Prepayment of German Bauspar-Loans: A look at the importance of portfolio considerations and borrower characteristics

Marcus Cieleback*
Lehrstuhl VWL I, University of Bayreuth
Universitätsstr. 30
95447 Bayreuth, Germany
e-mail: marcus.cieleback@uni-bayreuth.de

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Abstract

In the USA, a substantial literature has emerged to investigate the prepayment behavior of mortgage borrowers using loan level data to identify the effects of borrower characteristics. This paper contributes to the existing literature in three ways. First, the study looks for the first time at the prepayment behavior of German mortgage borrowers. Second, it uses a unique Bauspar-Loan data set consisting of over 55,000 Bauspar-Loans paid off or prepaid between January 1998 and September 2000. Third, based on the special characteristics of the Bauspar-Loan, it is possible to identify portfolio considerations as the driving force for prepayment.

Keywords: Prepayment, Bauspar-Loan, portfolio considerations
JEL-classification: D10, G11, G20, R20

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1 Introduction

The analysis of prepayment behavior has so far mainly focused on the U.S. Market. One of the reasons could be the high degree of securitization observed in the United States. Nearly half of the stock of outstanding mortgages is held in mortgage-backed securities and about 50 percent of all new mortgages is securitized. Prepayment analysis is an essential part in forecasting mortgage cash flows which form the basis for the pricing of mortgage-backed securities. Most of the empirical research in the U.S. has used publicly available mortgage pool data to get information for the reasons of mortgage prepayments. The main focus in this research is on the importance of the relation between the contract rate of the mortgage and the prevailing market rate. Additional information used in these studies are the age of the loan, time of issue and the issuer of the mortgage.[1]

Given the limitations of this research to distinguish defaults from prepayments in the last years an increasing number of studies has used loan level data to investigate the prepayment decision of households. Using American Housing Survey data from the 1980s Archer/Ling/McGill (1995) find, that factors like age, household income, two wage earner household and family size have an statistically significant effect on the probability of mortgage termination. Based on a data set provided by the Mortgage Research Group of Jersey City supplemented by TRW Information Services credit history variables Peristani et al. (1997) examine the role of individual homeowner credit histories in mortgage refinancing. They find that a poor credit history significantly reduces the probability of refinancing and that refinancing probabilities are sensitive to the amount of equity a homeowner has in his property. LaCour-Little (1999) investigates the pure refinancing behavior, explicitly controlling for credit and collateral constraints. He finds that borrower characteristics affect mortgage prepayments primarily when the prepayment option is at the money. Supporting the importance of transaction costs in the prepayment decision of the household.

So far a study on the prepayment behavior of German mortgage borrowers is lacking. The main reasons are the low degree of securitization observed in Germany and the fact, that in

Germany prepayment of mortgage loans obtained by mortgage banks is usually only possible if a hefty prepayment penalty is paid. On the other hand, mortgage loans obtained in the German contractual saving for housing system (Bausparkassensystem) are not subject to a prepayment penalty. Because these loans are refinanced within the system and not on the capital markets, prepayment of Bauspar-Loans has so far not gained much attention.

This study tries to fill this gap by using a unique Bauspar-Loan data set to test the importance of interest rate movements and borrower characteristics on the likelihood of Bauspar-Loan prepayment. The empirical results suggest, that prepayment of Bauspar-Loans is to a great extend the result of portfolio considerations by the individual household and not driven by a refinancing decision. This is the first time that portfolio considerations could be identified as the main reason for the prepayment of a mortgage loan.

The paper is organized as follows: Section 2 gives a brief overview of the German Bausparkassensystem and the characteristics of the Bauspar-Loans. Section 3 discusses the theory of mortgage prepayment from a wealth maximizing perspective. Section 4 describes the data set used and section 5 explains the methodology used in the empirical investigation. Section 6 presents the empirical findings. Section 7 is a brief conclusion.

2 Contractual Savings for Housing System

Contractual savings for housing systems like the German Bausparkassensystem involve in their simplest form an agreement between a household and a financial institution regarding the granting of a loan at a future date after successful completion of a savings period. The German system follows a strict principle of mutuality and the contracts are only offered by specialized institutions, the Bausparkassen, governed by special legislation, the Bausparkassengesetz (BSpKG).

