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Pricing Strategies and the Guidance of Depositors

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Bank Funding Stability

Pricing Strategies and the Guidance of Depositors

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Abstract: Banks face a 'behavioralization' of their balance sheets since deposit funding increasingly consists of non-maturing deposits with uncertain cash flows exposing banks to asset liability (ALM) risk. Thus, this study examines the behavior of banks' retail customers regarding non-maturing deposits. Our unique sample comprises the contract and cash flow data for 2.2 million individual contracts from 1991 to 2010. We find that contractual rewards, i.e., qualified interest payments, and government subsidies, effectively stabilize saving behavior and thus bank funding. The probability of an early deposit withdrawal decreases by approximately 40%, and cash flow volatility drops by about 25%. Our findings provide important insights for banks using pricing incentives to steer desired saving patterns for their non-maturing deposit portfolios. Finally, these results are informative regarding the bank liquidity regulations (Basel III) concerning the stability of deposits and the minimum requirements for risk management (European Commission DIRECTIVE 2006/48/EC).

JEL classification: *G01, G21, G28*

Keywords: retail saving behavior, non-maturing deposits, deposit funding, contractual rewards, interest rate bonus, saving persistence, cash flow volatility

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1 Introduction

Increasingly bank funding is based on non-maturing deposits - such as overnight deposits or deposits redeemable at notice. Especially for German banks non-maturing deposits nowadays represent the most important funding source after exhibiting a dynamic growth in the aftermath of the financial crisis of 2008. For all European banks, these deposits gain major shares in their funding portfolios, exposing banks to changing depositor behavior as depicted in Figure 1:

------ Please insert Figure 1 approximately here ------

These structural changes in deposit portfolio composition pose major challenges to banks: While deposits with agreed maturity - such as time deposits or savings bonds - are comparably easy to handle in bank management because of contractual tied saving durations, this does not hold true for non-maturing deposits: In non-maturing products depositors are both free to withdraw their deposited cash at any time or to deposit new cash on their account. Because of ex ante unknown cash flows these product characteristics demand for statistical models to estimate the behavior of depositors. The results of these models substantially affect bank management: The estimated saving duration, i.e., the time duration of deposit commitment, is used to assess a bank's degree of maturity transformation and its true mismatch position of long term assets and short term deposits. Further, an entire bank's cash flow profile depends on the estimated saving durations in non-maturing deposits to a great extent. Therefore, bank managements' key responsibilities such as asset liability management (ALM) risk are extensively affected by assumptions on non-maturing product behavior. Additionally, liquidity risk arises, if the bank has not anticipated early deposit withdrawals by self-determinedly acting depositors. This directly relates to new financial Basel III regulations requiring classification models for retail deposits being 'stable' or 'less stable' (Basel Committee, 2011).

Thus, for banks relying on deposit funding the individual, self-determined behavior of its retail customers will be most challenging, particular in the current environment of increasing non-maturing deposit volumes and the involved balance sheet 'behavioralization'. This suggests

the important question of how banks can influence and guide their depositors towards providing stable funding. In this manner, this study refers to stable deposit funding as being depositors providing funding for long time durations as well as that they save on a smooth and steady way that is not characterized by highly irregular cash flows.

Consequently, this study seeks to analyze to what extent deposit pricing incentives guide the saving behavior of a bank's retail customers. Will it be possible to obtain a different, stabilized portfolio behavior if a bank imposes pricing incentives on its depositors that still are free to move funds from one bank to another on a daily notice?

To answer these questions the study is able employ a unique and well suited dataset to analyze depositor behavior: A German bank provides full access to its database covering all contract-, cash flow- and customer information for 2.2 million individual saving contracts. We are able to obtain that data from January 1991 to December 2010. This rich dataset is most appropriate for our analysis because the data providing bank specializes in offering retail saving contracts, whose contract terms are very stable over time. This provides us with a well suited test environment to isolate pure contractual settings and assess how pricing incentives influence customer behavior.

To bring depositors to providing stable funding, the bank offers tariffs with contractual rewards for their customers.[1] First, a saving contract may be equipped with an **interest bonus** (i.e., using a pricing incentive, the customer will be rewarded if she saves for a longer time period). These 'bonus contracts' pay a basis interest and an additional qualified interest on deposited cash if the customer saves longer than four years. If depositors withdraw their money within four years, they lose their interest bonus but keep the basis interest. This contractual setting allows us to analyze whether the bank can increase the **customers' saving duration** by offering that contractual reward. If so, the key question becomes by how much can the bank increase the customers' saving persistence? Is early contract termination, on average, reduced by 10%, 20% or 30%? How much longer can the average depositor be induced to provide funds to the bank? Is this effect on customer behavior linear in the interest bonus rates that range from 0.5% to 2.5%?

