Loss Given Default for residential real estate banks: Evidence from the Euro area

by

Claudio Giannotti

University LUMSA

e-mail: c.giannotti@lumsa.it

Gianluca Mattarocci

University of Rome Tor Vergata

e-mail: gianluca.mattarocci@uniroma2.it

and

Xenia Scimone

(corresponding and presenting author)

University of Rome Tor Vergata

e-mail: xenia.scimone@uniroma2.it

Loss Given Default for Residential Real Estate Banks:

Evidence from the Euro area

Abstract

Loss given default (LGD) for residential real estate loans is affected by real estate market trends due to the impact on the value of debtors' main collateral. Banks specialized in real estate lending are expected to be better at selecting lending opportunities, properly evaluating real estate collaterals, and managing the recovery process. The recovery process is expected to differ for specialized lenders but there is no consensus about their differences from other market players.

The paper examines LGD for a representative sample of European banks to underline the key differences related to real estate specialization. Results show that real estate banks, on average, perform a better recovery process. Moreover, real estate banks not fully specialized in real estate can better manage the real estate market cycle effect, reducing the pro-cyclicality of LGD.

Keywords: Loss Given Default, Real estate banks, Real Estate market, Lending

1. Introduction

Banks' loss given default (LGD) is affected by systemic risk and the recovery process in normally less effective in a market downturn than in stable markets (e.g. Dullmann and Trupp, 2004). The last financial crisis demonstrates that real estate mortgages could be one of the main drivers of loss in the event of default if the value of collateral decreases and the recovery process duration increases (Andersson and Mayock, 2014).

The literature on residential mortgages underlines the unique features of exposure related to mortgages and different degrees of sensitivity to changes in market scenario (e.g. Agarwal et al., 2006). Lenders' capital requirements are set without considering the specific risk that can characterize the real estate mortgage (e.g. pre-payment risk) or the diversification strategy adopted by the bank in selecting counterparties (e.g. geographical diversification; Calem and Lacour-Little, 2004). Empirical evidence on the risk assumed by banks specialized in real estate lending is still ambiguous, with some authors supporting the hypothesis that increasing exposure in the sector drives risk taking (Blasko and Sinkey, 2006) and others demonstrating that specialization in real estate lending allows return maximization and minimization of the risk of the lending portfolio, especially for banks that already have expertise in the sector (Eisenbais and Kwast,1991).

This paper aims to evaluate differences in LGD risk between banks specialized in real estate lending (REBs) and other lenders, as well as in the sensitivity of the effectiveness of their recovery processes to real estate market trends. The results show that, normally, REBs have a lower average LGD than other banks (an yearly average gap of 1%-2%) and their risk proxy distribution is less concentrated in the tails. Analysis of the main LGD risk drivers shows that specialization in real estate does not per se increase the recovery risk, but a lack of diversification in the lending portfolio composition (too concentrated on residential mortgages) leads to an increase in the lender's risk.

The remainder of the paper is organized as follows. Section 2 presents a detailed literature review of the measurement issues for LGD and its main drivers, focusing on the main distinctive features of residential mortgages. Section 3 describes the empirical analysis, presenting the sample (Section 3.1), the methodology

(Section 3.2), the main results (Section 3.3), and the results of robustness tests (Section 3.4). Section 4 concludes the paper, summarizing the results and presenting their implications.

2. Literature Review

LGD is the amount of losses sustained by the lender in the event of default of a borrower (e.g. Fesovalyi and Hurt, 1998) and it can be measure using the following alternative approaches:

- Implied market premium;
- Workout process;
- Accounting proxy.

The first category of models uses information on defaulted corporate bonds to forecast the value of LGD, assuming financial market efficiency. The approach uses the current price of the defaulted loans to identify the expected LGD on the basis of a no-arbitrage strategy, comparing the return on the defaulted loans with that of other corporate bonds (Maclachlan, 2005).

The workout LGD is obtained as the ratio between the actual value of cash flows related to the recovery process and the exposure at default. Although this approach is more complex, its greater accuracy and flexibility allow it to be applied to many kinds of debt (Calabrese and Zenga, 2010).

Accounting LGD is based on charge-off amounts in terms of non-performing facilities and computes the LGD proxy based on the banks' annual information disclosure in the balance sheets. The charge-off amounts are affected by lending product types, average past due amounts, collateral used, and accounting standards that could affect the degree of prudence adopted by the lenders in their risk management policies (Lehutova, 2011).

Independent of the approach used to measure recovery risk, the literature identifies different drivers that could affect banks' exposure independently of the country and time period. The main factors that may affect the LGD are the following (Schuermann, 2004):

- Capital structure;
- Presence and quality of collateral;
- Type of contract;
- Business cycle;
- Relationship lending.

Firms normally adapt their optimal/target capital structure to macroeconomic dynamics to maximize the benefits and minimize the costs related to the debt–equity structure. In the event of default, borrowers who have adjusted their capital structure dynamically are normally able to significantly reduce lenders' losses (Hackbarth et al., 2006).

The type of collateral could be a personal guarantee and real collateral and the value of the LGD is normally significantly higher in the case of personal guarantees with respect to real collateral (Dermine and Carvalho, 2006). While collateral reduces the expected LGD for any type of exposure, the current value of the guarantee provided does not affect the impact on the recovery rate: In fact, the collateral value could decline before the bank gains ownership of the asset and supervisors normally require the value of the covenant to be adjusted on the basis of the expected value in the event of default (Frye, 2000). The value and recovery rates of defaulted bank loans could be analysed by considering both secondary market loan pricing and actual payments to defaulted loan holders (Carty and Lieberman, 1996).