There are four distinct phases in the life of a typical contract (Figure 1). The first phase is the conclusion of the savings and loan contract. In this phase the size of the savings and loan contract, the interest paid on the savings and the interest rate of the future mortgage (Bauspar-Loan) is fixed. In the following savings period the household saves a prespecified amount each month to reach the minimum requirements for the Bauspar-Loan, specified by law and in the provisions of the contract.

The third phase is the allotment. Given the regulatory requirements for Bausparkassen, the allotment date is uncertain to the households participating in the contractual savings for housing system. Bausparkassen are only allowed to give some information about historical

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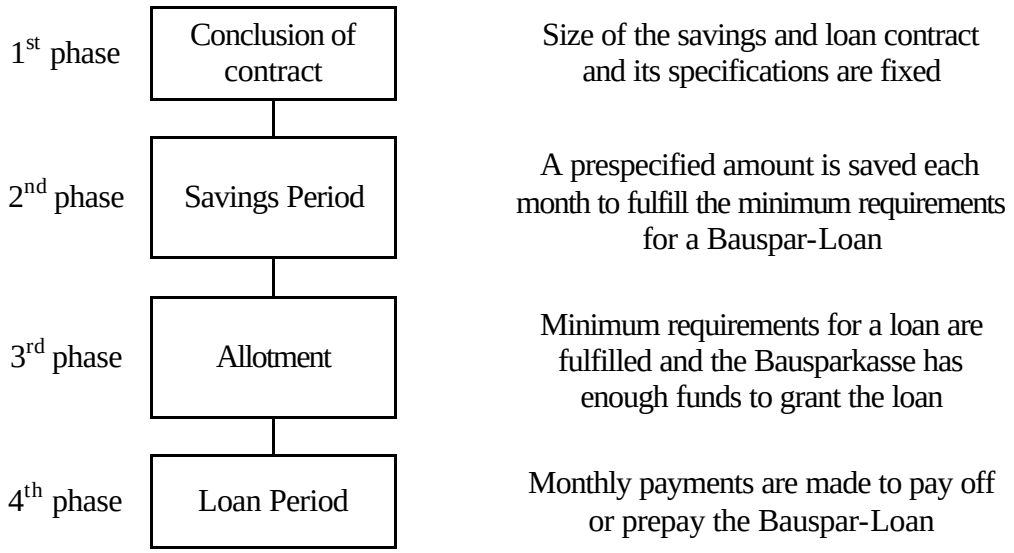
[1] E.g. Richard/Roll (1989), Schwarz/Torous (1989), Quigley/van Order (1995).

allotment experience, they can not guarantee a specific allotment date. The allotment date depends on the funds available to the Bausparkasse. If the funds of the Bausparkasse are not adequate to meet all loan demands by the households at an specific allotment date, the participating households will be served according to well defined queuing rules.[2] In the last phase, the loan period, the households are paying off the obtained Bauspar-Loan with regular payments or prepay their loan. The average duration of such a contract lies somewhere between 12 and 18 years from the conclusion of the contract till the loan is paid off.

Figure 1 Phases of a contractual savings for housing contract



Bauspar-Loans obtained from a Bausparkasse have specific characteristics that distinguish these loan from conventional mortgages obtained from mortgage banks in Germany. First of all, they are designed as second mortgages to serve as additional financing to mortgages provided by mortgage banks (Hypothekenbanken) if real estate is bought. The other main function of Bauspar-Loans is the financing of improvements on existing real estate. According to the law, the loan-to-value ratio of Bauspar-Loans is not allowed to exceed 80 percent[3], compared to 60 percent for mortgages of mortgage banks.[4] Another difference between conventional mortgages and Bauspar-Loans is the prepayment penalty. Prepaying a Bauspar-Loan (partial or full) is not subject to a prepayment penalty, because it benefits the other households participating in the contractual savings for housing system, while prepayment of conventional mortgages is subject to a hefty prepayment penalty. Moreover,

