Explaining the recovery rate for retail and commercial customers in Germany with a particular focus on the collateral

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Abstract

Based on our unique data set of 909 defaulted retail and commercial customers in Germany stemming from 123 different banks, our article confirms the significant positive influence of an amicable agreement between the debtor and the bank (redemption) and the collateral on the recovery rate in a first step. In a further analysis it becomes obvious that there are systematic biases between the expected and realized values of collaterals on real estate although the appraisal reports should already consider all factors influencing the value. By using valuations that were adjusted for the recognized biases to explain the recovery rate we can increase the explanatory power of the model. In future empirical studies, the combined analysis on the borrower and collateral level should therefore be an integral part when analyzing factors influencing the recovery rate.

Keywords: redemption, collateral, retail and commercial customers, collaterals on real estate, recovery rate

JEL Classification: G21, G28

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1 Introduction

Besides the probability of the debtor defaulting (Probability of Default (PD)), the recovery rate (1 - Loss Given Default (LGD)) is the essential credit risk parameter for risk-adjusted pricing of loans in the context of Basel II. The PD is usually employed as a measure for a debtor's creditworthiness while the LGD can be measured on the level of individual loans or debtors. Regardless of the applied level, the recovery rate relates the proceeds and costs from realization and the outstanding amount at the time of default (Exposure at Default (EAD)) and thereby quantifies the recovery ratio. For internal risk management purposes, the recovery rate, the PD, the EAD and their correlations are included into the calculation of expected and unexpected losses of the credit portfolio and thereby influence the calculation of the value at risk (VaR) as well as the (future) credit terms. Therefore the bank's internal risk management has to develop a model which allows for an accurate estimation of the recovery rate. A precise estimation can generate a competitive advantage on the one hand and reduce problems arising from adverse selection by undifferentiated agreeing to the terms of a loan on the other hand.

The recovery rate is of high importance not only from a risk management´s perspective but for regulatory requirements also. Banks that prove to have appropriate internal models for predicting the recovery rate are allowed to use advanced internal rating based (IRB) approaches. These approaches can result in reduced requirements of regulatory capital. Hence, a detailed estimation of the recovery rate is beneficial from a regulatory perspective as well.[1]

In order to retrieve clues regarding the design of appropriate models for explaining and predicting the recovery rate, scientific studies should ideally base on default loan data. Because of the confidentiality and limited availability of this data to scientific research, there are few empirical studies dealing with the analysis of the recovery rate for bank loans.

So far, studies are only able to prove the intuition that recovery rates are significantly higher if loans are collateralized. However, type and extent of the collateralization and therefore also their influences are depending on the analyzed group of customers (retail, small and medium size companies or corporate customers), the type of loan (consumer credit, mortgage, etc.) and the analyzed geographical area. Although the German banking system is according to the assets among the largest in the world, a study investigating the recovery rate for retail

[1] A study conducted by the Basel Committee on Banking Supervision (2006) concludes that for almost all banking segments, the capital requirements are reduced when switching from the standard approach to the IRB approach.

and commercial customers in Germany is still non-existent. In Germany, this specific group of customers is according to Deutsche Bundesbank (2011) of high importance regarding the fact that more than 50% of the loan volume is granted to retail customers and small and medium sized companies.

This article analyzes the recovery rate of 909 defaulted retail and commercial customers stemming from 123 different banks and provides empirical evidence for Germany in a first step. We confirm the positive influence of collaterals on the recovery rate and can moreover demonstrate that there are amicable settlements (redemption) between the bank and the debtor in cases of which 40% were originally classified as defaulted. By performing a multivariate analysis we confirm the positive influence of redemptions on the level of the recovery rate. Our model explains the majority of the recovery rates variance which is mainly caused by fact that collaterals on real estate usually carry a high intrinsic value. In our data set, collaterals on real estate play a dominant role.

Secondly, due to the outstanding influence of collaterals in the form of real estate, we will take a closer look at the valuation rate of the collaterals underlying real estate. For the bank the valuation arises from the (market value) appraisal report which displays a proxy for the expected selling price. Since the appraisal report should consider all possible factors that have an influence on the value, the realized selling price should not differ significantly from the expected value. Nevertheless, our analysis shows a systematic bias. The condition as well as the location of the property is not adequately considered. For the first time in recovery rate research, our method uses an index based on postal codes to measure the attractiveness of the property´s location and to secure the discrimination of the location on the smallest possible level. In order to analyze the influence of the bias, we develop a model to predict the proceeds ratio in order to eliminate the systematic bias in the market value identified earlier.

Third and last, we use the predicted proceeds ratios to adjust the market value. Thereby, we obtain an adjusted collateralization ratio which can be used to explain the recovery rate as well. Hence the explanatory power of the original model is increased. Furthermore, the robustness can be demonstrated by using various out-of-sample tests. Moreover, some of the control variables for the retail customers lose their previous significant influence. Interestingly, the inflation rate still has a highly significant statistical influence on the recovery rate – even though it is not part of the macroeconomic control variables recommended by the Basel Committee on Banking Supervision (2005). The combined analysis of the collateral

and borrower level is therefore an important part in the analysis of factors influencing the recovery rate in the context of future empirical studies.

Our study provides valuable insights to the practice of banking with regard to the design of adequate models and can provide optimization advice with respect to the collection and processing of data. The results are of particular importance for small and medium sized banks as savings and cooperative banks. On the one hand the analyzed customer segment represents the clientel for the bank's core business. On the other hand due to the size of the institutes, they often lack appropriate numbers of cases to perform a comparable analysis.

Our paper is structured as follows: Chapter 2 presents the data set and its structure. In chapter 3 we first derive our research hypotheses for the recovery rate based on previous studies. Secondly, we analyze our hypotheses using bivariate and multivariate analyses. Afterwards, we check the valuation rate of collaterals on real estate for systematic biases (chapter 4). In chapter 5 we correct the recognized biases and use the adjusted collateralization ratio for an a new explanation approach of the recovery rate. Conclusively chapter 6 summarizes the gained results.

2 Description of the data set

Our data set was provided by the Bankaktiengesellschaft Hamm (BAG). BAG was founded by dissolving the troubled Hammer Bank Spadaka eG and therefore formed Germany´s first bad bank. In the following years, BAG regularly took over sub-performing loans from troubled cooperative banks, because it tied the according know-how. In the beginning of 2006, the 'bad bank' responsibility was assigned to another institution and ever since BAG offered its services – the acquisition of sub-performing loans – to the whole German banking sector. As common in the context of the acquisition of sub-performing loans BAG takes over the whole settlement and liquidation risk and considers the risk via a purchase price reduction.

The processed and analyzed sample comprises information about 909 debtors that were transferred to BAG between January 2006 and January 2011. The following analysis of the recovery rate for a debtor (borrower level) in chapter 3 only includes the 499 debtors whose workout-processes have already been completed.[2] The workout-process is considered to be

[2] See Section 3 for the different types of workout-processes. The authors are aware of the selection bias addressed by Gürtler and Hibbeln (2013) that cases going well seem to be over-represented in comparison to problematic cases. Therefore, the overall average recovery rate is overestimated. However, there are a number of problematic cases included in our 5-year analysis (see the high number of sales by court order in particular). Consequently, we consider the mentioned problem as negligible.

completed if all collateral securities have been processed entirely or an amicable agreement was settled.

The analysis of the individual collaterals (collateral level) in chapter 4 includes all 909 debtors and considers all securities for which the workout-process is completed individually. Whether a debtor or a collateral was included in our analysis on different levels or not is demonstrated in figure 1.

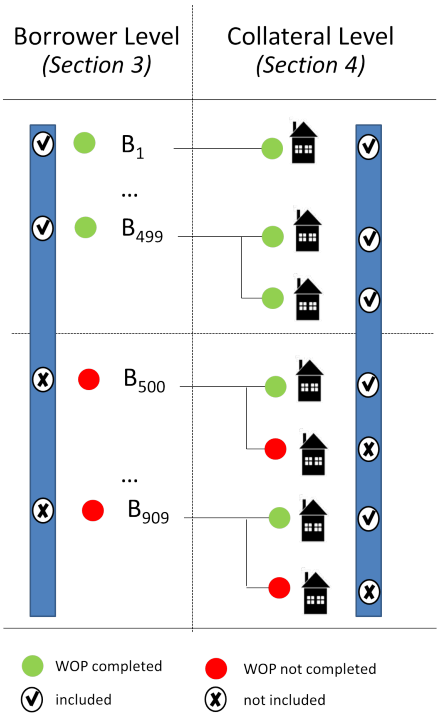

Figure 1: Inclusion of cases on borrower and collateral level.

The data set also contains encoded information for every debtor with respect to the bank that originally granted the loan. As a result, we are able to conclude that the debtors were transferred to BAG by 123 different banks. The transferring banks can predominantly be included into the cooperative sector due to BAG's historical rootage.[3] Thereby, the data set reflects to a large extent the customer structure of cooperative banks which comprises typically mostly out of retail and commercial customers (self-employed as well as small and medium size companies) whereas larger corporations (corporate customers) are usually attended to in cooperation or exclusively by the central institutions of the cooperative sector.

[3] For the 123 banks, we are unaware of the exact volume of payables (and the number of debtors respectively) as our sample only includes the debtors whose workout-process was already completed entirely or at least completed for one collateral.

3 Empirical analysis of the recovery rate on the borrower level

3.1 Derivation of the research hypotheses

In contrast to defaulted bonds it became common practice to use the so-called workout-method for the determination of the recovery rate on bank loans. When a debtor defaults, the individual proceeds (i.e. realization proceeds from collaterals) as well as the costs aligning with the workout-process (i.e. material and personnel costs, legal expenses) are determined for each time t. Proceeds and expenses are then to be discounted to the time of default in order to account for the present value of money.[4] Putting the aggregated net proceeds in relation to the EAD at the time of default (EAD_0) concludes in the recovery rate:

$$Recovery\ Rate = \frac{\sum_{t=0}^{T} \frac{Proceeds_t - Expenses_t}{(1+r_t)^t}}{EAD_0}. \tag{1}$$

Empirical studies dealing with the analysis of the recovery rate for bank loans analyze a number of potential influencing factors. However, the results regarding most of the factors are ambiguous. Franks et al. (2004), for example, identify a significant, positive influence of macroeconomic factors on the recovery rate, while these factors have no influence according to a study by Dermine and Neto de Carvalho (2006). Nevertheless, nearly all studies such as those by Carty et al. (1998), Gupton et al. (2000), Thorburn (2000), Kabance (2001), Bos et al. (2002), Araten et al. (2004), Emery et al. (2004), Franks et al. (2004), Hamilton et al. (2004), Grunert and Weber (2009), Qi and Yang (2009), Bastos (2010) and Gürtler and Hibbeln (2013) demonstrate that the recovery rate is higher if loans are collateralized.

