

4.5	Interim Result	111
5	Unbiased Exposure at Default Modeling.....	113
5.1	Fundamentals and Research Questions	113
5.2	Literature Review	115
5.3	Theoretical Analysis of CCF Forecasts	118
5.3.1	Variable Description	118
5.3.2	The Model	119
5.3.3	Overview of CCF Approaches	122
5.4	Empirical analysis.....	125
5.4.1	Variable Description	125
5.4.2	Data Description.....	126
5.4.3	Empirical Strategy.....	129
5.4.4	Comparison of Different Parameters.....	133
5.4.5	Comparison of Different Estimation Approaches Evaluated at the CCF Level.....	141
5.4.6	Comparison of Different Estimation Approaches Evaluated at the EL Level .	143
5.5	Interim Results.....	149
5.6	Appendix	150
5.6.1	Proof of the Proposition	150
6	Conclusion	152
	References	157



List of Figures

Figure 1: Limit and negative balance of checking accounts	29
Figure 2: Cash inflows and outflows of checking accounts	30
Figure 3: Change in cash inflows and outflows	32
Figure 4: Days with credit line usage and overdrafts.....	33
Figure 5: Consistency of information across credit products.....	44
Figure 6: Accuracy of PD estimates for different time horizons by information source	48
Figure 7: Credit line usage by credit rating	54
Figure 8: Particular characteristics of the summary statistics	83
Figure 9: Negative balance and limit of credit card accounts	88
Figure 10: Inflow and outflow for full payment customers and revolvers.....	89
Figure 11: Days with usage and overdrafts for full payment customers and revolvers	90
Figure 12: Different estimation approaches of CCF/EaD	124
Figure 13: Frequency distribution of realized CCF, LEQ, EaDF, and EaD	127
Figure 14: CCF for different reference periods.....	144



List of Tables

Table 1 The German banking system: Number of banks and assets.....	9
Table 2 Summary statistics	13
Table 3: Summary statistics	25
Table 4: Characteristics of accounts in default versus non-default.....	35
Table 5: PD of checking accounts, credit cards and cross-product information with fixed effects model	38
Table 6: PD of checking accounts, credit cards and cross-product information with probit estimates	41
Table 7: Screening with cross-product information	42
Table 8: Accuracy of PD estimates by information source.....	46
Table 9: CLU from checking accounts, credit cards, and cross-product information.....	53
Table 10: Alternative estimation methods for CLU at default.....	55
Table 11: Credit lines usage at default and cross-product information.....	58
Table 12: CLU at default restricted to positive values	60
Table 13: Default at the customer level	62
Table 14: Summary statistics	79
Table 15: Summary statistics and comparisons of variables from full payment customers and revolvers	81
Table 16: Characteristics of accounts in default vs. non-default	91
Table 17: Probability of default of credit cards.....	94
Table 18: Comparison of monthly default rate for credit cards	95
Table 19: Comparison of monthly default rate for credit cards conditional on usage	96
Table 20: Nearest neighbor matching	97
Table 21: Comparison of monthly default rate for credit cards of matched customers	98
Table 22: Treatment effects analysis by nearest neighbor one-to-one matching: probability of default.....	98
Table 23: Credit line usage of credit cards.....	100
Table 24: Treatment effects analysis by nearest neighbor one-to-one matching: credit line usage	101
Table 25: Heckman estimation method for credit line usage at default.....	102



Table 26: Treatment effects analysis by nearest neighbor one-to-one matching: Credit line usage at default	103
Table 27: Count and time of switches	105
Table 28: How do customers behave 12 months before redemption type change?	108
Table 29: How do customers behave 12 months after redemption type change?	109
Table 30 Difference of customers before and after redemption type change	110
Table 31: Empirical studies concerning the credit conversion factor	117
Table 32: Summary statistics for EaD analysis	126
Table 33: Model Selection for Parameters	132
Table 34: Comparison of different parameters evaluated at the EaD level	134
Table 35: Comparison of different parameters evaluated at the CCF level	135
Table 36: Comparison of different parameters evaluated at the EaD level based on mixture regression models	137
Table 37: Comparison of different parameters evaluated at the CCF level based on mixture regression models	138
Table 38: Comparison of different parameters evaluated at the EaD level based on out-of-time analyses	139
Table 39: Comparison of different parameters evaluated at the CCF level based on out-of-time analyses	140
Table 40: Comparison of different approaches for CCF estimation at the CCF level	142
Table 41:Summary statistics for CCF, EaD, and PD	143
Table 42: Comparison of different approaches for CCF-estimation at EL-level based on historical averages	146
Table 43: Comparison of different approaches for CCF estimation at the EL level based on regression models	148



Variables

a	Function
A	Set of Choices
ABS	Absolute Error
ATE	Average Treatment Effect
ATET	Average Treatment Effect on the Treated
ATT	Average Treatment Effect on the Treated
B_t	Balance at Time T
c	Variable
c_t	Consumption over time
$\text{CCF}_{t,T}$	Expected Credit Conversion Factor at T from the Perspective of Time T
$\text{CLU}_{i,t}$	Credit Line Usage of Account I in Month T
d	Default Time
$\text{Def}_{i,t+12}$	Default Variable
$\text{EaDF}_{t,T}$	Expected Exposure at Default Factor at T from the Perspective of Time T
$\text{EaD}_{t,T}$	Exposure at Default at T from the Perspective of Time T
$\text{EL}_{t,T}$	Expected Loss in the Period Between T and T
e_t	Exposure at Time T
$E_t()$	Expected Value at Time T
f	Function
i	Account
$\text{LEQ}_{t,T}$	Expected Loan Equivalent Factor at T from the Perspective of Time T
$\text{LGD}_{t,T}$	Expected Loss Given Default
ℓ_t	Share of the Exposure That is Lost if The Borrower Defaults
L_t	Limit Advised at Time T
MAE	Mean Absolute Error
p	Level of Significance
P	Probability Measure
\bar{P}	Level of Significance
$\text{PD}_{i,t}$	Probability of Default of Account I in Month T