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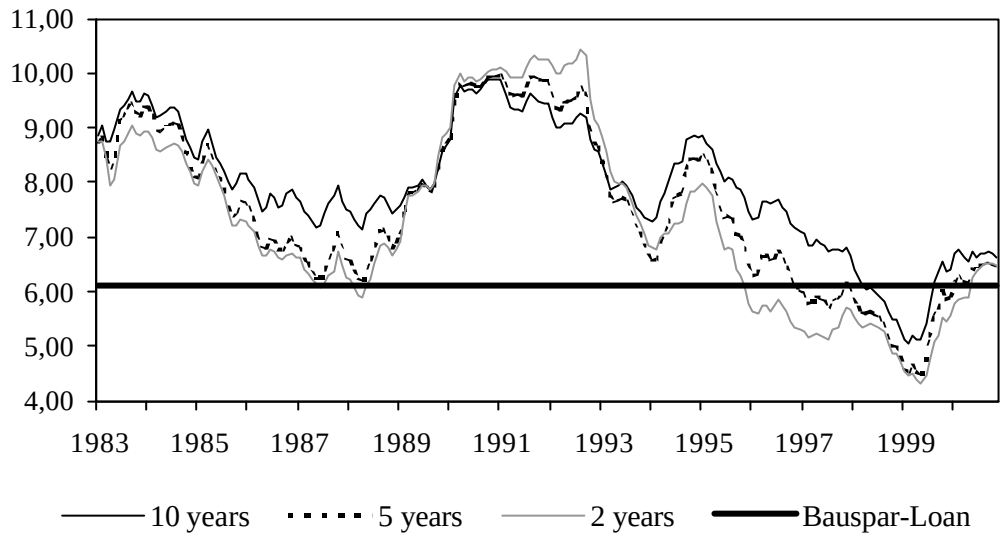
[2] For a detailed description of this queuing rules and the factors influencing the allotment see Zink (1984) and Laux (1992).

[3] § 7 BSpKG.

because conventional mortgages are refinanced with Pfandbriefe on the capital markets that have a maturity of 10 years, nearly all mortgage banks exclude prepayment of their mortgages in the first 10 years.[5]

Figure 2 Mortgage rates and Bauspar-Loan rate[6] since 1983



Due to the closed nature of the German Bausparkassensystem and its legislation, the interest paid on the Bauspar-Loans is independent of the actual conditions on the mortgage markets. Generally can be said, that the spread between loan rate and interest rate paid on the savings is a minimum of 200 basis points. Given the low interest rate paid on the savings in the contractual savings for housing system, the Bauspar-Loans usually have a very attractive loan rate, far below the rate of conventional mortgages. Only during the period of very low interest rates at the end of the 1990s mortgage rates fell for a longer period below the loan rate of a Standard Bauspar-Loan (Figure 2).

3 Theory of mortgage prepayment

Following Archer/Ling/McGill (1995), the probability of mortgage termination for all reasons at time t, λ_{Tt} can be stated as:

$$l_{Tt} = l_{Dt} + (1 - l_{Dt})[l_{Mt} + (1 - l_{Mt}) l_{P.NMt}] \quad (1)$$

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[4] § 11 HBG (Mortgage Bank Act).
[5] Munsberg (1997), p. 73.

where λ_{Dt} is the probability of default at time t, λ_{Mt} is the probability of moving and terminating at time t and $\lambda_{P.NMt}$ is the probability of not moving and prepaying the mortgage at time t.[7] It should be noticed carefully, that the last term, $\lambda_{P.NMt}$, is conditional upon not moving.

Given the near zero default rate of Bauspar-Loans[8], the low mobility of German homeowners[9] and the special characteristics of Bauspar-Loans, λ_{Dt} and λ_{Mt} can be set equal to zero in the following study. The probability that a Bauspar-Loan is terminated at time t is therefore equal to the probability that the household does not move and prepays his Bauspar-Loan at time t. The reason for the prepayment of the Bauspar-Loan can either be refinancing or prepayment due to portfolio considerations.

Household wealth at time t, W_t, is given by

$$W_t = FA_t + \left(H_t - MV_t\right) \tag{2}$$

where FA_t are other financial assets at time t, H_t is the value of the house at time t and MV_t is the market value of the mortgage at time t. The market value of the mortgage MV_t is a function of the contractual loan payments, the market interest rate r_m and the remaining loan term at time t, $MV_t = MV(r_m, t)$.

Focusing only on the refinancing strategy of a household from a wealth maximizing behavior in the presence of transaction costs, TC, the following rule can be derived:[10]

$$\text{Prepay when } \frac{MV\left(r_m,t\right)}{BV\left(r_c,t\right)+TC} > 1 \tag{3}$$

where $BV(r_c, t)$ is the book value of the existing mortgage with contract rate r_c. This pure refinancing strategy means for the household minimizing the market value of the mortgage in consideration of the transaction costs.