Depending on the quality and quantity of the present data, the collateral can be displayed in various ways within the analysis. Dermine and Neto de Carvalho (2006) incorporate the collateral with dummy variables for every category of collaterals (collaterals on real estate, guarantees, etc.). In contrast, more recent studies (Caselli et al. (2008), Grunert and Weber (2009) and Qi and Yang (2009)) display the collateral with a collateralization ratio representing the relation between the bank´s valuation ratio for the collaterals at disposition and the EAD. We are expecting a higher recovery rate for loans with a higher collateralization ratio since the bank can generate higher proceeds from the provided collaterals.

[4] The risk-free interest rate r, the contractually agreed interest rate (the variable interest rate might be weighted time related), the return on equity, or the effective interest rate in the sense of IAS 39 can be used as the interest rate r for the discounting factor. There are no explicit specifications made by the Basel committee.

Hypothesis 1 (H1): A higher collateralization ratio goes hand in hand with a higher recovery rate.

Besides collaterals accounted for on a value basis, in the practice of banking there are additional securities which, although they may result in realization proceeds, are not considered due to legal uncertainty or market dependence in general. In analogy to the collateralization ratio we are expecting these additional securities to influence the level of the recovery rate positively.

Hypothesis 2 (H2): Additional securities which are not accounted for on a value basis go along with a higher recovery rate.

Studies by Elsas and Krahnen (2002), Grippa et al. (2005) as well as by Grunert and Weber (2009) have identified the processing of defaulted borrowers among collaterals as another important factor influencing the recovery rate. Generally, there are three essential processes for defaulted borrowers: continuing the business activities in line with a restructuring, an amicable settlement with the debtor (redemption) and the liquidation of the loan along with the provided collateral. For economic reasons, continuing the business activities is only applicable for sufficiently large debtors that are usually corporate customers.[5] Active restructuring, that is the bank accompanying an operational and strategic realignment mostly with corporate customers, is rarely possible or economically reasonable for retail and commercial customers.

With retail and commercial customers, the banks prefer direct negotiations in attempt to achieve an amicable agreement or, if necessary, settle for resigning on part of the receivable. If an amicable settlement can be achieved, redemption is settled. The debtor then makes the previously agreed redemption payment while the bank releases the provided collateral in return. The bank however will only accept a redemption payment if the offered payment equals at least the sum of the expected discounted (net) returns from the collaterals and the personal arbitrary measures against the debtor (lower bound). On the other hand, the debtor will not pay back more than the outstanding liability (upper bound).

[5] In the study by Grunert and Weber (2009) who analyze 120 defaulted corporate customers of a single German bank, 40% were able to continue their business operations and therefore the workout type has a significant influence on the recovery rate. Even though the study by Elsas and Krahnen (2002) can only be partly considered in the field of recovery rate research, the authors show continuing operations after restructuring for 85% of the 128 German corporate customers.

If the negotiations fail or are not possible due to the debtor´s lack of financial means, the bank can only fall back on the third form of the workout-process, the liquidation of the collateral.[6] In the case of redemption, the redemption payment should be in the interval identified above. The difference between the realized redemption payment and the lower bound marks the premium.

In their analysis of 11,649 defaulted loans to retail customers and small and medium size companies in Italy, Grippa et al. (2005) demonstrate that an amicable agreement between the bank and the borrower can be achieved in 40% of the cases. However, there is a specific characteristic to their study: The authors did not derive the percentage of redemptions from the individual debtor´s data, but the participating banks identified the percentage in a survey. In order to perform a multivariate analysis the authors combined the bank specific data (here the estimated portion of redemptions) with other surveyed quantitative data (individual information regarding the individual loans, collaterals, etc.). Thereby, they were able to demonstrate a significant, positive influence of the workout type redemption on the recovery rate.

Hypothesis 3 (H3): Amicable settlements with the debtors (redemptions) come along with a higher recovery rate.

3.2 Definition of variables

For the analysis we first determine the recovery rate (RR_j) for every debtor $j \in (1,2,...,499)$. In our data set, the proceeds include the returns from the liquidation of possible collaterals as well as the payments made by the debtor. Costs include all external costs (costs for arbitrary measures, real estate agent´s commission fees, etc.).[7] Determining the EAD appears to be critical at first, since the exact time of a default event as well as the criteria for a default is not known.[8] Therefore, we are using the definition of a default event specified under the Basel accord. Following the Basel Committee on Banking Supervision (2006) a loan is considered to be defaulted if the bank is selling the loan obligation and thereby accepting an economic loss. Due to the selling price´s reduction, selling a receivable to BAG is always conforming to this definition. Hence, we take the debtor´s existing liabilities at the time of transferal to

6 When liquidating, the bank tries to sell the provided collaterals as best as possible and may initiate arbitrary measures against the individual debtor (i.e. attachment of wages and salaries).

7 Like for many other studies in this field (e.g. Grippa et al. (2005); Grunert and Weber (2009)), we have no information regarding the internal costs.

8 See Grunert and Volk (2008) regarding the influence of the definition of a default event when determining the recovery rate.

BAG as the exposure at default (*EAD*). By using this definition the difficulty of considering inconsistent definitions of a default event of the 123 included banks can be avoided.

With respect to the EAD we only have aggregated information; therefore, we are not able to identify which types of loans (i.e. credit line, housing loan, etc.) were originally granted.[9] While other studies analyzing the segment of retail and/or commercial customers determine the recovery rate for every debtor individually,[10] we are following the approach used in studies on corporate customers and look at the individual loans and collaterals of one customer as a unit. Focussing on the debtor as a unit instead of looking at each loan individually complies with the banking practice's viewpoint in Germany. First, the liens incorporated in the general business terms in Germany can be used for collateralizing all loans of one debtor. Second, the amicable settlement comprises the total commitment instead of the individual loans and securities.

Not only the EAD but also the proceeds and the expenses were only available in an aggregated form and without explicit information regarding their timing. However, Franks et al. (2004) and Schaaff (2009) only demonstrate a marginal difference between the results from using the present value and the result from not using it in their research. In combination with the historically low level of interest rates during the time of observation, we consider the implication of not discounting as negligible – partially because of the missing discounting it is possible for the recovery rate to take on value greater than 1. In analogy to Friedman and Sandow (2003) and Grippa et al. (2005), we limit the recovery rate to the interval $[0, 1]$.

With respect to collaterals, BAG only considers certain collaterals on a value basis, including money on account (i.e. building loan contracts, savings account, endowment life insurance, etc.) and collaterals on real estate. In order to illustrate the valuation of the collateral, usually the collateral value is formed. The collateral value of money on account ($CV^{deposit}$) equals the respective balance or the surrender value at the time of transferal.

The value for the collaterals on real estate ($CV^{realestate}$) results from a sequential calculation. Possible existing preloads (*PL*) are subtracted from the relevant[11] market value[12] of

[9] Furthermore, the data set does not provide any characteristic at the time when the loan was originally granted like the amount of the receivable or the debtor´s creditworthiness.

[10] This approach is especially reasonable when dealing with certain types of loans such as credit card debt (e.g. Bellotti and Crook (2012) consumer credits (e.g. Gürtler and Hibbeln (2013)) or vehicle financing (e.g. Appasamy et al. (2008)). Especially for automotive financing as object financing there is a close relation between loan and collateral.

[11] The relevant market value is the value resulting from the most recent appraisal report at the time of the purchase. With respect to the different types of appraisal reports see section 4.2.

[12] The market value is materially equivalent to the fair value used in international accounting.

the property (MV). Moreover, the collateral value is limited to the sum of the property´s recorded land charge (LC). The collateral value on real estate i is therefore given by

$$CV_i^{realestate} = MAX(MIN(MV_i - PL_i; LC_i); 0). \tag{2}$$

Other studies do not provide many details on how to determine the collateral value but it can be assumed that the $CV^{realestate}$ determined by the bank is applied. We, on the other hand, combine information from different sources for each collateral individually to determine the $CV^{realestate}$ using formula (2).

We compute the collateralization ratio (CR_j) for every debtor j by summing up m collateral values on real estate and n collateral values on money on account which is then put into relation to the EAD:

$$CR_j = \frac{\sum_{i=1}^{m} CV_{i,j}^{realestate} + \sum_{i=1}^{n} CV_{i,j}^{deposit}}{EAD_j}. \tag{3}$$

A collateralization ratio greater than 1 connotes an over-collateralization. In practice, the collateral value is usually assigned to the EAD so that the collateralization ratio can only reach a maximum value of 1.[13] We account for this fact by limiting the collateralization ratio to a maximum of 1.

In order to assess whether additional securities not recognized on a value basis can increase the recovery rate ($H2$) we determine the variable COL which incorporates the number of additional securities that are not recognized on a value basis.[14]

Since there is no restructuring for the debtors in our data set, we only differentiate between an amicable agreement and a liquidation in order to assess hypothesis $H3$. The binary variable redemption (RED) equals 1 if there has been an amicable agreement between BAG and the debtor.

To check for scale efficiencies of the credit volume we take the logarithm of the EAD (EAD^{LN}). Additionally, we consider the workout process´ duration in month (WOP). BAG´s purchase of a certain liability marks the starting point while the completion of the workout process marks the end of the workout process for the debtor. With respect to the debtor

[13] This limitation is also used in the study of Grunert and Weber (2009).

[14] Other securities include individual assignments of claims, global or overall assignments, assignments of loan receivables, guarantees or transfers of ownership of vehicles, machinery and warehouses.

we differentiate between retail and commercial (self-employed, small and medium sized companies) customers. The binary variable borrower type (BT) equals 1 if the debtor is a commercial customer. The variable INS shows the status of bankruptcy and equals 1 if the debtor declares their bankruptcy before or during the workout process. The variation of the gross domestic product (GDP) with respect to the previous year, the unemployment rate (UER), and the inflation rate (INF) at the time of the completion of the workout process take the role of macroeconomic control variables.[15]

3.3 Descriptive statistics

	Variable	Description	Mean	Median	Min.	Max.	σ	N
metric	RR	Recovery Rate	0.58	0.59	0	1	0.36	499
	CR	Collateralization Ratio	0.66	0.73	0	1	0.32	499
	COL	Number of additional securities	1.68	1	0	14	2.18	499
	$CV^{realestate}$	Collateral value of real estate (in thousand EUR)	160	79	0	2621	289	491
	$CV^{deposit}$	Collateral value of deposits (in thousand EUR)	41	20	2	404	63	60
	EAD	Exposure at Default (in thousand EUR)	286	158	5	4110	413	499
	WOP	Length WOP (in months)	31.5	30	4	69	12.2	499

	Variable	Description	Quantity of realisations		∅ RR of realisations		W.-R.-Test	
			0	1	0	1	Significance	*(P-Value)*
binary	RED	=1, if redemption	304	195	0.42	0.82	***	*0.0000*
	BT	=1, if customer is commercial	368	131	0.58	0.57		*0.6560*
	INS	=1, if customer is bankrupt	412	87	0.61	0.40	***	*0.0000*

Table 1: Descriptive statistics on borrower level.
***, **, * indicates a 1%, 5% and 10%-Confidence level using the Wilcoxon-Ranksum-Test (W.-R.-Test).