The main aspect of the contract that can affect the recovery process results is the loan's seniority and the LGD is normally lower for more senior and secured exposures (Renault and Scaillet, 2004) and even more so for market financing solutions (Mora, 2012). Riskier financial contracts are revolving loans, where, near

default, borrowers normally tend to increase their usage ratio and the lender's exposure (Zaniboni et al., 2013). The LGD can be also affected by the borrower's relative size (with respect to the bank's other debtors) and, normally, above-average exposure implies a lower recovery rate due to the excessive concentration of the lending portfolio and the lower independence of the lender with respect to the borrower (Grunert and Weber, 2008**).**

The business cycle affects the efficiency and effectiveness of the recovery process and, normally, better economy conditions have a positive impact on the recovered value (Lowe and Segoviano, 2002). The role of the business cycle depends on the firm's sector and, normally, sectors characterized by a greater share of immaterial assets suffer higher losses in a market downturn (Dermine and Carvalho, 2006). The literature finds an economic downturn has a negative impact on the recovery rate, considering all counterparties' rating grades, even if a difference in sensitivity exists (Bade et al., 2011).

Variables such as the length of the relationship, income, the number of esisting baking relationships, the type of employment, borrower credit or behavioural scores, debit balance, and the region of residence may influence the LGD od a specific contract(Crook and Bellotti, 2012). Banks that establish long-term relationships with customers suffer less from information asymmetry and they are better able to properly evaluate debtors and (especially if the debtor has no multiple banking relatioships) they can easily renegotiate the debt before an increase of the probability of default and/or LGD risk exposure(Gupton et al., 2000).

The literature on residential mortgages demonstrates that LGD behaviour may differ with respect to other types of lending solutions offered by the same bank and the main issues are related to foreclosure law, loan to value dynamics, and risk sharing agreements.

The efficiency of foreclosure law can affect recovery value due to the increase in time necessary for recovery and the additional costs related to the judicial procedure (Clauretie and Herzog, 1990). The probability of no recovery of the lender's exposure can increase in countries characterized by inefficient civil courts and can create an incentive for out-of-court procedures and debt renegotiation.

The loan-to-value ratio is the main proxy of the LGD risk assumed by the bank; however, the mortgage loss severity in distressed housing markets is significantly higher than under normal housing market conditions due to the decreasing appraisal value of the collateral provided (Qi and Yang, 2009).

In the residential mortgage loan industry, senior mortgages generate very low loss rates, while losses for subordinated claims are higher (Park and Won Bang, 2014). However, the use of simple risk sharing arrangements can greatly mitigate expected losses and reduce the variability of losses and these results are confirmed even for sub-prime loans (Pennington-Cross, 2003).

3. Empirical analysis

3.1 Sample

The sample considers all banks in the euro area for which Bankscope has detailed information about the amount of residential mortgages outstanding between 2006 and 2015. Of the starting sample of all 6871 banks in the euro area for the time horizon analysed, only around 27% disclose in their balance sheets the amount of exposure to residential mortgages and the level of disclosure differs across countries (Table 1).

Table 1: Sample composition by Country and year

Country	Number	%	Year	Number	%
Germany	1873	43.45%	2005	2939	68.17%
Italy	654	15.17%	2006	3073	71.28%
France	439	10.18%	2007	3132	72.65%
Austria	359	8.33%	2008	3167	73.46%
Spain	196	4.55%	2009	3231	74.95%
Portugal	148	3.43%	2010	3349	77.68%
Luxemburg	129	2.99%	2011	3538	82.07%
Netherlands	100	2.32%	2012	3581	83.07%
Belgium	88	2.04%	2013	3591	83.30%
Ireland	82	1.90%	2014	3516	81.56%
Finland	67	1.55%	2015	2564	59.48%
Cyprus	39	0.90%			
Slovenia	26	0.60%			
Switzerland	25	0.58%			
Malta	25	0.58%			
Latvia	21	0.49%			
Greece	17	0.39%			
Estonia	12	0.28%			
Lithuania	11	0.26%			

Source: Bankscope data processed by the authors

Table 1 shows that the most represented country in the sample is Germany (43.45%), followed by Italy (15.17%), France (10.18%), and Austria (8.33%). The remaining countries represent less than 4.55% of the banks in the sample.

The sample is quite stable over time because, apart from 2015, when less than 60% of the sample shows data, almost 70% of the banks have information available for the full time horizon and the sample does not have a survivorship bias problem.

3.2 Methodology

The study uses the accounting LGD, measured as the net charge-off rate computed at the bank level for each year, following the approach proposed by Sironi and Zazzara (2003). The dependent variable *LGD* is the percentage of the charge-off over the outstanding balance at default in the previous time period (e.g. Siddiqi and Zhang, 2004):

$$LGD_{it} = \frac{Charge - off_{it}}{Defaulted\ Loans_{it-1}} \times 100 \qquad (1)$$

where

LGD_{it} = estimated value of the LGD

$Charge - off_{it}$ = value of passage into loss for bank *i* at time *t*

$Defaulted\ Loans_{it-1}$ = amount of bad and doubtful debts for bank *i* at time t - 1

The proxy considers all types of possible defaulted loans that are classified in the balance sheet as doubtful loans, restructured loans, past due 90 days, loss loans, or substandard loans.

In order to consider that the role of real estate exposure could differ on the basis of the bank's degree of specialization in real estate lending, a new proxy for real estate exposure is constructed for each bank in each year as the ratio between the residential mortgages' exposures and the overall amount of loans for each bank:

$$REexposure_{it} = \frac{Residential\ Mortgages_{it}}{Loans_{it}} \tag{2}$$

where higher values indicate the bank's increasing exposure at time t to residential real estate lending and potentially greater specialization in mortgages. Following the standard approaches proposed in the literature, a bank is classified as a real estate bank if its exposure to residential mortgages is greater than 30% (Eisenbeis and Kwast, 1991).[1]