[1] For details on the contractual setting and institutional background see section 3.1.

The second reward that a customer can receive is a government subsidy called Wohnungsbauprämie (**wop**). In Germany this subsidy is exclusively paid to depositors signing a saving contract like those analyzed in this study and who meet certain eligibility conditions that are determined by a German law. These conditions mainly depend on the customer's taxable income.[2] Savings up to an amount of 1024 EUR (married) or 512 EUR (single) per year are subsidized with a factor of 8.8% (i.e., a customer can receive an extra 90 EUR or 45 EUR per year, respectively). Primarily, the incentive character of this saving subsidy is similar to that of the interest bonus: The depositor loses the complete subsidy if she saves for less than seven years. In other words, if the customer draws on the deposited cash within seven years, she must repay the obtained subsidies. Thus, wop exhibits a reward characteristic similar to that of the interest bonus. The difference emerges in the required saving duration (i.e., four years for the interest bonus vs. seven years for wop).

In addition to the analysis to what extent these two pricing incentives affect the saving duration, the smoothness of the deposit cash inflows is significant to the bank. Thus, is the **volatility of the cash inflows (vola)** reduced by the qualified interest bonus and wop? Analyzing the saving duration together with the cash flow volatility will yield a comprehensive method of describing the behavior of retail customers.

Our results are as follows. First, relating to the saving duration, we predict and find that contractual rewards (i.e., qualified interest payments and government benefits) effectively stabilize deposit funding. Turning to the economic significance the probability of early deposit withdrawals decreases by 40%, and cash flow volatility decreases by 25%. More precisely, capital commitment by depositors is even extended for several years. With respect to the question of whether the reward mechanisms are substitutes or complements, our results show that for the contracts with interest bonuses *and* wop eligibility, both rewards will act as complements (i.e., increasing the probability of saving persistence and decreasing cash flow volatility). Last, this study is the first to analyze how the government subsidy wop influences customer behavior within such a comprehensive sample. Our results indicate that such a government saving benefit could improve welfare for present biased agents.

[2] See www.bausparkassen.de/uploads/mit_download/House_Building_Premium.pdf for details.

2 Related Literature

Non-maturing deposits exhibit stochastic cash flow patterns because in- and outflows may occur unforeseen attributable to the depositors' self-determined behavior. These product features motivate questions regarding deposit volume predictability, but the academic literature on deposits and depositor management is scarce.

Although there is ample evidence of macroeconomic conditions affecting interest rate pass-through and thus the manner of how banks price their retail products (e.g., Hofman and Mizen, 2004; ECB, 2009), little is known about customer reactions to price setting. Some studies observe changes in non-bank deposit volumes at the aggregated bank level (e.g., Gatev and Strahan, 2006). However, in general, these studies cannot relate deposit volume changes to individual customers.

One could suggest that the guidance of depositor behavior could be related to relationship banking. However, this strand of literature mainly focuses on corporate credits and mortgages (e.g., Degryse et al., 2009; Agarwal et al., 2010; Ongena et al., 2011).

Further, because of the major difficulties associated with observing customer reactions on the individual level, some studies analyze surveys, which address aspects, such as customer loyalty (Humphrey, 2010; Simon et al., 2010). The household finance literature considers the people's views and questions how they invest their capital (Bergstresser and Poterba, 2004; Campbell, 2006; Calvet et al., 2007). In contrast, our study takes the bank's perspective and analyzes how a bank can influence the behavior of its own customers, regardless of what other investments they undertake.

With respect to the impact of government subsidies Engelhardt (1996) documents the effects of government subsidization on saving activity in Canada. Only two studies have been conducted on the German government subsidy **wop**. Börsch-Supan and Stahl (1991) and Rotfuß and Westerheide (2010) analyze the consequences of the subsidy from a political economics perspective. Both studies take advantage of cross-sectional data provided by the Federal Bureau of Statistics. The researchers find that no crowding out effects emerge if the German government exclusively subsidizes certain contract types. However, whether the wop subsidy guides behavior during the lifetime of a saving contract could not be determined.