Table 1 contains the descriptive statistics for the previously explained variables. The data set shows an average recovery rate of 58%. Figure 2 shows the corresponding frequency distribution. There are peeks at 0% and 100%; however this bimodality can be found in almost all empirical studies such as those by Asarnow and Edwards (1995), Felsovalyi and Hurt (1998), Araten et al. (2004), Grippa et al. (2005), Dermine and Neto de Carvalho (2006), Caselli et al. (2008) and Grunert and Weber (2009).

The collateralization ratio is on average 66% with only a small percentage (approx. 6-7%) of debtors not providing any collaterals at all ($CR = 0$).[16] Thereby, our dataset shows a significantly lower percentage of unsecured liabilities compared to other studies.[17] This

[15] According to the Basel Committee on Banking Supervision (2006) banks have to consider economic upswings when estimating the recovery rate. These requirements are satisfied due to Basel Committee on Banking Supervision (2005) by using the variation of both the GDP and the unemployment rate.

[16] See figure 6 in the appendix.

[17] Dermine and Neto de Carvalho (2006) determine a percentage of 36% for unsecured loans when analyzing 374 defaulted small and medium sized companies in Portugal. Nevertheless, a recovery rate of 71% is achieved. However, there are no information regarding the collateralization ratio. A high portion of unsecured securities becomes evident in a study by Jimenez and Saurina (2002) on the Spanish market as well.

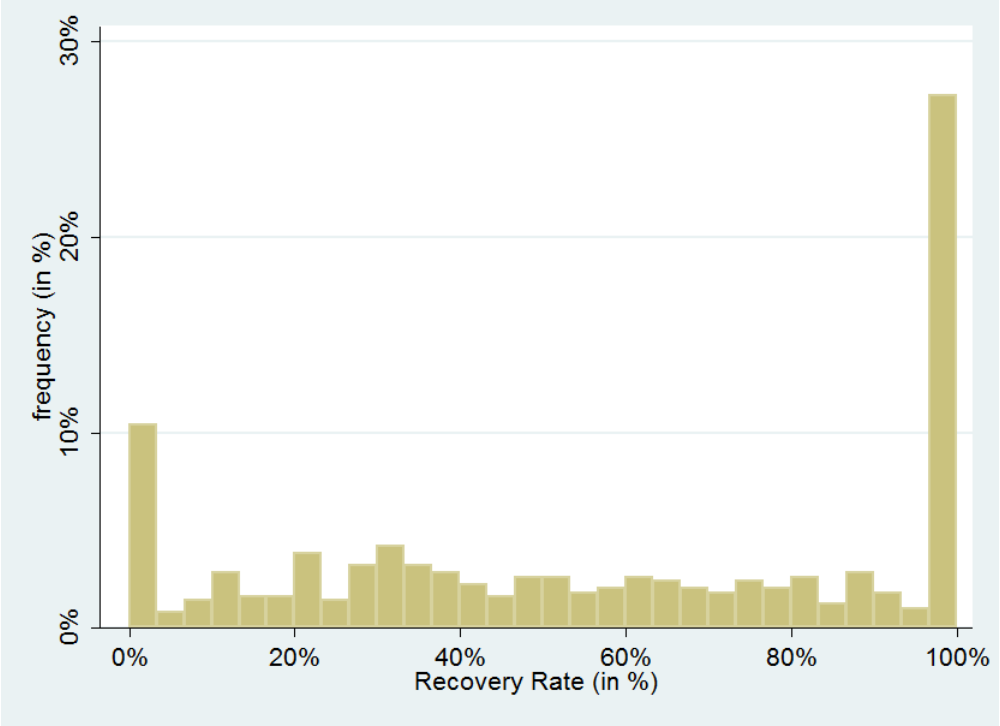

Figure 2: Realized Recovery Rate.

could be caused by the origin of the data set. It is possible that unsecured liabilities are directly depreciated by the granting bank and never be offered for purchase to BAG.

The average collateral values – 160 k € for collaterals on real estate and 41 k € for collaterals on money on account – lead to the conclusion that the collateralization ratio is mainly determined by the collaterals on real estate. The collateralization in our data set is mostly comparable to the study of Qi and Yang (2009) who even show a collateralization ratio of 100%. The included 240,000 mortgages of US retail customers in their study could explain the higher collateralization ratio. Interestingly, there is a more significant difference in the collateralization rate (100% vs. 66%) than in the realized recovery rate (70% vs. 58%).

The portion of redemptions in our data set amounts to 40% (195 out of 499 cases) and is consistent with the results from the study by Grippa et al. (2005). The study contains only few descriptive statistics, in particular, information regarding the collateralization ratio is missing. The authors only differentiate between completely secured and unsecured loans. The former shows a recovery rate of 70%, the latter a recovery rate of 32%.

In order to analyze to what extent differences between retail and commercial customers exist, we have presented the important factors in dependency of the borrower types in table 2. It becomes obvious that loans to commercial customers demonstrate on average a lower collateralization ratio but a higher number of additional securities that are not recognized on a

value basis. One reason may be that commercial customers are usually in possession of more specific assets that can be used as collateral (i.e. transfer of ownership of a special-purpose machine) to which retail customer do not have access. By looking at the customer structure, the average EAD (EUR 213,000 for retail customers and EUR 490,000 for commercial customers respectively) demonstrates that our study is quite different from studies on classical corporate customers i.e. Grunert and Weber (2009) with a mean value of EUR 5.6 million.

Borrower type	quantity	∅ *CR*	∅ *COL*	fraction *RED* in %	∅ *EAD* in EUR 000's	∅ *WOP*	∅ *RR*
Retail customer	368	0.70	1.20	39%	213	30.72	0.58
Commercial customer	131	0.58	3.00	38%	490	33.60	0.57

Table 2: Comparison of retail and commercial customers.

3.4 Bivariate analysis

In analogy to Grunert and Weber (2009) the Bravais and Pearson´s correlation coefficient is used for the single and bivariate analysis of the metric variables (see table 10 in the appendix). There is a strong significant positive correlation of 0.7 between the collateralization ratio and the recovery rate (hypothesis $H1$). Thereby, the first hypothesis can be confirmed in a bivariate context. The correlation coefficient for additional securities (*COL*) equals 0.03 which may lead to the conclusion that hypothesis $H2$ cannot be confirmed. Furthermore, there are no other remarkable correlations between the control variables.

The binary analysis with respect to the redemption´s influence may lead to the conclusion that hypothesis $H3$ can be confirmed. The average recovery rate of redemption (0.82) is considerably higher than the rate of liquidation (0.42) (see table 1). The significantly positive correlation (0.31) between redemption and the collateralization ratio has to be considered (see table 10 in the appendix). In the following multivariate analysis we are going to assess whether redemption can influence the recovery rate beyond the collateralization ratio.

3.5 Multivariate analysis

3.5.1 Econometric model

In this section we analyze the influence of the 10 previously explained variables[18] (in the following: x_k, k ∈ (1,2,...,10)) on the recovery rate of the individual debtors j (j ∈ (1,2,...,N)). In order to do so, we use a Fractional Logit Model, which among others, was used in the

[18] These are *CR*, *COL*, *RED*, EAD^{LN}, *WOP*, *BT*, *INS*, *GDP*, *UER* and *INF*.

studies by Grippa et al. (2005), Dermine and Neto de Carvalho (2006) and Bastos (2010).[19] Due to the restriction for the explanatory value it is not reasonable to use an Ordinary Least Squares Estimation (OLS) as shown in equation 4 because it cannot be assumed that the estimation for the recovery rate falls into the interval of [0;1].

$$E(RR_j|x_j) = \beta_0 + \beta_1 \cdot x_{1,j} + ... + \beta_{10} \cdot x_{10,j} = x_j\beta. \tag{4}$$

Therefore we toggle in a so called link function $G(\cdot)$ into the OLS estimation in equation (4):

$$E(RR_j|x_j) = G(x_j\beta). \tag{5}$$

The overall condition $0 < G(z) < 1$ ensures for all $z \in \mathbb{R}$ that the estimation of the recovery rate lies within the unit interval. The logit distribution function is used as a link function

$$G(z) = \frac{exp(z)}{1+exp(z)}. \tag{6}$$

According to equation (4) we can estimate β consistently if the Bernoulli log-likelihood function is maximized given by

$$l_j(\hat{\beta}) = RR_j log[G(x_j\hat{\beta})] + (1-RR_j) log[1-G(x_j\hat{\beta})]. \tag{7}$$

Since equation (7) is a linear exponential equation, the quasi-maximum likelihood estimator for β derived from the maximization problem

$$\max_b \sum_{j=1}^{N} l_j(b), \tag{8}$$

is consistent and $\sqrt{N}$-asymptotic normal for any given x_j., regardless of the recovery rate´s (RR_j) distribution.

3.5.2 Regression results

Using the Fractional Logit Model with robust standard errors leads to the estimation results listed in table 3.

[19] The Fractional Logit Model is considered to be a Generalized Linear Model and is specifically designed for an explanatory variable in the interval of 0 and 1 when there is a positive probability that a value between 0 and 1 can be realized.

	variable	model 1a Recovery Rate std. coefficient (standard error)	model 1b Recovery Rate std. coefficient standard error)	model 2 Recovery Rate std. coefficient (standard error)
H1	CR	0.6170***	0.7135***	0.6456***
		(0.268)	(0.432)	(0.229)
H2	COL	0.0399	0.0785	0.0419
		(0.0459)	(0.0357)	(0.0308)
H3	RED	0.4311***	0.2855***	0.3813***
		(0.164)	(0.229)	(0.130)
control variables	EAD^{LN}	0.0937**	-0.1548***	0.0233
		(0.0877)	(0.103)	(0.0678)
	WOP	0.00177	0.1372**	0.0690*
		(0.00685)	(0.00865)	(0.0056)
	BT			0.0709**
				(0.144)
	INS	-0.0760*	-0.0209	-0.0706**
		(0.204)	(0.233)	(0.165)
	GDP	-0.0066	-0.1271*	-0.0364
		(0.0285)	(0.0392)	(0.0229)
	UER	0.0365	0.0901*	0.0501
		(0.132)	(0.141)	(0.104)
	INF	0.1109***	0.1284	0.1250***
		(0.0848)	(0.176)	(0.0768)
	constant	-5.945***	-1.922	-4.874***
		(1.510)	(1.932)	(1.215)
	observations	368	131	499
	AIC	0.8014	0.8951	0.8007
	BIC	-2008.52	-558.7123	-2888.61
	Mc Fadden R^2	0.3436	0.3383	0.3328
	R^2	0.6353	0.7020	0.6346
	Adj. R^2	0.6261	0.6798	0.6271
	Wald Test (χ^2)	395.57 (0.000)	192.09 (0.000)	537.58 (0.000)

Table 3: Fractional Logit Regression with the Recovery Rate as dependent variable.
***, **, * indicates a 1%, 5% and 10%-Confidence level. The robust standard errors are given in brackets.