The analysis of the impact of real estate lending on banks' LGD is conducted using the following formulas (Castro 2013) in a random effect panel regression model:

$$\begin{aligned} LGD &= \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta UR_{it-1} + \gamma_3 \Delta IR_{it-1} + \gamma_4 \Delta Cred_{it-1} + \gamma_5 \Delta Shares_{it-1} \\ &+ \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \varepsilon_{it} \end{aligned} \tag{3}$$

$$\begin{aligned} LGD &= \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta UR_{it-1} + \gamma_3 \Delta IR_{it-1} + \gamma_4 \Delta Cred_{it-1} + \gamma_5 \Delta Shares_{it-1} \\ &+ \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 ReExposure_{it-1} + \varepsilon_{it} \end{aligned} \tag{4}$$

$$\begin{aligned} LGD &= \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta UR_{it-1} + \gamma_3 \Delta IR_{it-1} + \gamma_4 \Delta Cred_{it-1} + \gamma_5 \Delta Shares_{it-1} \\ &+ \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 Reb30_{it-1} + \delta_3 Reb30ReExposure_{it-1} \\ &+ \delta_4 ReExposure_{it-1} + \varepsilon_{it} \end{aligned} \tag{5}$$

$$\begin{aligned} LGD &= \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta GDP_{it-1} + \gamma_3 \Delta IR_{it-1} + \gamma_4 \Delta Cred_{it-1} + \gamma_5 \Delta Shares_{it-1} \\ &+ \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \varepsilon_{it} \end{aligned} \tag{6}$$

$$\begin{aligned} LGD &= \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta GDP_{it-1} + \gamma_3 \Delta IR_{it-1} + \gamma_4 \Delta Cred_{it-1} + \gamma_5 \Delta Shares_{it-1} \\ &+ \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 ReExposure_{it-1} + \varepsilon_{it} \end{aligned} \tag{7}$$

$$\begin{aligned} LGD &= \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta GDP_{it-1} + \gamma_3 \Delta IR_{it-1} + \gamma_4 \Delta Cred_{it-1} + \gamma_5 \Delta Shares_{it-1} \\ &+ \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 Reb30_{it-1} + \delta_3 Reb30ReExposure_{it-1} \\ &+ \delta_4 ReExposure_{it-1} + \varepsilon_{it} \end{aligned} \tag{8}$$

$$\begin{aligned} LGD &= \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta UR_{it-1} + \gamma_3 \Delta Indebtness_{it-1} + \gamma_4 \Delta Pubdebt_{it-1} \\ &+ \gamma_5 \Delta Shares_{it-1} + \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \varepsilon_{it} \end{aligned} \tag{9}$$

$$\begin{aligned} LGD &= \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta UR_{it-1} + \gamma_3 \Delta Indebtness_{it-1} + \gamma_4 \Delta Pubdebt_{it-1} \\ &+ \gamma_5 \Delta Shares_{it-1} + \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 ReExposure_{it-1} + \varepsilon_{it} \end{aligned} \tag{10}$$

$$\begin{aligned} LGD &= \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta UR_{it-1} + \gamma_3 \Delta Indebtness_{it-1} + \gamma_4 \Delta Pubdebt_{it-1} \\ &+ \gamma_5 \Delta Shares_{it-1} + \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 Reb30_{it-1} \end{aligned} \tag{11}$$

[1] Thresholds other than 30% are considered in the robustness tests presented in Section 3.4.

$$+\delta_3 Reb30ReExposure_{it-1} + \delta_4 ReExposure_{it-1} + \varepsilon_{it}$$

$$LGD = \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta GDP_{it-1} + \gamma_3 \Delta Indebtness_{it-1} + \gamma_4 \Delta Pubdebt_{it-1}$$
$$+\gamma_5 \Delta Shares_{it-1} + \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \varepsilon_{it} \quad (12)$$

$$LGD = \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta GDP_{it-1} + \gamma_3 \Delta Indebtness_{it-1} + \gamma_4 \Delta Pubdebt_{it-1}$$
$$+\gamma_5 \Delta Shares_{it-1} + \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 ReExposure_{it-1} + \varepsilon_{it} \quad (13)$$

$$LGD = \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta GDP_{it-1} + \gamma_3 \Delta Indebtness_{it-1} + \gamma_4 \Delta Pubdebt_{it-1}$$
$$+\gamma_5 \Delta Shares_{it-1} + \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 Reb30_{it-1} \quad (14)$$
$$+\delta_3 Reb30ReExposure_{it-1} + \delta_4 ReExposure_{it-1} + \varepsilon_{it}$$

where the independent variables are specified as
LGD_{it-1} = one-year-lagged value of the LGD
ΔUR_{it-1} = unemployment rate
ΔGDP_{it-1} = growth rate of the real gross domestic product (GDP)
ΔIR_{it-1} = spread between the long-term (10-year) and short-term (three-month) interest rates
$\Delta Cred_{it-1}$= yearly credit growth
$\Delta Shares_{it-1}$ = yearly growth rate of a share price index (Eurostock)
HPI_{it-1} = housing price trend measured by Eurostat (country-level data)
$REER_{it-1}$ = real effective exchange rate (to control for external competitiveness)
$\Delta Indebtness_{it-1}$ = yearly growth rate of the ratio of total private loans to the GDP
$\Delta PublicDebt_{it-1}$ = yearly growth rate of the government's public debt as a percentage of the GDP
$FinCrisis_{it}$ = dummy variable to control for the financial crisis period that assumes the value of one from the fourth quarter of 2008 onwards and zero otherwise (Reinhart and Rogoff, 2009)
$Reb30_{it-1}$ = control dummy that indicates real banks i has a real estate exposure at least equal to 30% at time t-1
$ReExposure_{it-1}$ = ratio between residential mortgage and gross loans for the bank i at time t-1
$Reb30ReExposure_{it-1}$ = interaction term between *Reb* and *ReExposure*

All the panel regressions consider fixed effects on the basis of the results of a Hausman specification test. Standard statistical fitness measures are presented to evaluate the contribution of the real estate proxies to the LGD proxy's forecasting accuracy.

3.3 Results

A preliminary analysis of the sample considers summary statistics of the LGD proxy for the full-time horizons to evaluate if there is any time trend in the risk proxy (Table 2).