In sum, to the best of our knowledge, no study has been able to analyze contract designs that reward a special saving behavior though being commonly offered by many banks.[3] Put differently, this is the first study that evaluates the cash flow patterns of individual depositors together with all contract information and a variety of customer characteristics for an entire bank.

3 Institutional Background and Data

3.1 Institutional background

Our dataset is obtained from a large bank in Germany whose business objective is to accept saving deposits from retail customers and to grant loans to customers mainly for housing finance activities ('Bausparkasse'). In Germany, 23 specialist credit institutions are authorized to conduct this type of business.[4] Although this number may initially appear restrictive, it is important to know that this type of savings product is offered in almost every bank branch in Germany. The product is commonly available because the specialist credit institutions cooperate with banks or are owned by banking groups and use their distribution networks (e.g., 'BHW' is owned by Deutsche Bank, the ten 'LBS' building associations belong to approximately 400 savings and loans associations, 'Schwäbisch Hall' belongs to the 1,300 cooperative banks). Therefore, a contract with a building association is commonly offered if customers contact their bank and ask for savings products. In fact, these deposit products are popular among German retail depositors: On average, one-third of all Germans have a contract with a building association.[5] Furthermore, approximately 9% (i.e., 140 bn. EUR) of all German retail deposits are held by the building associations.[6] In Germany, the total contract sum is approximately 763 bn. EUR or roughly 30% of the gross domestic product.[7] Thus, our analysis produces general insights into a popular, widespread retail customer product.

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3 See, e.g., CreditSuisse (2012), Commerzbank (2012), UniCredit (2012), Haspa (2012).

4 See, e.g., www.bausparkassen.de

5 In 2010, there are 30 million individual contracts, as shown in the annual report of the industry association for 2010 on p. 83, which is available at http://www.bausparkassen.de/fileadmin/user_upload/VPB_GB_2010.pdf.

6 See monthly reports at www.bundesbank.de. All statistics are as of December 2010.

7 See www.bausparkassen.de/fileadmin/user_upload/english/The_Bauspar_System_in_Germany.pdf

It will be necessary to give a short introduction to the German building association system with its specialties but first of all its commonalities with typical banking products for retail customers (see also Börsch-Supan and Stahl, 1991; Scholten, 2000).[8] Customers can always withdraw their capital and are completely free in saving decisions such that the analyzed contracts represent non-maturing deposits. Typically, a saving contract is closed on a contract volume. If the sum of the deposited cash reaches 40% of the contract volume, the customer will be eligible to obtain a loan with pre-specified conditions on the remaining 60% of the contract volume. If the customer does not take a loan, she can continue saving. Although this combination of a saving contract together with a mortgage option initially appears to be special, a very large proportion of all German retail customers saves money on such saving contracts and does not take loans. Instead the banks invest free deposits in other assets such as bonds. The specialty of this product is that during the contract's lifetime, the contractual conditions do not vary (i.e., the deposit interest and future loan rates are fixed at the start of the contract).

To facilitate homebuilding and private savings after the Second World War, the German government introduced the subsidy wop in 1952.[9] This upper-bounded subsidy is exclusively paid to the customers of Bausparkassen who save a minimum amount per year and meet certain eligibility conditions that are mainly based on the customer's income. The customer loses her subsidy if deposits are withdrawn during the first seven years. Because only retail savers of building associations can obtain the subsidy and because the banks promote their product by highlighting the greater return attributable to the government grant, we refer to wop as a contractual reward for the analyzed contracts.

3.2 Sample description

The main sample consists of information regarding 2,182,743 contracts with available cash flow data during the 20-year period from 1991 to 2010. Because customers can save on a monthly or yearly basis, we obtain annual data yielding approximately 14 million contract-year observations. We limit our analysis to retail customers.[10] Additionally, the contracts must

[8] See also the description of the German building association system available at www.bausparkassen.de/index.php?id=90

[9] See the law entitled "Bausparkassen Act" available at http://www.bausparkassen.de/fileadmin/user_upload/english/Bausparkassen_Act.pdf

[10] We omit 328,080 contracts that are negotiated with other banks, corporate clients or government authorities.

not have already existed when our data coverage begins in 1991. During the two decades, the bank offers approximately 40 different tariffs of which we obtain all information for each contract (e.g., the contract type, pay scale, volume, offered deposit interest rates, offered interest bonus rates). We also obtain the complete, disaggregated cash flow information during each contract's lifetime (e.g., single cash flow time series for inflows, outflows, basic interest or interest bonus payments for each contract). Thus, we can observe the amount of saved money, the start and end times of the contract and the specific saving patterns. We also gather the information whether the customer is eligible for the government saving subsidy wop.[11]