In model (2) we show the estimation results with respect to the customers by using the binary variable BT. We have already illustrated (see table 2) that there is a big difference between the two types of customers, for example with respect to the collateralization ratio. For that reason we split the sample in the basic model (1) in the two customer types (model (1a) = retail customers and model (1b) = commercial customers). This sample split allows for an individual analysis of the independent variables. By doing so, we are able to demonstrate significant differences with respect to the influence of individual variables. In the following, we will therefore concentrate on model 1.

Regardless of the group of customers it can be shown that the collateralization ratio has a statistically high, significant, positive influence on the recovery rate even in a multivariate context. The collateralization ratio´s outstanding importance is not surprising since it is mainly determined by the collaterals on real estate which have been attested a high intrinsic value.[20]

With respect to hypothesis $H2$ there is no significant influence in the multivariate analysis of additional securities (COL) on the recovery rate – for retail as well as for commercial customers.

[20] See e.g. Franks et al. (2004) and Grunert (2005) for the valuation of collaterals on real estate.

While there is no significant correlation between additional securities and the recovery rate ($H2$), we have been able to confirm the third hypothesis ($H3$). There is a significantly positive coefficient for redemption which shows a relation with the recovery rate beyond the collateralization ratio. In order to identify the differences with respect to the different workout processes in more detail, we form a variable DIF_j for every debtor which is the difference between the realized recovery rate (RR_j) and the collateralization ratio (CR_j). If DIF_j is positive, a premium can be realized. Figure 3 shows the distribution of DIF depending on the different workout processes.

The distribution of DIF is reminiscent of the normal distribution; however, there are too many observations with a negative difference (left skewed). This intuition can be statistically proven since we have to reject the null hypothesis with a Shapiro-Wilk-Test (p-value 0.000). Splitting the sample into the different workout-processes reveals the main differences. The collateralization ratio is realized ($DIF = 0$) for redemption in the majority of the cases, which is understandable considering that redemption is only optional for BAG. From a relative viewpoint, there are significantly more cases with a premium since the according curve lies above the curve for the whole population for values on the x-coordinate greater than 0%. Reciprocally, there are, from a relative viewpoint, more cases with a discount for liquidation. Altogether, our illustration regarding the premium clarifies the positive influence of the workout-process redemption.

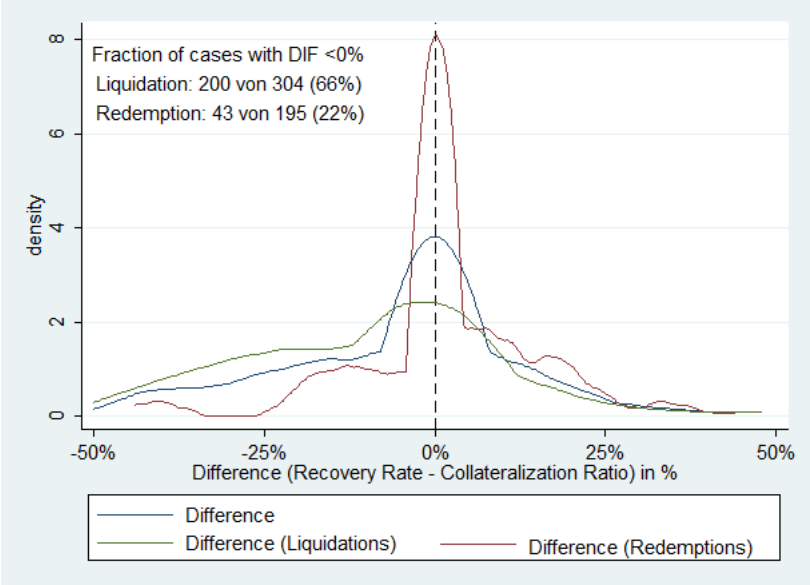

Figure 3: Distribution of Difference (DIF) dependent on the workout-type.

With respect to the control variables the diametrical influence of the loan´s volume (EAD^{LN}) is important. There is a positive, significant correlation for retail customers while the cor-

relation is negative for commercial customers. One possible explanation is offered by the premium (DIF_j is positive). For retail customers, there is a positive correlation between the credit volume and the premium (see figure 4, left side) concluding in a decreasing liquidation risk with increasing volume. The inverse relation exists for commercial customers.

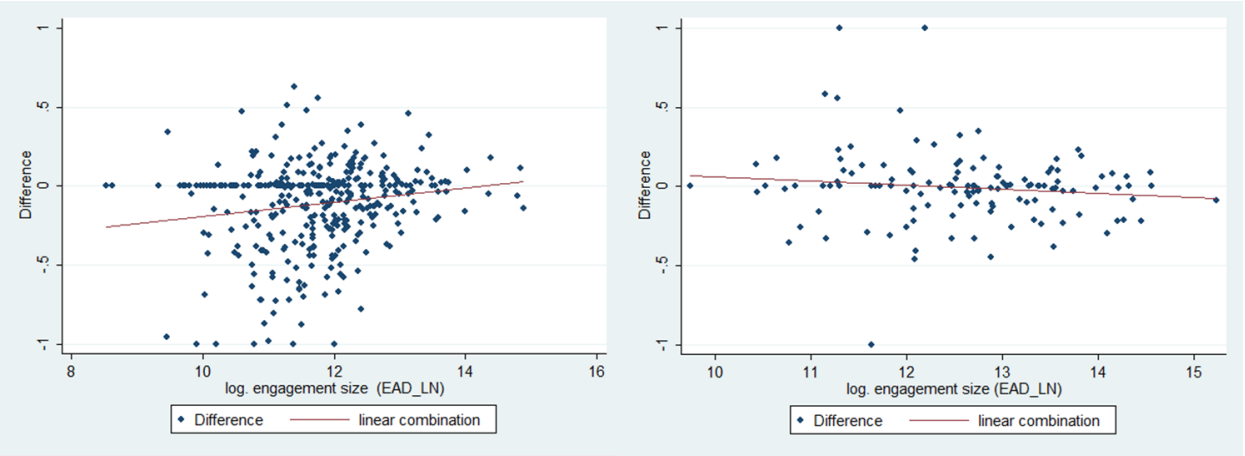

Figure 4: Distribution of Difference (DIF) dependent on the logarithm of the engagement size (EAD^{LN}) as well as the borrower type (retail customers left, commercial customers right).

Besides the EAD the duration of the WOP and the status of bankruptcy INS do also have a partial influence with no difference regarding the direction of causality for both customer groups. The duration of the workout process only has an impact on commercial customers. The fact that a longer processing time is accompanied by a higher recovery rate could be explained with a time-consuming marketing of the collaterals by BAG and by the missing discounting. The status of bankruptcy (*INS*) is accompanied with a significantly lower recovery rate for retail customers. Since proceeds from bankrupt debtors only comprise out of the provided collaterals with no further payments to be expected, the relation appears coherent. Moreover, an amicable agreement is less likely because there are no other assets or sources of financing available for redemption due to the debtor´s bankruptcy. Therefore, the redemption ratio for bankrupt retail customers is significantly lower (5%) than for solvent debtors (46%) (See table 4).

Borrower Type	status of bankruptcy	∅ *CR*	fraction *RED* in %	DIF in %-points
Commercial customers	0	0.58	42.72%	0.0033
	1	0.56	21.43%	-0.0468
Retail customers	0	0.72	45.95%	-0.0895
	1	0.59	5.08%	-0.2488

Table 4: Collateralization Ratio, Redemptions and Differences dependent on the status of bankruptcy as well as the borrower type.

With respect to macroeconomic factors a significant relation between the gross domestic product and the unemployment rate regarding commercial customers exists, while there is only a significant relation for the inflation rate regarding retail customers. Therefore, the variables recommended by the Basel committee – gross domestic product (*GDP*) and unemployment rate (*UER*) – can only be confirmed with respect to commercial customers. We will discuss the influence of the inflation rate in the following analysis on the collateral level in more detail.[21]

In conclusion, the collateralization ratio ($H1$) and redemption as a workout process ($H3$) have a positive influence on the recovery rate. Our model is able to explain 63% and 68% respectively of the variance using the adjusted R^2 as a measure. Therefore, our results provide empirical evidence for the possibility of estimating the recovery rate quite precisely if appropriate models are used. However, the high explanatory power could be caused by the high portion of collaterals on real estate which, as explained earlier, are assigned a high intrinsic value. If the collateralization ratio is excluded from the analysis the adjusted R^2 is reduced to 21% for commercial customers and to 39% for retail customers.[22] Due to the major influence of the collateralization ratio on the recovery rate we are going to analyze the essential driver in the following: the valuation of the real estate (see equation (2)).

4 Empirical analysis of the proceeds ratio on the collateral level

4.1 Derivation of research hypothesis

Since empirical studies have identified a significant influence of the collaterals on the recovery rate, there has been a second field of literature studying the provided collaterals instead of the individual debtors or loans. Studies in this field analyze the intrinsic value of different collaterals such as collaterals on real estate, guarantees, etc. The intrinsic value is measured by the proceeds ratio relating the realized proceeds to the original intrinsic value assumed by the bank. Grunert (2010) analyzes potential factors of influence on the proceeds ratio based on a data set consisting of 104 collaterals (thereof 62 collaterals on real estate) of a German bank. The average proceeds ratio resulting from the study is 61%. Among others the author concludes that the proceeds ratio is fluctuating depending on the type of collateral. Franks et al. (2004) analyze the intrinsic value of in total 1,016 collaterals in Germany,

[21] See Caselli et al. (2008), whose study covers a period of 14 years, for a more detailed analysis of the influence of macroeconomic factors.

[22] Qi and Yang (2009) achieve a similar result with a reduction of the adjusted R^2 from 61% to 15% if the collateralization ratio comprising entirely of collaterals on real estate is not considered.