Table 2: Summary statistics on LGD values and determinants by year

	LGD_t	Charge-offs$_t$ / Gross Loans$_t$	Defaulted loans$_t$ / Gross Loans$_t$
2007	55.86%	0.47%	0.21%
2008	22.97%	0.34%	0.70%
2009	20.90%	0.41%	0.67%
2010	21.29%	0.45%	0.80%
2011	28.70%	0.43%	1.05%
2012	63.61%	0.61%	1.81%
2013	68.34%	1.07%	2.93%
2014	62.64%	1.21%	3.35%
2015	55.15%	2.91%	2.83%

Source: Bankscope data processed by the authors

Table 2 shows the LGD values starting in 2007 at 55.86% and reaching 55.15% in 2015. The maximum value was recorded in 2013 (68.34%) but the risk proxy value is abnormally low in 2008–2011, probably due to conservative policies in the write-off policy adopted by the banks. In fact, with the charge-off and defaulted loans dynamics considered separately, the percentage of defaulted loans over gross loans is increasing over time. The percentage of charge-offs to gross loans during 2008–2011 does not increase linearly but it is, at the end of the time horizon, in 2015, comparable to the defaulted loans ratio (with growth of +2.44% for the former and +2.62% for the latter). The slow growth of the charge-off rate in the first years of the crisis is consistent with the assumption that the write-off policy adopted by banks is normally backward looking (e.g. Beck and Narayanamoorthy, 2013) and less representative of the real losses expected in an extraordinary economic downturn scenario.

The analysis of the LGD values for banks classified on the basis of real estate exposure allows the identification of interesting differences with respect to the average (Table 3).

Table 3: Average LGD on the basis of the Real Estate exposure

	Overall	RE1Q	RE2Q	RE3Q	RE4Q
2007	55.86%	56.90%	67.44%	52.31%	47.18%
2008	22.97%	23.47%	24.70%	21.98%	21.52%
2009	20.90%	19.60%	23.24%	17.25%	22.43%
2010	21.29%	22.07%	22.60%	19.99%	20.67%
2011	28.70%	25.34%	31.07%	31.22%	26.51%
2012	63.61%	65.71%	65.96%	61.56%	61.52%
2013	68.34%	71.73%	68.17%	67.42%	66.17%
2014	62.64%	64.88%	63.52%	61.56%	60.76%
2015	55.15%	54.43%	53.78%	56.81%	55.40%
Overall	54.23%	56.18%	54.93%	53.93%	52.09%
	Overall	RE1Q	RE2Q	RE3Q	RE4Q
LGD<10%	42.85%	42.03%	42.20%	41.89%	45.19%
10%≤LGD<20%	2.74%	1.88%	2.39%	3.81%	2.77%
20%≤LGD<30%	0.89%	0.28%	0.99%	1.08%	1.14%
30%≤LGD<40%	0.38%	0.47%	0.50%	0.50%	0.08%
40%≤LGD<50%	0.28%	0.28%	0.33%	0.33%	0.16%
50%≤LGD<60%	0.11%	0.19%	0.08%	0.17%	0.00%
60%≤LGD<70%	0.08%	0.09%	0.08%	0.08%	0.08%
70%≤LGD<80%	0.17%	0.00%	0.33%	0.17%	0.16%
80%≤LGD<90%	0.06%	0.00%	0.00%	0.08%	0.16%
LGD≥90%	52.44%	54.78%	53.10%	51.90%	50.24%
LGD<10% & LGD≥90%	95.29%	96.81%	95.29%	93.79%	95.43%

Source: Bankscope data processed by the authors

The analysis of the average LGD value shows a negative linkage between the risk proxy and residential real estate loan exposure (from a maximum of 56.16% for banks with minimum real estate exposure to a minimum of 52.09% for those with maximum exposure). The difference is driven by the years 2007 and 2008 and 2012–2015, when, on average, the LGD for banks with maximum exposure to real estate (RE4Q) was lower than that of all the other groups of banks (RE1Q, RE2Q, and RE3Q).

The LGD distribution for the full sample is not normal and is characterized by a bimodal distribution with modal values equal to 0% and 100%. The results are consistent with existing literature (e.g. Asarnow and Edwards, 1995) that justifies this type of anomaly due to prevalent recovery process characteristics that could totally fail if bankruptcy is declared (*LGD* = 100%) or could allow for full recovery from the exposure in the event that the defaulted entity become again able to pay (*LGD* = 0%) (Chalupka and Kopecsni, 2009). Banks with above-average exposure to real estate (RE3Q and RE4Q) are characterized by a lower incidence of bimodal values (93.8% for RE3Q and 95.4% for RE4Q), even if the difference from the other types of banks is limited to one to two percentage points (96.81% for RE1Q and 95.29% for RE2Q).

Table 4: LGD macro-determinants and the role of real estate exposure – Panel fixed effect

The table presents a panel regression analysis of the current value of the LGD for the bank i at time t with respect to a set controlling variables related to macro-economic conditions (ΔUR_{it-1} and ΔGDP_{it-1}), financial market conditions (ΔIR_{it-1}, $\Delta Cred_{it-1}$, $\Delta Share_{it-1}$), housing market trend (HPI_{it-1}), exchange rate dynamics ($REER_{it-1}$), a financial crisis dummy ($FinCrisis_{it}$), and a set of bank's real estate exposure proxies ($Reb30$, $Reb30ReExposure$ and $ReExposure$). All indepedent variables (excluding the *FinCrisis* dummy) are lagged of one year in order to avoid endogeneity problems. For more details about the variables construction see section 3.2.

	(3)	(4)	(5)	(6)	(7)	(8)
LGD_{it-1}	0.277***	0.278***	0.277***	0.280***	0.280***	0.280***
ΔUR_{it-1}	0.233***	0.233***	0.230***			
ΔGDP_{it-1}				-0.408***	-0.408***	-0.405***
ΔIR_{it-1}	-0.172	-0.191	-0.197	-0.537	-0.553*	-0.557*
$\Delta Cred_{it-1}$	0.299***	0.305***	0.306***	0.338***	0.342***	0.344***
$\Delta Share_{it-1}$	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
HPI_{it-1}	-0.038	-0.042	-0.047	-0.377	-0.381**	-0.381**
$REER_{it-1}$	0.084	0.087	0.087	0.104	0.106	0.105
$FinCrisis_{it}$	-0.005	-0.056	-0.006	-0.006	-0.006	-0.007
$Reb30_{it-1}$			-0.054			-0.058
$Reb30ReExposure_{it-1}$			0.271**			0.292*
$ReExposure_{it-1}$		0.038	-0.204		0.334	-0.226*
α_t	0.344***	0.328***	0.366***	0.343***	0.328***	0.369***
N° banks	1071	1071	1071	1071	1071	1071
N° obs	3293	3293	3293	3293	3293	3293
R^2	0.882	0.877	0.872	0.8818	0.880	0.874