Turning to the descriptive statistics the sum of all contract volumes exceeds 35 bn. EUR, where the average contract has a volume of 16,138 EUR, as shown in Table 1, Panel A. Furthermore, the average customer deposits 5,027 EUR. Thus, the complete deposit sum exceeds 11 bn. EUR during the twenty years of observation. Only 16% of all customers take a loan with an average amount of 7,843 EUR. Regarding the reward distribution among the contracts, we find that 20% are equipped with interest bonuses, which range from 0.5% to 2.5% depending on the tariff and 36% of all contracts are wop eligible. Panel B of Table 1 presents the contract volume classes, the corresponding frequencies of the rewards within the contract volumes and their average values as well as the customer occupations and age classes.

We analyze our samples' representativeness regarding the overall industry statistics and ensure that our results are not driven by any particular characteristics of the bank that provided us with the data.[12]

Finally, we add macroeconomic data, which is obtained from the German central bank (Deutsche Bundesbank) and from the Federal Statistical Offices. We use these data as a set of

[11] In addition to the government subsidy wop, employers commonly pay an additional employee savings allowance (Vermögenswirksame Leistungen) denoted as "VL" to their employees. This benefit does not bind the customer to the saving contracts analyzed in this study. Put differently, the employee is entitled to this allowance if she invests in, for example, certain equity funds. The customer is free to switch and keep the VL on her own. Thus, we do not refer to VL as a contractual reward, but we do control for VL in our regressions. For additional information on this topic, see http://www.bausparkassen.de/uploads/mit_download/Arbeitnehmer_Sparzulage_En.pdf. All results are qualitatively similar if we drop all contracts with VL payments.

[12] General market reports provided by the Deutsche Bundesbank as well as the annual reports (only available in German) produced by the Association of Private Bausparkassen indicate that our sample seems not to be impaired in any particular way. Results are not tabulated but available upon request.

control variables that capture the market interest levels for deposits and loans, the GDP or the average stock index during the contract's lifetime.

------ Please insert Table 1 approximately here ------

Regarding the main variables of interest (i.e., saving duration and cash flow volatility), the descriptive statistics suggest that rewards may have a great impact as summarized in Table 2. Panel A of Table 2 presents the average saving duration: 32% of all contracts are terminated within four years, and 59% of all contracts are terminated within seven years, which highlights that early termination is rather common. Further, by comparing the durations of the contracts that are entitled to rewards, we observe that the average duration seems to be significantly extended by approximately two years if interest bonuses are offered (6.71 vs. 4.88) and by approximately four years if the contract is wop eligible (8.91 vs. 4.88).

------ Please insert Table 2 approximately here ------

Panel B of Table 2 shows that cash flow volatility is significantly reduced by both rewards (0.10 vs. 0.15 for interest bonus and 0.08 vs. 0.16 for wop). First conjectures regarding the impact of rewards can also be drawn from Panel A of Figure 2, which presents histograms on the saving durations for the contracts without any rewards, for those with interest bonuses and for the contracts with wop eligibility. Each type of reward seems to lengthen the duration of customer saving. Panel B presents the estimated distribution of vola for the contracts with and without interest bonuses (left column) as well as for the contracts with and without wop (right column). Both rewards seem to decrease vola, as the distributions are skewed towards zero.

------ Please insert Figure 2 approximately here ------

4 Econometric Analysis

4.1 Hypotheses Development

If customers terminate the contract early during the first four years, the interest bonus is lost and thus the contract's return will be reduced. Furthermore, approximately 36% of all contracts are wop eligible. This government subsidy will be lost if the customer draws on her deposited cash within the first seven years of saving. Because early contract termination is sanctioned, we expect contracts with interest bonus or wop subsidies to be less likely having saving durations of less than four years if interest bonuses are offered or less than seven years if the contract has wop eligibility.