France and Great Britain. The German subsample consists of 259 valued collaterals. The authors conclude as well that the average proceeds ratio fluctuates depending on the type of collateral. Nevertheless, an above-average intrinsic value of collaterals on real estate is pointed out. Their result is congruent with practical experience according to a survey carried out by Grunert (2005) banking professionals have identified collaterals on real estate to have the highest intrinsic value.

Following this result, Schaaff (2009) focuses on an isolated analysis of different factors influencing the proceeds ratio of collaterals on real estate. The author analyzes 1,120 collaterals on real estate which were transferred to BAG between 1999 and 2005. The resulting average proceeds ratio amounts to 61% with a median of only 28%. The strong discrepancy can be traced back to the fact that there was for approximately 41% of the analyzed collaterals no cash inflow. This specific feature could be caused by the data set itself. Even the author herself notes that the date set´s representativeness has to be reviewed critically. The collaterals used as well as their most recent valuation originate from banks undergoing restructuring and having sought help from the central organization of the cooperative banking group in Germany (Bundesverband der Deutschen Volksbanken und Raiffeisenbanken – BVR) due to their economic situation. Among others the author identifies the macroeconomic environment, the type of workout-process for the property, the size and the location as important factors of influence on the proceeds ratio.

Previous studies show average liquidation proceeds below the value originally set by the bank. Therefore, the collateralization ratio used to analyze the recovery rate is too positive and thereby influences the results from the recovery rate´s analysis. As previously mentioned the collateralization ratio is mainly dominated by collaterals on real estate. The $CV^{realestate}$ stems from a sequential calculation as shown in formula (2) with the property´s market value as a starting point. According to §194 of the German Federal Building Code (BauGB) the market value is determined by the price that can be achieved in an arm´s length transaction on an active market considering the specific qualities of a property such as its condition and location. Therefore, the market value equals the expected market value considering objective value measures and ought to consider all factors influencing the value.

The realization of the expected market value is the price actually achieved on the market. It reflects following Kleiber and Simon (2007) the result of the negotiations between seller and buyer who each have different opinions regarding an object´s value depending on their subjectives and personal beliefs. Nevertheless, the relation between the realized and the

expected price being the market value is still considered to be the proceeds ratio despite the deviation from the above mentioned definition because it serves the same purpose by measuring the intrinsic value.

If it is assumed that creators of appraisal reports on the market value of real estate consider all factors possibly influencing its value according to the definition of the market value, an unsystematic deviation of the individual market values from the realized prices should show.

Hypothesis 4 (H4): The proceeds ratio of real estate is not systematically biased.

4.2 Variables

In order to measure the recovery rate we use the relation between the *realized* and the *expected* property´s price. The price realized on the market is illustrated with the variable MP. In case of redemption, there is no objective market price since there is no market-oriented realization. If the debtor´s EAD is smaller than the property´s market value, the proceeds ratio is smaller than 1 even if the liability is completely repaid with the redemption payment. However, this cannot necessarily be traced back to the property alone. If a debtor is in possession of more than one property, a package price is paid. Splitting the price would always be subject to criticism of arbitrariness as the debtor´s individual willingness to pay for the individual properties is unknown. Therefore, property of a redemption will not be considered in the following analysis.

The property´s market value (MV) is used as a reference for the calculated value. The proceeds ratio for property i is defined as

$$PR_i = \frac{MP_i}{MV_i}. \tag{9}$$

Due to the specific characteristics of our data set we have to differentiate between three types of creators providing appraisal reports on the market value of a property. If there is a report prepared by the bank ($BANK$) or a judicial report ($COURT$) available at the time of transferal, the most recent one is considered to be the relevant report. In the case of such an appraisal report lacking or being outdated, a local expert is assigned by BAG to prepare the appraisal report (BAG). In conclusion, there is only one relevant report on the market value. Its source is shown by three dummy variables ($BANK$, $COURT$ and BAG) that take on the value of 1 if the report stems from one of these sources.

Looking back at the definition of the market value it becomes obvious that the property´s condition as well as its location have to be considered when determining the market value. In order to include the property´s condition, we analyzed based on the appraisal report of the market value the backlog of repairs and set it in relation to the market value of a property in perfect condition (backlog of repair ratio). If the ratio lies between 0% and 25%, we assume a normal condition. The dummy variable $Condition^{NORMAL}$ then equals 1. A ratio above 25% is displayed with the dummy variable $Condition^{BAD}$. We were not able to identify the condition explicitly in 40% of the cases due to the information provided by the data set. Not including these cases would lead to a loss of a majority of observation. For that reason the binary variable $Condition^{WITHOUT}$ represents property with unknown condition.

According to §194 of the German Federal Building Code (BauGB) the location alongside with the condition is an important factor when determining a property´s market value. We have assessed many different measures (i.e. regional purchase power, regional bankruptcy quotes) in order to indicate the attractiveness of a location and therefore the demand linked to a property in an attractive location. Analyses have shown that the attractiveness of a location has to be measured for very small areas. In cities with a high population density the attractiveness of the location diverges strongly in between the various neighborhoods. Therefore, an aggregated observation i.e. for the wealthy area of Duesseldorf is neither reasonable nor productive. Among measuring particular neighborhoods, the attractiveness of location shall be expressed with an aggregated ratio that expresses as much advantages and disadvantages (i.e. transport links, nuisance, etc.) at the same time as possible.

The company F+B GmbH identifies and distributes an objective average selling price per square meter for different types of property (single-family home, condominium, apartment house, commercial properties).[23] This indicator satisfies almost perfectly the previously listed requirements. Since we cannot compare the absolute average prices of the different types of property we determine an index for each type of property. In order to do so, we first form the average of the prices for all postal codes on an annual basis. Afterwards, we reference the given value for the according postal code to the previously determined

[23] Since 2002, F+B evaluates all purchase offers for single and duplex houses, apartments, condominiums and commercial properties and offers databases which are updated every three month. The data is processed concerning the type of an object, the object´s age, its area, its facilities and price according to segment markets. Afterwards the data is modified using empirically determined transaction deductions and is according to property type and type of use included into the database. There is a professionally standardized evaluation of the data and a referencing according to addresses. The evaluation is based on the purchase offers out 100 websites on real estate and a comparison of the offered prices with the realized purchase prices that determines the transaction reduction. See F+B GmbH (2013)

average. Thereby, we receive an index value providing information regarding the relative attractiveness of a location. An index value above 1 indicates prices above the German average for a certain property type in a specific postal code area. We capture the index value for every property i with the metric variable $LOCATION$. The year in which the workout-process started is considered to be the relevant year in order to display the expert´s knowledge optimally. The four previously mentioned types of property are displayed with the dummy variables SFH, $CONDO$, APH and $COMPROP$.

We control for the type of workout-process because the determination of the market value is based on the normal course of business that is trading on an active market where seller and buyer are not under any stress, time pressure or any other afflictions. If there is an amicable agreement between BAG and the debtor, all collaterals from the debtor are released. If there is no amicable agreement, the collaterals will be liquidated. First, collaterals on real estate are offered by a regional real estate agent instructed by BAG. If a buyer can be located the property is sold in an over-the-counter trade. If an over-the-counter trade is not possible because for example the debtor is not willing to cooperate or another creditor denies his consent BAG initiates a sale by court order. The property´s realization in a sale by court order is displayed with the dummy variable CO which equals 1 in case of a disposal by court order.

Among the type of workout-process we also control for changes in the gross domestic product (GDP), the unemployment rate (UER) and the inflation rate (INF) at the time of the workout-process´ completion.

4.3 Descriptive statistics and bivariate analysis

In table 5 we state the descriptive statistics for the variables introduced in the previous section. The metric variables can be found at the top of the table while the binary variables can be found at the end of the table. The correlation between the different variables is shown in table 11 in the appendix.[24] 1,236 properties were available for analysis, 470 (248) thereof were realized through a sale by court order (over-the-counter trades). Redemption took place in 376 of the cases.[25] The remaining 142 objects are classified as 'Miscellaneous'. This section comprises properties for which the realized market value could not be found because,

[24] The partially quite high correlations are caused by the fact that we display all possible values for the binary variables (i.e. condition).

[25] This matches approximately 30% of the real estate. The previously mentioned portion of 40% regards the borrower level (195 out of 499 debtors).

for example, the intention of liquidating was not pursued any further due to extensive rights of third parties. In these cases as well as for the 376 cases of redemption, the realized market price is missing. For the explanatory model we therefore only consider 718 objects for which a realized market price is known, here sale by court order and over-the-counter trade.

	Variable	Description	Mean	Median	Min.	Max.	σ	N
	PR	Proceeds Ratio	0.78	0.74	0	3.13	0.37	718
	MV	Market Value Real Estate (in thousand EUR)	200	122	3	4441	326	718
	LOCATION	Index Value	0.94	0.86	0.40	2.82	0.35	718

	Variable	Description	Quantity of Realisations		∅ PR of Realisation		W.-R.-Test	
			0	1	0	1	Significance	*(P-Value)*
Report	*BANK*	=1, if report from bank	518	200	0.78	0.77		*0.3800*
	COURT	=1, if report from court	580	138	0.83	0.57	***	*0.0000*
	BAG	=1, if report from BAG	338	380	0.69	0.86	***	*0.0000*
Condition	$Condition^{WITHOUT}$	=1, if condition cannot be ascertained	438	280	0.77	0.79		*0.5226*
	$Condition^{NORMAL}$	=1, if backlog of repair ratio = >0%-25%	450	268	0.74	0.84	***	*0.0000*
	$Condition^{BAD}$	=1, if backlog of repair ratio = >40%	548	170	0.81	0.67	***	*0.0000*
Type of Property	*APH*	=1, if apartment house	618	100	0.78	0.79		*0.8410*
	COMPROP	=1, if commercial property	442	276	0.77	0.80		*0.5763*
	SFH	=1, if single-family home	519	199	0.78	0.78		*0.8558*
	CONDO	=1, if condominium	575	143	0.79	0.74		*0.2900*
	CO	=1, if sold by court order	248	470	0.92	0.71	***	*0.0000*

Table 5: Descriptive statistics - collateral level.
***, **, * indicates a 1%, 5% and 10%-Confidence level using the Wilcoxon-Ranksum-Test (W.-R.-Test).

The proceeds ratio is 78% on average and the median is just a little below that (74%). Due to the deviating definition of the proceeds ratio and the differences in the groups of the loan-granting banks, the proceeds ratio is comparable to the results of other studies only to a limited extent. For example at the time of the study by Schaaff (2009) BAG mostly took over loans from banks that were subject to restructuring.