Notes: *** statistically significant at 1%, ** statistically significant at 5%, * statistically significant at 10%.
Source: Bankscope data processed by the authors

The analysis shows a high degree of autoregressive persistence for the LGD value, independent of the model selected, and the results are consistent with international evidence of the low (near-zero) variability over time of the recovery risk proxy (Camba-Méndez and Serwa, 2016). As expected, better (worse) economic conditions, proxied by the GDP growth or unemployment rate, have a positive (negative) impact on the LGD. An increase in the credit available to both private and public entities has a negative (positive) impact on the recovery rate (LGD) because the collateral provided is unable to ensure full recovery of the initial exposure. In an upward (downward) real estate market, proxied by the housing market trend, the value of collateral increases (decreases) and LGD exposure therefore decreases (increases). None of the other macrovariables (long-term interest rate, stock market trends, and exchange rates) or the crisis dummy is statistically significant in explaining LGD dynamics.

The introduction of real estate lending proxies has an impact on the LGD estimation, but the result is not only driven simply by the amount of residential mortgages offered, which is positively linked with the LGD but not statistically significant. Analysis of the REBs shows more interesting results: Specialization in real estate does not imply an increase of the LGD, while excessive exposure to real estate for specialized lenders has a positive impact on the LGD. The results support the hypothesis presented in literature that real estate specialization does not imply a higher risk (Eisenbeis and Kwast, 1991) but the lack of diversification in the lending portfolio increases the recovery risk for lenders (Winton, 1999)

Due to the significant differences in public debt policies adopted by the countries in the sample, the analysis is replicated by considering separately the growth in public and private debt to test if the effectiveness of the recovery policy is affected by the main type of debtor raising funds in the market (Table 5).

Table 5: LGD macro-determinants and the role of real estate exposure – Panel fixed effect with extended model

The table presents a panel regression analysis of the current value of the LGD for the bank i at time t with respect to a set controlling variables related to macro-economic conditions (ΔUR_{it-1} and ΔGDP_{it-1}), financial market conditions $\Delta Indebtness_{it-1}$, $\Delta PubDebt_{it-1}\Delta Share_{it-1}$), housing market trend (HPI_{it-1}), exchange rate dynamics ($REER_{it-1}$), a financial crisis dummy ($FinCrisis_{it}$), and a set of bank's real estate exposure proxies ($Reb30, Reb30ReExposure$ and $ReExposure$). All indepedent variables (excluding the *FinCrisis* dummy) are lagged of one year in order to avoid endogeneity problems. For more details about the variables construction see section 3.2.

	(9)	(10)	(11)	(12)	(13)	(14)
LGD_{it-1}	0.275***	0.275***	0.275***	0.275***	0.275***	0.275***
ΔUR_{it-1}	0.118**	0.119**	0.114*			
ΔGDP_{it-1}				-0.533**	-0.536**	-0.542**
$\Delta Indebtness_{it-1}$	0.051	0.052	0.055	0.367**	0.369**	0.372*
$\Delta PubDebt_{it-1}$	0.255***	0.253***	0.254***	0.372***	0.372***	0.371***
$\Delta Share_{it-1}$	-0.001**	-0.001**	-0.001**	-0.000	-0.000	-0.000
HPI_{it-1}	0.220	0.221	0.218	0.111	0.112	0.112
$REER_{it-1}$	0.094	0.093	0.092	0.315**	0.314**	0.313*
$FinCrisis_{it}$	-0.005	-0.005	-0.006	-0.007	-0.007	-0.009
$Reb30_{it-1}$			-0.059			-0.069
$Reb30ReExposure_{it-1}$			0.279*			0.308*
$ReExposure_{it-1}$		0.012	-0.231*		0.015	-0.245*
α_t	0.327***	0.322***	0.361***	0.317***	0.310***	0.353***
N° Banks	1072	1072	1072	1072	1072	1072
N° obs	3296	3296	3296	3296	3296	3296
R^2	0.8773	0.8766	0.8695	0.8755	0.8744	0.8646

Notes: *** statistically significant at 1%, ** statistically significant at 5%, * statistically significant at 10%.
Source: Bankscope data processed by the authors

Considering public and private debt separately, the results show that the increase of the LGD is mainly driven by an increase in public debt, demonstrating that the recovery process is longer and less effective for this type of customer compared to private ones. The results are consistent with international evidence, because sectors in Europe that are prevalently public or offered by publicly owned firms (e.g. healthcare, public transportation, and communication) normally exhibit low recovery rates (e.g. Altman and Kishore, 1996).

The new model shows that, as before, real estate banks with excessive exposure to real estate loans are characterized by a higher LGD, but now an increase in real estate exposure also has a negative and statistically significant effect on the LGD of all the other banks.

3.4 Robustness test

As robustness tests, the analysis considers different thresholds for discriminating between REBs and non-REBs. A preliminary analysis of the summary stastitics allow evaluating the thresholds that can be used in order to discriminate among banks in the sample (Table 6).

Table 6. Percentage of REBs description on the basis of the threshold selected

	2007	2008	2009	2010	2011	2012	2013	2014	2015
REB 10	89.76%	89.20%	88.25%	88.36%	88.06%	88.24%	87.95%	88.74%	89.43%
REB 20	83.13%	80.62%	79.30%	80.04%	80.04%	80.49%	80.69%	81.98%	82.51%
REB 30	71.69%	70.69%	70.60%	72.07%	70.57%	70.30%	70.03%	72.31%	72.98%
REB 40	54.22%	57.81%	59.54%	60.62%	57.29%	56.91%	57.07%	59.45%	59.14%
REB 50	42.17%	41.31%	39.90%	40.23%	35.37%	34.85%	35.36%	37.36%	36.95%
REB 60	28.92%	22.00%	20.88%	20.57%	19.06%	18.48%	17.92%	18.74%	19.39%
REB 70	18.07%	6.84%	6.96%	6.88%	6.78%	6.99%	6.93%	7.25%	7.25%
REB 80	10.24%	1.88%	1.86%	1.99%	2.24%	2.33%	2.56%	3.02%	2.74%
REB 90	4.82%	0.54%	0.68%	0.72%	0.95%	0.98%	0.91%	1.10%	1.17%
REB 100	2.41%	0.00%	0.06%	0.06%	0.06%	0.11%	0.16%	0.22%	0.13%

Source: Bankscope data processed by the authors

Data show that the sample composition could be similar(on the basis of the number of banks) if the analysis considers alteratively the threshold of 30%, 40% and 50% while for other thresholds the sample will be too concentrated only on type of bank (REB vs NoREB).