Wealth maximizing behavior of a household may cause prepayments even if the benefits from refinancing do not exceed transaction costs. In this situations the prepayment decision is based on portfolio considerations. The prepayment of the mortgage can be viewed as an investment with a riskless return equal to the contract rate of the mortgage.

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[6] The Bauspar-Loan rate is the effective rate of a Tarif F-Standard loan by the Bausparkasse Schwäbisch Hall AG.

[7] Archer/Ling/McGill (1995), p. 6. This definition of the probability of mortgage termination at time t is consistent with a hierarchy of choices.

[8] The near zero default rate is due to fact, that by law the loan to value ratio is not allowed to exceed 80 percent and the use of the Bauspar-Loans for improvements on existing real estate.

[9] Some new research sees the rising homeownership rate in Europe (Germany) as one central part for the explanation of the high unemployment rates observed in Europe (Oswald 1996).

Suppose there are two assets. One of them pays a fixed return of r_f and the other has an expected return of r_i with standard deviation σ_i. Normally a household will invest in both assets, and the expected return of his portfolio will be the weighted average of the two expected returns. At the optimal choice of risk and return the marginal rate of substitution between risk and return must be equal to the price of risk reduction

$$MRS = -\frac{\partial U/\partial s}{\partial U/\partial r} = \frac{r_i - r_f}{s_i} \tag{4}$$

If the contract rate of the mortgage is greater than the risk free return, the price for risk reduction (right hand side of equation 4) is lowered due to an increase in the risk free return ($r_c > r_f$). A wealth maximizing household will pay of all or a part of the outstanding mortgage, depending on the amount of financial assets available to the household for investment. The prepayment of the loan not simply depends on the amount of financial assets available to the household, even more important is the structure of these financial assets (maturity, return).

The probability that a Bauspar-Loan is terminated at time t can therefor be written as

$$l_{Tt} = l_{P.NMt} = l_{P.NMt}\left(R_t, FA_t, TC, B\right) \tag{5}$$

where R_t is a vector of relevant interest rates at time t and B is a vector representing borrower characteristics that influence the prepayment decision of the household, like credit history, age, income etc. Equation (5) is the starting point for the empirical analysis in section 6.

4 Data

The data for the empirical analysis was provided by the biggest private Bausparkasse, Bausparkasse Schwäbisch Hall AG. There are observations of 56,489 savings for housing contracts closed between January 1983 and December 1989. All loans were regularly paid off or prepaid between January 1998 and September 2000. Of the 56,489 loans in the sample 23,847 loans were prepaid while the remaining 32,642 were paid off regularly.