With respect to the creators of the appraisal reports it becomes obvious that the reports prepared by BAG show a significantly higher proceeds ratio than the comparable group. While the proceeds ratio derived from appraisal reports prepared by the banks does not differ significantly from the comparable group (reports prepared by BAG and judicial reports on the market value) the judicial reports differ significantly. The average proceeds ratio for sales on the basis of these reports is only 57% and thereby significantly lower. One possible reason for this might be the fact that, in comparison to judicial reports, BAG and loan-granting banks have to bear the consequences themselves if their estimation is wrong and therefore provide a more conservative estimate.

With respect to *Condition* it can be demonstrated that real estate in worse condition has a significantly lower proceeds ratio (67%) in comparison to the comparable group (81%), although the condition as well as the location should already be considered by the expert. The fact that property in bad condition only attracts a very limited range of prospective buyers

could offer one explanation. The very limited range of potential buyers as well as the demand of the clients for a risk discount if they fear additional, yet undiscovered, defects could explain the negative influence of the variable *Condition*. There is no significant difference in the proceeds ratio for property in unknown condition ($Condition^{WITHOUT}$) and a comparable group consisting of properties in good and bad shape respectively which may indicate that the group with unknown condition is in fact a mixture of properties in good and bad shape.

The index value for the variable *Location* is on average 0.94 and indicates that the location of the properties included in the data is slightly below average compared on a national German basis. At the same time the maximum value (2.82) and the minimum value (0.40) indicate strong differences in attractiveness. Moreover, a statistically significant, positive relation between a property´s location and the proceeds ratio can be demonstrated (see table 11 in the appendix). Although the location should be considered in the expert´s appraisal report, there still seems to be a significant influence on the proceeds ratio at least in the bivariate context. This contradicts hypothesis $H4$.

In a bivariate comparison the type of workout-process shows the most noticeable influence on the proceeds ratio. With 92%, the proceeds ratio for over-the-counter trades is significantly higher than the proceeds ratio for sales by court order (71%).

4.4 Multivariate analysis

4.4.1 Econometric model

In the multivariate analysis, the proceeds ratio (PR_i) of the property i serves as the explanatory variable. Due to multi-collinearity not all binary variables could be included in the model. The reference value is the binary variable which value most often equals 1. Precisely, these are the appraisal reports issued by BAG (*BAG*), property with unknown condition ($Condition^{WITHOUT}$) as well as commercial property (*COMPROP*). The complete model reads as follows:

$$\begin{aligned} PR_i &= \beta_0 + \beta_1 \cdot BANK_i + \beta_2 \cdot COURT_i + \beta_3 \cdot MV_i^{LN} + \beta_4 \cdot Condition_i^{NORMAL} \\ &+ \beta_5 \cdot Condition_i^{BAD} + \beta_6 \cdot LOCATION_i + \beta_7 \cdot APH_i + \beta_8 \cdot CONDO_i \\ &+ \beta_9 \cdot SFH_i + \beta_{10} \cdot CO_i + \beta_{11} \cdot GDP_i + \beta_{12} \cdot UER_i + \beta_{13} \cdot INF_i + \varepsilon_i. \end{aligned} \tag{10}$$

In comparison to the analysis on the borrower level we now use a multivariate linear regression analysis as an econometric explanatory model since the proceeds ratio, in contrast to the recovery rate, is not limited to the interval [0,1].

4.4.2 Regression results

variable	model (3) Proceeds Ratio std. coefficient (standard error)	*marg. effect*
BANK	-0.1622*** (0.0321)	*-0.133*
COURT	-0.3014*** (0.0313)	*-0.280*
MV^{LN}	-0.1320*** (0.0168)	*-0.047*
$Condition^{NORMAL}$	-0.0366 (0.0315)	*-0.028*
$Condition^{BAD}$	-0.1764*** (0.0329)	*-0.152*
LOCATION	0.2203*** (0.0422)	*0.230*
APH	-0.0389 (0.0426)	*-0.041*
CONDO	-0.1061** (0.0385)	*-0.097*
SFH	0.0059 (0.0318)	*0.005*
CO	-0.1968*** (0.0274)	*-0.152*
GDP	-0.0689* (0.0038)	*-0.007*
UER	0.0952*** (0.0171)	*0.051*
INF	0.1865*** (0.0152)	*0.071*
observations	718	
Adj. R^2	0.249	

Table 6: Results of OLS-estimation with Proceeds Ratio as dependent variable.
***, **, * indicates a 1%, 5% and 10%-Confidence level. The robust standard errors are given in brackets.

The estimation results can be found in model (3) in table 6 where we display the marginal effects among the standardized coefficients. The results from the binary analysis can be confirmed with respect to the creators of the reports. Appraisal reports prepared by the issuing bank or the court respectively come along with a significantly lower proceeds ratio.[26]

Interestingly the study still shows that properties with high values measured by taking the market value´s logarithm, are linked to a significantly lower proceeds ratio which is consistent with the results of Grunert (2010).[27] The result seems especially reasonable for real estate regarding that with an increasing market value the number of potential buyers decreases.

[26] Because of potential differences in the properties of the independent variables depending on the creators of appraisal reports that could not become obvious in a binary analysis, we performed in analogy to the customer groups a sample split. In other words, the overall sample was split into the according three subsamples. There was no change in the essential results, especially regarding the property´s location and condition. In particular with respect to future analyses and for clarity, we consider displaying the creators of the appraisal reports with dummy variables as more reasonable.

[27] We have to point out that the analysis by Grunert (2010) is not only based on collaterals on real estate. Furthermore, in his study a collateral is assumed to be 'small' if its value is less than EUR 660,000.

Additionally, an increasing market value is linked to an increasing specificity limiting the class of potential buyers additionally.

Regarding the property´s condition, properties in a bad condition show a significantly lower proceeds ratio. The reasoning has already been specified while discussing the results of the binary analysis. Therefore we are able to confirm the educated guess by Schaaff (2009) who was not able to analyze the influence of the condition in more detail due to missing data. The poor condition of a property could be a significant factor of influence on the proceeds ratio.

Among the property´s condition, its location also has a positive influence on the proceeds ratio, as already demonstrated in the bivariate analysis. Objects located in an attractive area according to the index, show a significantly higher proceeds ratio.

While analyzing the property´s size it was mentioned that the negative influence between the proceeds ratio and the logarithmized market value could be caused by a limited class of potential buyers since an increasing market value is linked to an increasing specificity. On the contrary, the property type 'condominium' is linked to a significantly lower proceeds ratio. In relative comparison to other types of properties, especially commercial properties, this type of property is characterized by a very low specificity. However, realizing more than one condominium of a single debtor usually results in a package price being lower than the sum of the single prices. This could offer an explanation for the negative influence.

Reviewing the control variables, a high significant influence of the workout process can be demonstrated. In the multivariate context the proceeds ratio for property sold in a sale by court order is significantly lower in comparison to the proceeds ratio achieved by over-the-counter sales. Nevertheless, it remains questionable whether the workout process can really considered an influencing factor or whether the workout process is only a result of the various property´s characteristics. In conclusion, the workout-process´ influence could also be caused by the fact that many characteristics such as the year of construction cannot be analyzed but are partly captured by the type of workout-process.

Interestingly, there are significant influences for two of the macroeconomic control variables. There is a significantly positive relation for the unemployment rate and the inflation rate with the proceeds ratio. The results regarding the unemployment rate are consistent with the results published by Schaaff (2009) who also finds a positive relation. The positive relation with the inflation rate could be caused by the fact that in time of high inflation prices increase significantly, a fact that cannot be anticipated by experts. At the same time, an

increasing inflation rate could trigger a higher demand for real estate which could explain the higher proceeds ratio. The inflation rate´s influence on the recovery rate (borrower level) was already mentioned in section 3.5.2. Since a higher proceeds ratio leads, ceteris paribus, to a higher recovery rate the macroeconomic effects could be transferred from the collateral level to the borrower level and therefore also the significant influence of the inflation rate on the recovery rate accordingly.

In conclusion, we were able to identify various factors for which there is a significant relation to the proceeds ratio. However, considering time, we have to differentiate between two kinds of factors: For one, there are factors already known at the time when the appraisal report is prepared like the condition and the location. Furthermore, there are control variables which we only get to know after the workout-process is completed such as the type of liquidation. Since the factors which are known at the time when preparing the appraisal report influence the proceeds ratio significantly although we were controlling for other variables, there is indication of a systematic distortion of the appraisal report on the market value. Therefore, hypothesis $H4$ has to be rejected.

However, the question arises how this may affect the recovery rate´s explanation. In order to give an answer we will develop a prediction model based on our results to identify an individual correction factor δ_i for each individual property i in the following section (section 4.5). This equals the predicted proceeds ratio $\hat{PR}_i$. Multiplying this factor with the market value results in the adjusted market value and therefore, in sum, the new, adjusted collaterization ratio (section 5.1). In consequence, we are able to analyze the influence of the adjustment on the borrower level (section 5.2). In the following we are going to present the prediction model.

4.5 Prediction model

In the context of our prediction model we have to differentiate between two groups of properties: one group is for calibrating the model ($group^{CAL}$), for the other group we predict the proceeds ratio ($group^{PRED}$). If the observations for both groups are identical, it is a mere in-sample observation. We have an out-of-sample observation if there is a difference between $group^{CAL}$ and $group^{PRED}$. In the following, we will describe the composition of both groups in more detail.

For the context of analysis, $group^{PRED}$ always consists of all 711 properties assigned to the 499 debtors for whom the workout-process is completed (see figure 5). To calibrate the

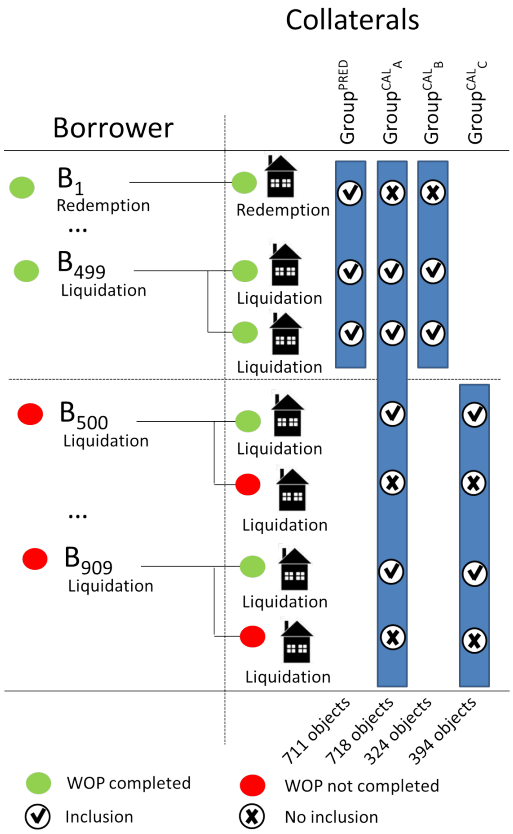

Figure 5: Borrower and collateral level

model we use three differently compounded groups. $group_A^{CAL}$ consists of 718 properties which were analyzed in the previous section. $group_B^{CAL}$ consists out of 324 properties for which the workout-process is completed while $group_C^{CAL}$ is made up of 394 properties with incomplete workout-processes.