On the basis of the sample features previously discussed, the panel regression analysis is tested using 40% and 50% as alternative thresholds with respect to the 30%. In formulas:

$$LGD = \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta UR_{it-1} + \gamma_3 \Delta Indebtness_{it-1} + \gamma_4 \Delta Pubdebt_{it-1} + \gamma_5 \Delta Shares_{it-1} + \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 Reb40_{it-1} + \delta_3 Reb40ReExposure_{it-1} + \delta_4 ReExposure_{it-1} + \varepsilon_{it} \quad (11a)$$

$$LGD = \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta UR_{it-1} + \gamma_3 \Delta Indebtness_{it-1} + \gamma_4 \Delta Pubdebt_{it-1} + \gamma_5 \Delta Shares_{it-1} + \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 Reb50_{it-1} + \delta_3 Reb50ReExposure_{it-1} + \delta_4 ReExposure_{it-1} + \varepsilon_{it} \quad (11b)$$

$$LGD = \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta GDP_{it-1} + \gamma_3 \Delta Indebtness_{it-1} + \gamma_4 \Delta Pubdebt_{it-1} + \gamma_5 \Delta Shares_{it-1} + \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 Reb40_{it-1} + \delta_3 Reb40ReExposure_{it-1} + \delta_4 ReExposure_{it-1} + \varepsilon_{it} \quad (14a)$$

$$LGD = \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta GDP_{it-1} + \gamma_3 \Delta Indebtness_{it-1} + \gamma_4 \Delta Pubdebt_{it-1} + \gamma_5 \Delta Shares_{it-1} + \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 Reb50_{it-1} + \delta_3 Reb50ReExposure_{it-1} + \delta_4 ReExposure_{it-1} + \varepsilon_{it} \quad (14b)$$

where, in addition to the variables in formulas (9) and (12), the new independent variables are:

$Reb40_{it-1}$ = dummy variable that assumes a value of one if the bank i at time t has real estate exposure at least equal to 40%
$Reb50_{it-1}$ = dummy variable that assumes a value of one if the bank i at time t has real estate exposure at least equal to 50%
$Reb40ReExposure_{it-1}$ = interaction term between *Reb40* and *ReExposure*
$Reb50ReExposure_{it-1}$ = interaction term between *Reb 50* and *ReExposure*

The results of the panel regression model for the two alternative thresholds are presented in Table 7.

Table 7: LGD macro-determinants and the role of real estate exposure with alternative REB proxies

The table present a panel regression analysis of the current value of the LGD for the bank i at time t with respect to a set controlling variables related to macro-economic conditions (ΔUR_{it-1} and ΔGDP_{it-1}), financial market conditions ($\Delta Indebtness_{it-1}$, $\Delta PubDebt_{it-1}\Delta Share_{it-1}$), housing market trend (HPI_{it-1}), exchange rate dynamics ($REER_{it-1}$), a financial crisis dummy ($FinCrisis_{it}$), and a set of banks real estate exposure proxies ($Reb40, Reb50, Reb40ReExposure, Reb50ReExposure$ and $ReExposure$). All indepedent variables (excluding the *FinCrisis* dummy) are lagged of one year in order to avoid endogeneity problems. For more details about the variables construction see section 3.2.

	(10a)	(13a)	(10b)	(13b)
LGD_{it-1}	0.276***	0.276***	0.275***	0.275***
ΔUR_{it-1}	0.112*		0.107*	
ΔGDP_{it-1}		0.558***		0.540**
$\Delta Indebtness_{it-1}$	0.051	0.373**	0.051	0.364**
$\Delta PubDebt_{it-1}$	0.257***	0.375***	0.260***	0.374***
$\Delta Share_{it-1}$	-0.001**	-0.000	-0.001**	-0.000
HPI_{it-1}	0.213	0.109	0.190	0.091
$REER_{it-1}$	0.103	0.327**	0.102	0.319**
$FinCrisis_{it}$	-0.005	-0.008	-0.006	-0.009
$Reb40_{it-1}$	-0.106**	-0.118**		
$Reb40ReExposure_{it-1}$	0.233*	0.263**		
$Reb50_{it-1}$			-0.027	-0.045
$Reb50ReExposure_{it-1}$			0.148	0.184
$ReExposure_{it-1}$	-0.092	-0.105	-0.148**	-0.155**
α_t	0.351***	0.343***	0.365***	0.357***
N° Banks	3296	3296	3296	3296
N° obs	1072	1072	1072	1072
R^2	0.8661	0.8605	0.8605	0.8554

Notes: *** statistically significant at 1%, ** statistically significant at 5%, * statistically significant at 10%.
Source: Bankscope data processed by the authors

Results for the 40% threshold are consistent with the base case scenario presented in Table 4 while results for the 50% threshold do not show a statistically significant linkage between real estate specialization and real estate exposure due to the lower number of banks classified as specialized lenders in the sample.