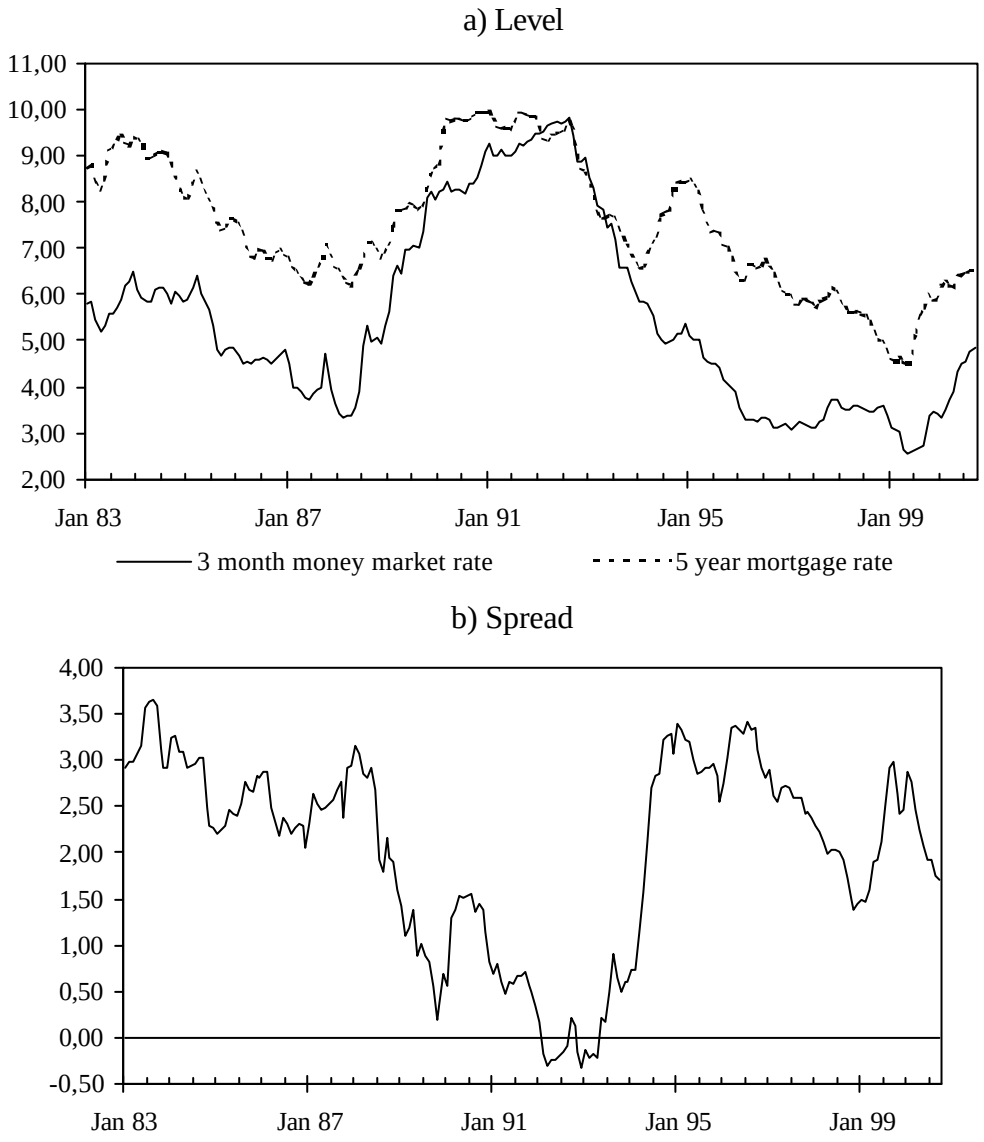
For each contract the duration of the savings and loan period is known, Smon and Dmon respectively, as well as the effective interest rate of the Bauspar-Loan (Tarif). It is known if the Bausparer at the time the Bauspar-Loan was terminated, had other savings and loan contracts in the savings period or in the loan period closed with the same Bausparkasse, Spar and Darl respectively. There are information about the monthly payments during the loan period specified in the contract, Moso, and about the relation of the actual payments to the

[10] LaCour-Little (1999), p. 47.

payments specified in the contract, Moso2 (equal to 1 if monthly payment is greater than Moso). If the minimum amount of accumulated savings necessary to obtain a Bauspar-Loan was paid at the time the loan was closed, the dummy variable Sofort is set equal to 1. Additional contract information include the size of the savings and loan contract in DM 1,000 (BS) and the initial size of the Bauspar-Loan in DM 1,000 (Darbeg).

Based on the information of the time the Bauspar-Loan is taken, the fraction (in percent) of the initial savings and loan contract, consisting of accumulated savings of the Bausparer is calculated, Anspar. Additional information about the borrower is limited to the age when he closed the savings and loan contract and the age when he obtained the loan, Age1 and Age2 respectively.

Figure 3 5 year mortgage rate and 3 month money market rate since 1983



To model the prepayment incentive two incentive measures were constructed. The first is, following Richard/Roll (1989), the coupon rate of the mortgage in relation to the current interest rate, represented by the 5 year mortgage rate (refinancing) or the risk free interest rate, represented by the 3 month money market rate (portfolio considerations), labeled prehyp1 and pre3m1 respectively. The second, like in Peristani et al. (1997), is the spread between the contract rate on the Bauspar-Loan and the prevailing market rate, labeled prehyp2 and pre3m2 respectively. The evolution of both interest rates and their spread is shown in Figure 3.