Therefore, we have an out-of-sample analysis for the subsequent observation on the borrower level for all three calibrating groups because the calibrating group and the estimation group always differ. The strongest out-of-sample test is represented by $group_C^{CAL}$ because there is no link between the analyzed borrowers and the collaterals used for calibration.

In the context of calibration of the three prediction models we use the proceeds ratio (PR_i) of property i as the value to be explained and the factors known at the time of creating the appraisal report function as explanatory variables. The explanatory variables are the preparers of the appraisal report, the condition, the kind of property, the location as well as the estimated market value of the property. Because of multi-collinearity we are not able to

include all variables into the model at the same time. Again, the reference group contains the variables BAG, $Condition^{WITHOUT}$ and $COMPROP$. The complete model is the following:

$$\begin{aligned} PR_i &= \beta_0 + \beta_1 \cdot BANK_i + \beta_2 \cdot COURT_i + \beta_3 \cdot MV_i^{LN} + \beta_4 \cdot Condition_i^{NORMAL} \\ &+ \beta_5 \cdot Condition_i^{BAD} + \beta_6 \cdot LOCATION_i + \beta_7 \cdot APH_i + \beta_8 \cdot CONDO_i \\ &+ \beta_9 \cdot SFH_i + \varepsilon_i. \end{aligned} \tag{11}$$

The multivariate linear regression model using robust standard errors is applied as the econometric model for the estimation. Since not all included variables are of statistical significance, but are correlating with the remaining factors of influence and could therefore influence the quality of the estimation, we use a backward elimination for the estimation models.[28]

variable	model (4) proceeds ratio marg. effect (standard error)	model (5) proceeds ratio marg. effect (standard error)	model (6) proceeds ratio marg. effect (standard error)
$BANK$	-0.105***		-0.168***
	(0.0327)		(0.0440)
$COURT$	-0.273***	-0.241***	-0.267***
	(0.0275)	(0.0336)	(0.0407)
MV^{LN}	-0.0404**	-0.0578**	
	(0.0170)	(0.0291)	
$Condition^{NORMAL}$			
$Condition^{BAD}$	-0.140***	-0.162***	-0.114***
	(0.0283)	(0.0406)	(0.0422)
OBJ^{APH}			-0.100**
			(0.0468)
OBJ^{CONDO}	-0.0986***	-0.108**	-0.0807**
	(0.0326)	(0.0505)	(0.0375)
OBJ^{SFH}			
$Location$	0.255***	0.309***	0.145***
	(0.0418)	(0.0728)	(0.0436)
constant	1.143***	1.268***	0.788***
	(0.199)	(0.331)	(0.0527)
observations	718	324	394
adj. R^2	0.167	0.230	0.143

Table 7: Marginal effects of OLS-regression with proceeds ratio as dependent variable.
In model (4), (5) resp. (6) the estimation of the coefficients is based on $group_A^{CAL}$, $group_B^{CAL}$ bzw. $group_C^{CAL}$. ***, **, * indicates a 1%, 5% and 10%-Confidence level. The robust standard errors are given in brackets.

The marginal effects of the OLS regression are displayed in table 7 for the three calibrating groups. On the one hand it becomes obvious that a statistical significance for the majority of the variables for all three models (i.e. $Condition^{BAD}$, $Location$) exists. On the other hand there are considerable differences of other variables depending on the model. For example, the preparation of the appraisal report by the bank is not included in model (2) due to its lack of statistical significance. Because of these differences it seems quite interesting to analyze how adjusting the market value influences the recovery rate.

[28] A partial F-test, testing how the coefficient of determination differs when several variables are excluded, given the variable is not significant, composes the basis for excluding variables from the model.

As previously explained in a next step we use the three calibrated estimation models (A, B and C) in order to estimate the according individual correction factors $\delta_{i,k}$ with $k \in (A,B,C)$ for all 711 properties. At this point it should be mentioned that the banks apply correction factors to their market values as well. The bank analyzed by Grunert (2010) applies 65% of the estimated value flat, regardless of the kind of collateral. Contrary to the flat discount we determine an *individual* correction parameter which can also take on values above 1 and therefore cause discounts and premiums.

5 Influence of adjusted market values for explaining the recovery rate

5.1 Adjusting the market values

In a last step we would like to analyze whether and how linking the result on the collateral level influences the recovery rate e.g. the borrower level. Therefore, we include the individual correction parameters to determine the collateralization value for real estate. Equation (2) changes to

$$CV_{i,k}^{realestate} = MAX(MIN(\delta_{i,k} \cdot MV_i - PL_i; LC_i); 0). \tag{12}$$

Therefore, the adjusted collateralization ratio for every debtor j and the calibration group k is now defined as

$$CR_{j,k} = \frac{\sum_{i=1}^{m} CV_{i,j,k}^{realestate} + \sum_{i=1}^{n} CV_{i,j}^{deposit}}{EAD_j}.^{29} \tag{13}$$

Afterwards, we form the according collateralization ratios for all 499 debtors whose liquidation is completed, and get four versions with respect to the collateralization ratio: the original, unadjusted version of CR as well as the version CR_A, CR_B and CR_C, derived from the different calibration groups k.

5.2 Regression results

Using the fractional logit model to explain the recovery rate on the borrower level with robust standard errors leads to the results displayed in table 8. Model (1) presents the results of regressions of the unadjusted collateralization ratio for retail customers (model (1a)) and commercial customers (model (1b)) respectively. Models (7) – (9) show the adjusted collateralization ratios (CR_A, CR_B and CR_C) resulting from the different calibration groups explained in the previous section.

[29] Again, we limit the maximum to 1.

	variable	model (1a)	model (1b)	model (7a)	model (7b)	model (8a)	model (8b)	model (9a)	model (9b)
		recovery rate std. coefficient (standard error)							
H1	CR	0.6170***	0.7135***						
		(0.268)	(0.432)						
	CR_A			0.7608***	0.8462***				
				(0.276)	(0.380)				
	CR_B					0.7503***	0.8759***		
						(0.287)	(0.372)		
	CR_C							0.7365***	0.8418***
								(0.279)	(0.376)
H2	COL	0.0399	0.0785	0.0602	0.0829	0.0521	0.0763	0.0717	0.0903*
		(0.0459)	(0.0357)	(0.0558)	(0.0313)	(0.0553)	(0.0319)	(0.0563)	(0.0313)
H3	RED	0.4311***	0.2855***	0.3529***	0.2621***	0.3491***	0.2328***	0.3777***	0.2683***
		(0.164)	(0.229)	(0.169)	(0.240)	(0.171)	(0.213)	(0.175)	(0.236)
	EAD^{LN}	0.0937**	-0.1548***	0.0585	-0.1797***	0.0694	-0.1461**	0.0309	-0.2070***
		(0.0877)	(0.103)	(0.0816)	(0.105)	(0.0824)	(0.103)	(0.0837)	(0.103)
	WOP	0.00177	0.1372**	-0.0163	0.1274**	-0.0363	0.0934*	0.0082	0.1339**
		(0.00685)	(0.00865)	(0.00685)	(0.00886)	(0.00707)	(0.00820)	(0.00672)	(0.00879)
control variables	BT								
	INS	-0.0760*	-0.0209	-0.0431	-0.0133	-0.0478	-0.0028	-0.0419	-0.0159
		(0.204)	(0.233)	(0.187)	(0.226)	(0.186)	(0.226)	(0.185)	(0.216)
	GDP	-0.0066	-0.1271*	-0.0133	-0.1114*	-0.0061	-0.104	-0.0078	-0.1252*
		(0.0285)	(0.0392)	(0.0273)	(0.0373)	(0.0270)	(0.0377)	(0.0281)	(0.0376)
	UER	0.0365	0.0901*	0.0486	0.0831	0.0211	0.0883*	0.0882*	0.0824
		(0.132)	(0.141)	(0.123)	(0.145)	(0.116)	(0.144)	(0.141)	(0.149)
	INF	0.1109***	0.1284	0.0870**	0.1749**	0.0696*	0.1719**	0.1030***	0.1884***
		(0.0848)	(0.176)	(0.0774)	(0.141)	(0.0786)	(0.145)	(0.0795)	(0.141)
	constant	-5.945***	-1.922	-4.972***	-1.228	-4.413***	-1.958	-5.388***	-0.689
		(1.510)	(1.932)	(1.383)	(2.003)	(1.382)	(1.907)	(1.416)	(1.996)
	observations	368	131	368	131	368	131	368	131
	AIC	0.8014	0.8951	0.7460	0.8398	0.7509	0.8294	0.7550	0.8429
	BIC	-2008.52	-558.7123	-2028.91	-565.97	-2027.11	-567.33	-2025.62	-565.55
	Mc Fadden R^2	0.3436	0.3383	0.3923	0.3876	0.3880	0.3969	0.3844	0.3848
	R^2	0.6353	0.7020	0.7138	0.7736	0.7066	0.7923	0.7010	0.7726
	Adj. R^2	0.6261	0.6798	0.7066	0.7568	0.6848	0.7769	0.6787	0.7556
	Wald Test (χ^2)	395.57 (0.000)	192.09 (0.000)	503.59 (0.000)	260.45 (0.000)	487.18 (0.000)	249.00 (0.000)	468.73 (0.000)	246.77 (0.000)

Table 8: Fractional Logit Regression with Recovery Rate as dependent variable for the unadjusted Collateralization Ratio (models (1)) as well as the three calibration groups based on adjusted Collateralization Ratios (models (7) - (9)). Models with a = retail customers and models with b = commercial customers.
***, **, * indicates a 1%, 5% and 10%-Confidence level. The robust standard errors are given in brackets.

(models with a = retail customers and models with b = commercial customers)

Results show that (regardless of the calibration group) considering correction parameters concludes in a significant improvement of the model´s explanatory power. The value for the adjusted R^2 of models (7) – (9) is higher than the one of model (1). It applies for both Akaikes Information Criterion (AIC) as well as Bayesians Information Criterion (BIC) that the model showing the lower value is able to show the context to be explained more effectively, therefore confirming the necessity of an adjusted collateralization ratio with respect to a precise estimation of the recovery rate.