An alternative approach for evaluating the impact of real estate lending exposure on the LGD could be constructed without any assumption about REB status, classifying banks into quartiles on the basis of their real estate exposure. The new regression models are as follows:

$$LGD = \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta UR_{it-1} + \gamma_3 \Delta Indebtness_{it-1} + \gamma_4 \Delta Pubdebt_{it-1} + \gamma_5 \Delta Shares_{it-1} + \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 RE1Q_{it-1} + \delta_3 RE2Q_{it-1} + \delta_4 RE3Q_{it-1} + \delta_5 RE4Q_{it-1} + \varepsilon_{it} \quad (15)$$

$$LGD = \alpha_t + \gamma_1 LGD_{it-1} + \gamma_2 \Delta GDP_{it-1} + \gamma_3 \Delta Indebtness_{it-1} + \gamma_4 \Delta Pubdebt_{it-1} + \gamma_5 \Delta Shares_{it-1} + \gamma_6 HPI_{it-1} + \gamma_7 REER_{it-1} + \delta_1 FinCrisis_{it} + \delta_2 RE1Q_{it-1} + \delta_3 RE2Q_{it-1} + \delta_4 RE3Q_{it-1} + \delta_5 RE4Q_{it-1} + \varepsilon_{it} \quad (16)$$

where, in addition to the variables in formulas (9) and (12), the new independent variables are:

$RE1Q_{it-1}$ = product of *ReExposure* and a dummy variable that assumes the value of one for banks with real estate exposure in the first quartile
$RE2Q_{it-1}$ = product of *ReExposure* and a dummy variable that assumes the value of one for banks with real estate exposure in the second quartile
$RE3Q_{it-1}$ = product of *ReExposure* and a dummy variable that assumes the value of one for banks with real estate exposure in the third quartile
$RE4Q_{it-1}$ = product of *ReExposure* and a dummy variable that assumes the value of one for banks with real estate exposure in the fourth quartile

The results of the analysis are presented in Table 8 and confirm that there is no linear relation between real estate exposure and the LGD, because the estimated coefficients do not increase with the degree of real estate exposure and are never statistically significant.

Table 8: LGD macro-determinants and the role of real estate exposure by quartile

The table present a panel regression analysis of the current value of the LGD for the bank i at time t with respect to a set controlling variables related to macro-economic conditions (ΔUR_{it-1} and ΔGDP_{it-1}), financial market conditions ($\Delta Indebtness_{it-1}$, $\Delta PubDebt_{it-1}\Delta Share_{it-1}$), housing market trend (HPI_{it-1}), exchange rate dynamics ($REER_{it-1}$), a financial crisis dummy ($FinCrisis_{it}$), and a set of banks real estate exposure proxies ($RE1Q$, $RE2Q$, $RE3Q$ and $RE4Q$). All indepedent variables (excluding the *FinCrisis* dummy) are lagged of one year in order to avoid endogeneity problems. For more details about the variables construction see section 3.2.

	(14)	(15)
LGD_{it-1}	0.275***	0.275***
ΔUR_{it-1}	0.115**	
ΔGDP_{it-1}		0.541**
$\Delta Indebtness_{it-1}$	0.053	0.371**
$\Delta PubDebt_{it-1}$	0.258***	0.376***
$\Delta Share_{it-1}$	-0.001**	-0.000
HPI_{it-1}	0.21	0.103
$REER_{it-1}$	0.093	0.313**
$FinCrisis_{it}$	-0.005	-0.008
$RE1Q_{it-1}$	0.103	0.088
$RE2Q_{it-1}$	0.019	0.012
$RE3Q_{it-1}$	0.008	0.003
$RE4Q_{it-1}$	0.023	0.018
α_t	0.307***	0.320***
N° Banks	3296	3296
N° observations	1072	1072
R^2	0.8738	0.8760

Notes: *** statistically significant at 1%, ** statistically significant at 5%, * statistically significant at 10%.
Source: Bankscope data processed by the authors

4. Conclusion

REBs are characterized by a lower LGD than that of banks with limited exposure to mortgages and are also less affected by extreme events that drive the LGD to extreme values (zero or one). The increase in real estate exposure is not linearly related with LGD risk and specialization in real estate loans does not imply an increase of the LGD, while excessive exposure to real estate has a positive impact on LGD.

The real estate cycle could affect the availably of lending due to changes in collateral value and especially rduring eal estate bubbles banks may offer an excessive amount lending assuming the vaue of the collateral provided will continue to grow over time. Empirical evidence on the recovery process shows that supervisors have a higher incentive to control because, in the event of debtor default, they will be less able to recover their exposure (Herring and Watcher, 2005).

LGD dynamics are normally affected not only by bank characteristics but also by contract (e.g. the LTV) and borrower characteristics, with supervisory authorities currently performing stress tests to evaluate how much of the risk assumed by financial systems can be ascribed to specific contract or debtor features (Greve and Hahnenstein, 2014). The empirical analysis proposed in the paper considers the full portfolio of loans and distressed loans without distinguishing them on the basis of contract features or customer type. This approach does not allow evaluating whether REBs are better at managing the recovery process, independent of the type of contract and exposure. The availability of internal data about banks' portfolios of distressed loans could allow the evaluation of which types of loans or customer REBs implement a more efficient recovery process.

References

Agarwal S., Ambrose B.W., Chomsisengphet S. , Chunlin Liud C. (2006), "An empirical analysis of home equity loan and line performance", *Journal of Financial Intermediation*, vol. 15, n. 4, pp. 444-469.

Altman EL., Kishore VM. (1996), "Almost everything you wanted to know about recoveries on defaulted bonds", *Journal Financial Analysts*, vol. 52, n. 6, pp. 57-64.

Andersson F., Mayock T. (2014), "Loss severities on residential real estate debt during the Great Recession", *Journal of Banking and Finance*, vol. 46, n. 9, pp. 266-284.

Asarnow E., Edward D. (1995), "Measuring loss on defaulted bank loans: A 24-year study", *Journal of Commercial Lending*, vol. 77, n. 7, pp. 11-23.

Bade B., Rosch D., Scheule H. (2011), "Empirical performance of LGD prediction models", *Journal of Risk Model Validation,* vol. 5, n. 2, pp. 25-44.

Beck PJ., Narayanamoorthy G.S. (2013), "Did the SEC impact banks' loan loss reserve policies and their informativeness?", *Journal of Accounting and Economics*, vol. 56, n. 2-3, pp. 42-65.

Blasko M., Sinkey J.F. (2006), "Bank asset structure, real-estate lending, and risk-taking ", *Quarterly Review of Economics and Finance*, vol. 46, n. 1, pp. 53–81.