Table 1 Descriptive statistics (means)

Variable	Description	Whole Sample	Prepaid loans	Not prepaid loans
Age1	Borrower age when closing the savings and loan contract	33.95	33.19	34.50
Age2	Borrower age when obtaining the Bauspar-Loan	41.74	41.05	42.24
Spar	Number of other savings and loan contracts in savings period	0.736	0.801	0.689
Darl	Number of other savings and loan contracts in loan period	0.759	0.457	0.979
Tarif	Effective interest rate of loan	5.83	5.81	5.84
Sofort	1 if the whole savings amount was paid when closing the savings and loan contract	0.028	0.015	0.037
BS	Size of the savings and loan contract in DM 1,000	35.271	35.468	35.128
Darbeg	Initial Loan size in DM 1,000	18.541	18.398	18.646
Anspar	Accumulated Savings as percent of total contract size (BS) at the time obtaining the loan	50.02	49.87	50.13
Moso	Monthly payment in DM according to contract specifications	188.76	187.94	189.36
Moso2	1 if monthly payment of the mortgage borrower is greater than Moso	0.028	0.016	0.036
Smon	Duration of savings period in month	91.18	92.24	90.40
Dmon	Duration of loan period in month	92.92	74.69	106.24
Pre3M1	Ratio of contract rate to 3-month money market rate	0.766	0.942	0.637
Pre3M2	Spread: contract rate - 3-month money market rate	-2.586	-1.205	-3.595
PreHyp1	Ratio of contract rate to 5-year mortgage rate	0.652	0.720	0.603
PreHyp2	Spread: contract rate - 5-year mortgage rate	-3.298	-2.479	-3.897
	Number of Observations	56489	23847	32642

The prepayment incentive was calculated at the time of prepayment for loans prepaying. For the other loans the maximum of the market interest rate (5 year mortgage rate or 3 month

money market rate) during the loan period was used to calculate the incentive variable. About the prepayment incentives can be said generally, that higher values should be associated with a higher likelihood that a Bauspar-Loan is prepaid, everything else equal. Table 1 displays descriptive statistics of the data set used.

5 Methodology

At any given point in time the household has to decide if he prepays or continues his Bauspar-Loan. The household is faced with a choice between to alternatives. Therefore a binary choice model based on equation (5) is used to estimate the impact of the variables given in Table 1 on the likelihood that a Bauspar-Loan is prepaid.[11]

The dependent variable in the logit model is the decision to prepay (Vor = 1) or continue (Vor = 0) the Bauspar-Loan. The general form of the binomial logit model, used in the empirical investigation, is given by

$$\begin{aligned} \text{Prob}\left(Vor = 1\right) &= \frac{e^{b'\mathbf{x}}}{1 + e^{b'\mathbf{x}}} \\ &= \Lambda\left(\boldsymbol{b}'\mathbf{x}\right) \end{aligned} \tag{6}$$

where Λ stands for the logistic cumulative distribution function.[12] $\mathbf{x}$ is the vector of the independent variables given in Table 1 and $\boldsymbol{b}$ is the corresponding coefficient vector, indicating the impact of each independent variable on the decision of the household to prepay or continue his Bauspar-Loan.

6 Empirical findings

If portfolio considerations are the driving force for the prepayment decision of the household, the models using the 3 month money market incentive (pre3m1 and pre3m2), should give better predictions about the occurrence of prepayment. Given the results in Table 2 and Table 3, the models based on the 3 month money market rate do a significantly better job in predicting the prepayments of the Bauspar-Loans, suggesting that the main reason for prepayment are portfolio considerations of the household.

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[11] In using a binary choice model this paper follows the approach used in Archer/Ling/McGill (1995), Peristani et al. (1997) and LaCour-Little (1999).

[12] Green (1997), p. 874.

Table 2 Logit model ratio specification

	3 month money market rate		5 year mortgage rate	
Variable	Coefficient	Wald chi-square	Coefficient	Wald chi-square
Constant	-9,6677***	984,93	-10,7787***	1149,71
Incentive				
Pre3m1	5,1422***	2781,22		
Prehyp1			10,6013***	2998,20
Alter2	-0,0130***	173,86	-0,0125***	159,97
Spar	0,2499***	264,00	0,2533***	267,59
Darl	-0,3591***	813,89	-0,3620***	816,67
Sofort	0,7208***	84,56	0,8980***	126,73
BS	-0,1220***	1406,11	-0,1192***	1352,12
Darbeg	0,2389***	1562,53	0,2333***	1505,27
Moso2	-3,3323***	1770,02	-3,1006***	1605,88
Dmon	0,2154***	1821,66	0,1359***	1099,87
$Dmon^2$	-0,0015***	3050,71	-0,0011***	2297,88
Smon	0,0651***	716,52	0,0870***	1213,40
$Smon^2$	-0,0003***	468,60	-0,0004***	837,98
Anspar	-0,0692***	976,82	-0,0609***	784,89
Chi-square of model	14583,28		15335,74	
Log Likelihood	-22184,11		-22162,37	
Correctly predicted	82,62%		74,87%	
Observations	56489		56489	

Notes:
* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level.

