer.
- The use of simple multipliers as stress factors for benchmarking purposes is not reasonable.
- ➢ **Idea: use an abstract characterisation of the LTV-distribution in order to create a simple "rule-of-thumb" for the stress impact on LGD_P.**

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Approximation of portfolio LGD assuming Beta-distributed LTVs (1/2)

- We assume that the LTV per monetary unit is Beta-distributed with parameters p and q.

$$f(x,p,q) = \frac{1}{B(p,q)} x^{p-1}(1-x)^{q-1}$$

beta function

$$F(u,p,q) = \int_0^u f(x,p,q)dx$$

- Then, LGD_P can be expressed as the following expected value:

cp. slides 9 and 10

$$LGD_P = \sum_{i=1}^{n} \left(1 - \frac{RR}{\max[RR, LTV_i]}\right) \cdot \frac{L_i}{\sum_{i=1}^{n} L_i}$$

$$\boldsymbol{LGD_P} = \int_0^1 g(x,RR) f(x,p,q)dx$$

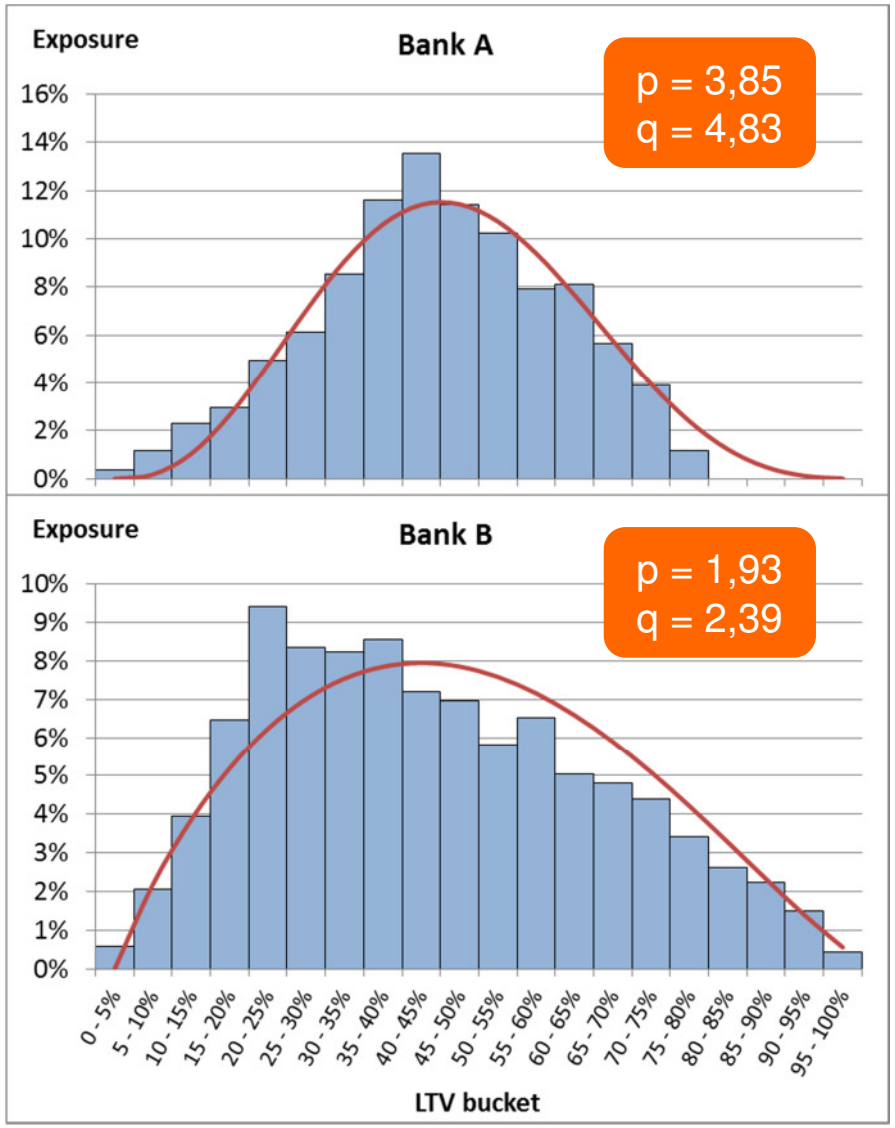
$$= \frac{1}{B(p,q)} \int_0^1 \left(1 - \frac{RR}{\max[RR,x]}\right) x^{p-1}(1-x)^{q-1}dx$$

$$= \ldots$$

$$= \mathbf{1 - F(RR,p,q) - RR \cdot \frac{p+q-1}{p-1} \cdot \left(1 - F(RR,p-1,q)\right)}$$

computable e.g. in MS Excel

Approximation of portfolio LGD assuming Beta-distributed LTVs (2/2)



- determination of p and q by Maximum-Likelihood-Estimation on loan-level-data
- knowing p and q, everyone is able to assess the plausibility of banks‘ stressed LGDs using the formula for LGD_P:

	LGD_P		stress factor
	$RR = 60\%$	$RR = 30\%$	
Bank A	1,9%	29,7%	16
Bank A (approx.)	2,0%	28,7%	14
Bank B	4,4%	27,4%	6
Bank B (approx.)	4,3%	28,9%	7

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Conclusions and outlook (1/2)

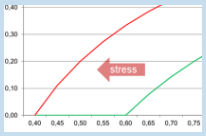
- Main results:
  - We demonstrated that the impact of stress on the mean LGD of a mortgage loan portfolio depends heavily on the shape of the underlying LTV-distribution.
  - We suggested a formula that can be used as a “rule-of-thumb” for properly assessing stressed portfolio LGDs, when loan-level data are not accessible.
  - A parametric characterization of the LTV-distribution is used to overcome the information asymmetry.

- Policy recommendations:
  - In any case, transparency about banks’ LTV-distributions on the basis of an internationally harmonized LTV definition seems to be a prerequisite for a sound LGD-benchmarking framework.
  - We suggest that the incorporation of our findings into future regulatory stress test and benchmarking exercises should be examined.

Conclusions and outlook (2/2)

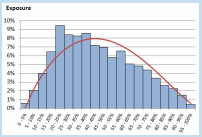
- Future research:
  - For now, empirical work could start with the available “LTV buckets” for RMBS/CMBS pools and their realized losses.
  - Our approximation approach could be generalized to other risk parameters (e.g. PD) and other portfolios (e.g. corporates) using the following three components:

1



benchmark model for the risk parameter (“granular level”)

2



multivariate portfolio distribution of input variables

3

$$\int_0^1 g(x, RR) f(x, p, q) dx$$

analytical or numerical approximation of portfolio parameter

Thank you for your attention!

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