Calabrese R., Zenga M. (2010), "Bank loan recovery rates: Measuring and nonparametric density estimation", *Journal of Banking & Finance*, vol. 34, n. 10, pp. 903-911.

Calem P., LaCour-Little M. (2004), "Risk-based capital requirements for mortgage loans", *Journal of Banking and Finance*, vol. 28, n. 3, pp. 647–672.

Camba-Méndez G., Serwa D. (2016), "Market perception of sovereign credit risk in the euro area during the financial crisis", *North American Journal of Economics and Financ*e, vol. 37, n. 7-8, pp. 168-189.

Carty L.V., Lieberman D. (1996), "Defaulted bank loan recoveries", *Moody's Investors Service.*

Castro V. (2013), "Macroeconimic determinants of the credit risk in the banking system: The case of the GIPSI", *Economic Modelling*, vol. 31, n. 1, pp. 672-683.

Chalupka R., Kopecsni J. (2009), "Modelling bank loan LGD of corporate and SME segment. A case study", *Czech Journal of Economics and Finance*, vol. 59, n. 4, pp. 360-382.

Clauretie T.M., Herzog T. (1990), "The effect of state foreclosure laws on loan losses: Evidence from the mortgage insurance industry", *Journal of Money, Credit and Banking*, vol. 22, n. 2, pp. 221-231.

Crook J., Bellotti T., (2012), "Loss given default models incorporating macroeconomic variables for credit cards", *International Journal of Forecasting*, vol. 28, n. 1, pp. 171-182.

Dermine J., Neto De Carvalho C., (2006), "Bank loan losses given default: A case study", *Journal of Banking & Finance,* vol. 20, n. 6, pp. 1219-1243.

Dullmann K., Trapp M. (2004), "*Systematic risk in recovery rates – An empirical analysis of US corporate credit exposures"*, Deutche Bundesbank working paper n.02/2004 available at www.bundesbank.de (accessed 11-30-2016).

Eisenbeis R.A., Kwast M.L. (1991), "Are real estate specializing depositories viable? Evidence from commercial banks", *Journal of Financial Services Research*, vol. 5, n. 1, pp. 5-24.

Felsovalyi A., Hurt L. (1998), "Measuring loss on Latin American defaulted bank loans: a 27-year study of 27 countries", *Journal of Lending and Credit Risk Management*, vol. 80, n. 1, pp. 41–46.

Frye J. (2000), "Collateral demage: A source of systematic credit risk", *Risk Magazine*, vol. 13. N-. 4., pp.28-29.

Greve C., Hahnenstein L. (2014), "*Stress testing the credit risk of mortgage loans: The relationship between portfolio-LGD and the loan-to-value distribution"*, EBA working paper available at www.eba.europe.eu (accessed 11-30-2016).

Grunert J., Weber M. (2008), "Recovery rates of commercial lending: Empirical evidence for German companies", *Journal of Banking & Finance*, vol. 33, n. 9, pp. 505-513.

Gupton G.M., Gates D., Carty L.V. (2000), "Bank loan loss given default", *Moody's Investors Service*, November.

Hackbarth D., Miao J., Morellec E. (2006), "Capital structure, credit risk, and macroeconomic conditions". *Journal of Finance Economics*, vol. 82, n. 3, pp. 519-550.

Herring R.J. , Wachter S.M. (2005), "Bubbles in real estate markets", in Hunter W.C. (ed), *Asset Price Bubbles: The Implications for Monetary, Regulatory, and International Policies*, MIT Press, 2005

Lehutova K. (2011), "Application of corporate metrics method to measure risk in logistics", *Instytut Logistyki i Magazynowania*, n. 6, pp. 1231-5478.

Lowe P.W., Segoviano M.A. (2002), *Internal ratings, the business cycle and capital requirements: Some evidence from an emerging market economy*, BIS Working Papers n. 117, available at www.bis.org (accessed 11-30-2016)

Maclachlan I. (2005), "Choosing the discount factor for estimating economic LGD", in Altman E.I., Resti A. and Sironi A. (eds), *Recovery Risk: The Next Challenge in Credit Risk Management*, Risk Books, London

Mora N. (2012)," What determines creditor recovery rates?", *Federal Reserve of Kansas City Economic Review*, vol 12, n. 2, pp. 79-109.

Park Y.W., Won Bang D. (2014), "Loss given default of residential mortgages in a low LTV regime: Role of foreclosure auction process and housing market cycles", *Journal of Banking & Finance*, vol. 39, n. 2, pp. 192-210.

Pennington-Cross A. (2003), "Subprime & prime mortgage: Loss distributions", Federal Housing Finance Agency, Government Document, available at www.fhfa.gov (accessed 11-30-2016)

Qi M., Yang X. (2009), "Loss given default of high loan-to-value residential mortgages", *Journal of Banking & Finance*, vol. 33, n. 9, pp. 788-799.

Reinhart C., Rogoff K. (2009), *This Time is Different: Eight Centuries of Financial Folly*, Princeton University Press.

Renault O., Scaillet O. (2004), "On the way to recovery: A nonparametric bias free estimation of recovery rate densities", *Journal of Banking & Finance*, vol. 28, n. 1., pp. 2915-2931.

Schuermann T. (2004), "What do we know about loss given default?", in D. Shimko (ed.), *Credit Risk Models and Management,* Risk Books, London.

Siddiqi NA., Zhang M. (2004), "A general methodology for modeling loss given default", *RMA Journal*, vol. 86, n. 8, pp. 92-95.

Sironi A, Zazzara C. (2003), "The Basel Committee proposals for a new capital accord: Implications for Italian banks", *Review of Financial Economics*, vol. 12, n. 1, pp. 99-126.

Winton A., (1999), "*Don't put all your eggs in one basket? Diversification and specialization in lending*", University of Minnesota working paper available at www.wharton.upenn.edu (accessed 11-30-2016).

Zaniboni N.C., De Araùjo A.C., De Avila Montini A. (2013), *Factors that influence LGD for retail loans in financial institutions*, Sixth Brazilian Conference on Statistical Modelling in Insurance and Finance.