If the prepayment of Bauspar-Loans is mainly bases on portfolio considerations, additional hypotheses about the effects of some variables in Table 1 can be stated. If the Bausparer paid the minimum amount of accumulated savings necessary to obtain a loan at the time the savings for housing contract was closed, it can be assumed that he owns more financial assets than a Bausparer not behaving in this manner. As a result, Sofort should positively affect the probability that a Bauspar-Loan is prepaid, because it is very likely that these Bausparer own more financial assets than regular saving Bausparer. In principle a longer savings period (Smon) should have a the same effect on the prepayment probability, because the Bausparer had more time to accumulate financial assets, making it more likely that portfolio considerations can play a dominant role in the prepayment decision. The same effect can be expected of additional savings for housing contracts in the savings period (Spar). All there hypotheses are supported by the empirical results in Table 2 and Table 3.

Table 3 Logit model spread specification

	3 month money market rate		5 year mortgage rate	
Variable	Coefficient	Wald chi-square	Coefficient	Wald chi-square
Constant	-3,0271***	175,61	-0,8799***	15,43
Incentive				
Pre3m2	0,7381***	4347,18		
Prehyp2			1,0982***	3992,59
Alter2	-0,0123***	147,93	-0,0122***	146,06
Spar	0,2466***	246,19	0,2498***	252,47
Darl	-0,3518***	743,78	-0,3560***	767,18
Sofort	0,8694***	116,92	0,9580***	138,96
BS	-0,1134***	1212,21	-0,1174***	1292,87
Darbeg	0,2228***	1359,98	0,2300***	1442,52
Moso2	-3,4284***	2007,17	-3,1234***	1677,18
Dmon	0,1866***	2110,88	0,1500***	1428,81
$Dmon^2$	-0,0013***	3483,29	-0,0012***	2661,10
Smon	0,0726***	847,85	0,0900***	1236,63
$Smon^2$	-0,0003***	564,58	-0,0004***	852,10
Anspar	-0,0755***	1127,59	-0,0683***	950,35
Chi-square of model	15399,04		15676,82	
Log Likelihood	-21354,92		-21545,69	
Correctly predicted	84,08%		82,75%	
Observations	56489		56489	

Notes:
* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level.

On the other hand, higher monthly payments than fixed in the savings for housing contract (Moso2 equals 1), should have a negative effect on the probability of prepayment. These households regularly exercise the prepayment option, given to them in the Bauspar-Loan. From the start of the loan period the prepayment option is included in the monthly plans of the household presumably due to portfolio considerations, therefore making it less likely that the loan will be prepaid before it is paid off with the (higher) regular payments. Other savings for housing contracts in the loan period (Darl) should have a similar effect, because financial assets of the household are tied up in these contracts, reducing the probability that the household owns enough funds to prepay the Bauspar-Loan. Like the positive portfolio effects discussed above, these negative portfolio effects are supported by the empirical results in Table 2 and Table 3.

At this point additional information about the situation of the Bausparer would be very interesting. Unfortunately the data set does not provide any information about the income of the households or the amount and structure of the financial assets owned by the households.

7 Conclusion

So far prepayment research has focused on the U.S. market and mostly on the refinancing decision of the household. This study tries to extend the prepayment research to the german market, dealing for the first time with Bauspar-Loans. Given the special nature of the Bauspar-Loans, portfolio consideration could for the first time be identified as the driving force behind the prepayment decision of a mortgage loan. The results can therefore ad to the understanding of the prepayment behavior of mortgage borrowers not only in the German Bausparkassen system. Further research should try to use additional information about the characteristics of the Bausparer and his financial assets to get a better picture of the importance portfolio aspects have in the decision to prepay a mortgage or Bauspar-Loan.

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