Another advantage of using BIC is the possibility of evaluating the strength of preference for one model over the other. According to Raftery (1995) there are four categories in total oriented to the absolute difference between two BIC values (see table 9). In comparison to model (1a(b)), the models (7a(b)) – (9a(b)) result in absolute differences significantly above 10(6) and therefore show a very strong (strong) preference for explanatory models considering the adjusted collateralization ratio. Interestingly, this result is very robust because it is valid for all three calibration groups and the maximum difference of the BIC-values between

models (7) – (9) is 3.29 which is, according to table 9, a positive though neither strong nor even very strong preference for model (7a) over model (9a). The poor values are reasonable because in model (9a), there is no relation between the analyzed debtors and the collaterals used for calibration (strongest out-of-sample test). However, we are able to conclude that considering the correction parameters significantly improves the explanatory power and the result can be confirmed for all calibration groups.

absolute difference	degree of preference
0-2	weak
2-6	positive
6-10	strong
> 10	very strong

Table 9: Degrees of preference according to Raftery (1995).

So far we discussed the explanatory powers of the various models. Now, we are going to analyze the significant changes with respect to the influence of the different variables resulting from consideration of the adjusted collateralization ratio. First, it becomes obvious that there is a relative shift in the power of influence. While the standardized coefficients of the collateralization ratio are increasing, the coefficients for redemption are decreasing. Apparently, a part of the distorted illustration of collaterals was captured in the variable redemption.

Furthermore, we are able to demonstrate that a majority of the control variables (EAD^{LN} and INS) for retail customers lose their previous significance whereas there is no change for commercial customers. Therefore, regarding commercial customers only changes in the macroeconomic factors are relevant. Consequently, the variables GDP and UER suggested by the regulators do not appear to be robust because there are different results regarding the significance depending on the calibration group. When adjusting, there is a highly significant influence of the inflation rate regardless of the calibration group. We already discussed the inflation rate´s effect on the collateral level in detail and showed that the influence is transferred from the collaterals to the debtors. The result raises the question if the macroeconomic variables that are suggested by regulators determines the recovery rate should be expanded by the inflation rate. These results are of specific importance for Germany since collaterals on real estate play such a dominant role.

Our results make an important contribution to further academic research. On the one hand, the analysis should be applied separately for every customer group because single variables

could function diametrically. On the other hand, factors influencing the recovery rate that were identified in other studies among the collaterals (in particular for retail customers), could be caused by the distorted display of collaterals. Future studies should therefore not consider the amount of the collateral as a given.

6 Conclusion

Previously, academic research as well as the practice of banking has been focusing on models and methods to estimate the probability of default (PD). Thus, similar well-founded results considering the recovery rate are still missing. Banks seeking the transition to advanced IRB-approaches have to demonstrate that they have appropriate internal models to estimate the recovery rate. In order to keep the effort for collecting and processing the data as small as possible, results from academic studies could provide essential insights to identify important factors influencing the recovery rate. However, a great part of the empirical research is based on US banking data. These results cannot, or only to a limited extent, be transferred to Germany due to differences in the collaterals and legal systems.

This article provides empirical evidence for the recovery rate for retail and commercial customers based on a data set with 909 defaulted customers from exactly this customer segment. In a first step, we are able to confirm a positive influence of the collateralization ratio and workout-process on the recovery rate. Furthermore, we could demonstrate the important role of redemption in the processing of problematic loans, because an amicable agreement with an already defaulted customer was achieved in 40% of the cases. With respect to the two customer groups it becomes obvious that a separate analysis is necessary as there are diametrical effects for some of the controlling variables. In total, our model is able to explain 63% and 68% of the recovery rate´s variance measured with the adjusted R^2 although it seems like this result is merely based on the collaterals on real estate.

Due to the major influence of collaterals on real estate, we analyzed the valuation of the properties included in the data set in more detail. The proceeds ratio, that is the relation between the expected and realized value, equals only 78%. The result is surprising because the valuation in the form of the market value should already include all factors influencing the value. A multivariate analysis of the proceeds ratio shows that, among others, the property´s condition is not considered accordingly in the value derived from the appraisal reports. The same is the case for the attractiveness of the property´s condition. In order to approx-

imate a location´s attractiveness we were able to use a postal code-based index depending on the property´s type for the first time in recovery rate research. We develop an prediction model for the proceeds ratio in order to eliminate systematic distortions in the market value identified in a second step. Thereby, this article goes beyond previous studies.

Third and last, we use the predicted proceeds ratio for adjusting the market value. Thereby, we receive an adjusted proceeds ratio. The new analysis of the recovery rate provides several essential insights: First, the models´ explanatory power can be increased by adjusting. This is also confirmed by the out-of-sample test. Second, some of the controlling variables for retail customers lose their previously significant influence. The combined analysis on the borrower and collateral level is therefore an essential part of the analysis of factors influencing the recovery rate in the context of future empirical studies. Furthermore, the question arises if the suggestions by the Basel Committee with respect to the macroeconomic factors to be considered in predition models should be expanded as we have identified a highly significant influence of the inflation rate regardless of the customer group.

Moreover, the study provides significant insights for the practice of banking. The final model is able to explain a majority of the recovery rate´s variance (adjusted R^2 equals 75%) and is able to identify the collateralization ratio as the essential driver for the recovery rate. Therefore, the practice of banking should concentrate on the collateralization ratio and its unbiased illustration. To allow for a systematic analysis of the collateralization ratio, the collection and processing of data should focus on the creation of databases for defaulted collaterals on real estate.

7 Appendix

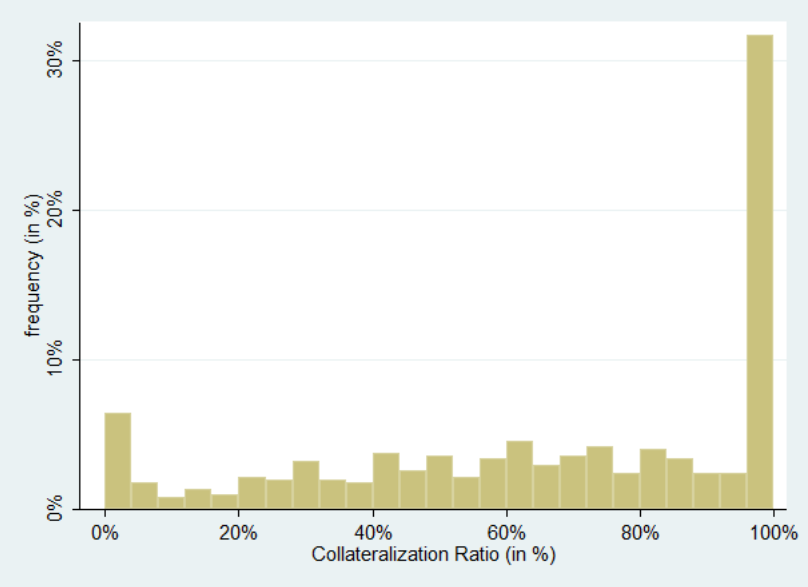

Figure 6: Frequency of Collateralization Ratio.

variable	EAD^{LN}	*CR*	*COL*	*RED*	*BT*	*WOP*	*INS*	*UER*	*INF*	*GDP*	*RR*
EAD^{LN}	1.00										
CR	-0.20*	1.00									
COL	0.31*	-0.09	1.00								
RED	-0.03	0.31*	0.06	1.00							
BT	0.35*	-0.16*	0.36*	-0.01	1.00						
WOP	0.18*	0.04	0.10*	-0.10*	0.10*	1.00					
INS	0.05	-0.12*	0.03	-0.27*	0.06	0.14*	1.00				
UER	-0.01	-0.04	0.01	-0.03	0.04	-0.25*	-0.03	1.00			
INF	0.05	-0.05	0.02	0.11*	-0.03	-0.20*	-0.16*	0.00	1.00		
GDP	-0.08	-0.04	0.05	-0.05	-0.07	0.06	0.02	-0.01	0.35*	1.00	
RR	-0.07	0.70*	0.03	0.55*	-0.02	0.01	-0.23*	-0.01	0.10*	-0.03	1.00

Table 10: Correlation matrix for the variables of the analysis on borrower level.
* indicates a 5%-Confidence level.

variable	$BANK$	BAG	$COURT$	MV^{LN}	$Condition^{WITHOUT}$	$Condition^{NORMAL}$	$Condition^{BAD}$	$LOCATION$	APH	$COMPROP$	$CONDO$	SFH	CO	GDP	UER	INF	PR
$BANK$	1.00																
BAG	-0.66*	1.00															
$COURT$	-0.30*	-0.52*	1.00														
MV^{LN}	-0.12*	0.18*	-0.10*	1.00													
$Condition^{WITHOUT}$	0.21*	-0.33*	0.18*	-0.17*	1.00												
$Condition^{NORMAL}$	-0.16*	0.32*	-0.22*	0.27*	-0.62*	1.00											
$Condition^{BAD}$	-0.06	0.01	0.05	-0.11*	-0.45*	-0.43*	1.00										
$LOCATION$	0.02	0.05	-0.09*	0.31*	-0.02	0.08*	-0.07	1.00									
APH	0.08*	-0.06	-0.02	0.06	0.26*	-0.18*	-0.10*	0.03	1.00								
$COMPROP$	0.00	0.09*	-0.12*	0.22*	-0.18*	0.09*	0.10*	-0.06	-0.32*	1.00							
$CONDO$	0.01	-0.06	0.07	-0.30*	-0.01	0.08*	-0.07	0.11*	-0.20*	-0.39*	1.00						
SFH	-0.07	0.00	0.08*	-0.02	0.00	-0.03	0.04	-0.05	-0.25*	-0.49*	-0.31*	1.00					
CO	-0.05	-0.11*	0.19*	-0.09*	0.02	-0.10*	0.09*	0.01	-0.03	-0.07	0.05	0.05	1.00				
GDP	-0.02	-0.02	0.05	-0.07	0.04	0.02	-0.08*	-0.06	0.00	0.00	-0.01	0.00	0.05	1.00			
UER	0.07	-0.16*	0.12*	-0.01	0.10*	-0.15*	0.05	0.11*	0.06	-0.02	-0.02	-0.01	0.02	-0.15*	1.00		
INF	0.08*	-0.15*	0.11*	0.08*	0.01	-0.01	0.01	0.16*	0.06	-0.01	-0.02	-0.02	-0.16*	0.16*	0.13*	1.00	
PR	-0.01	0.23*	-0.28*	0.06	0.02	0.12*	-0.17*	0.23*	0.01	0.04	-0.05	0.00	-0.27*	0.00	0.06	0.20*	1.00

Table 11: Correlation matrix for the variables of the analysis on collateral level.
* indicates a 5%-Confidence level.

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