To provide an idea of the economic effects of early contract termination, the table below presents four exemplary contracts highlighting the possible losses or gains due to rewards. Because of an early contract termination, the first contract loses the complete interest bonus sum of 1,006 EUR whereas the third contract loses 279 EUR of the wop:

case	contract event	saving duration (years)		required duration for reward (years)	sum of cash-in-flows (€)	basis interest (%)	sum of basis interest (€)	interest bonus rate (%)	sum of interest bonus (€)	sum of wop (€)
1	loses bonus	**3**	<	4	20,000	2	1,006	2	**1,006**	0
2	keeps bonus	5	>	4	15,430	2	1,302	2	1,302	0
3	loses wop	**6**	<	7	10,054	2	532	0	0	**279**
4	keeps wop	8	>	7	9,154	2	650	0	0	328

Several studies find that retail customers behave in a sticky manner or are much less informed than corporate customers such that retail customers exhibit suboptimal behavior (e.g., Calem and Mester, 1995; Kahn et al., 1999). However, we expect reward mechanisms to influence the behavior of bank customers. Therefore, our first hypothesis emphasizes saving persistence:

H1: *Tariffs with interest bonus or the government subsidy wop statistically and economically increase saving duration and thus decrease the probability of early contract termination.*

Notice that we first seek to document a relationship, but secondly we mainly explore the economic significance of positively guided portfolio behavior. In other words, are contractual rewards powerful enough to change and influence customer behavior to a large extent? Do the

contractual rewards affect the structure of the banks' deposit funding? The answers to these questions are not obvious because customer behavior may be sticky. Specifically, at the time that a depositor signs the contract, she could also arrange automatic (e.g., monthly) money transfer orders that are normally not revisited because liquidity flexibility may be ensured via other channels. Conversely, when a 'normal' household is confronted with bigger capital needs, customers may quickly remember that they have saved a significant amount in this product.

Regarding the relative importance of both contractual reward mechanisms, the following interesting question emerges. Consider the case of different contract volumes. Because the interest bonus is defined as a percentage of deposited cash, the perceived 'bonus clause's value' should remain stable (i.e., regardless of how much money the customer invests she will always lose 'x'-percent of the invested capital if she terminates the contract too early). However, wop is an upper-bounded contractual reward. Therefore, the subsidy's perceived value should be decreasing in absolute contract volume. Put differently, because the retail customer gains a fixed absolute amount, the additional return on the contract assigned to the wop reward decreases in deposit volume. Since low-volume contracts can generate high returns with a wop reward, we predict that the wop impact will be high on lowering the probability of early contract termination for this particular class. For high-volume contracts, the perceived importance of a possible wop reward loss will have less value than the perceived loss of the interest bonus, which will add up to a much greater absolute amount than wop. Comparing the average amounts of interest bonuses and wop for various contract volume classes, we find that the value of the interest bonuses exceeds the value of wop, on average, for the contract volumes higher than 20,000 EUR (see Table 1, Panel B). Therefore, we predict that with an increasing contract volume, the perceived risk of losing interest bonuses outweighs the perceived loss of wop-saving rewards. Thus, we assume that the following holds true:

H2: *While the impact of the interest bonus on saving persistence is stable (i.e., independent of the contract volume), the impact of wop decreases as the contract volume increases such that the relative importance of the two rewards flips at a certain critical contract volume.*

Thus far, we have been silent on the second dimension of saving behavior (i.e., the volatility of retail deposit inflows for the bank). One might suggest that customers save on a regular basis for this type of saving product and use, for instance, automatic debit transfer systems that lead to even cash flows in every period. However, practically we observe that cash flows vary for most contracts during the saving period (i.e., approximately 75% of all contracts are subject to cash flow variations). Whether and how contractual features reduce funding volatility has yet to be determined. During the twenty year period of observation, the aggregate interest on our observed contracts has been, on average, market competitive if the contract is equipped with interest bonus clauses. For descriptive statistics on this feature, we sum the basis interest rate and, if offered, the additional interest bonus rate, and we compare this value to a market-wide savings bonds rate with a duration of one year. Although the returns of our savings contracts fall short compared with the returns of the market-wide savings bonds during the first year of the contract, the average return of our contracts with interest bonuses exceeds the market-wide interest rate during the subsequent years.[13] Although exemplary, this result shows that, on average, the attractiveness of our saving contracts grew after the contract has been signed because the contract locked in a stable interest rate. Therefore, we hypothesize that cash inflows to the contracts with interest bonuses should be smoother because these contracts offer more attractive returns that are comparable with market-wide deposit facilities. Further, as a customer is requested to save a minimum amount of 1024 EUR (married) or 512 EUR (single) per year to receive the maximum possible government subsidy (8.8% of these savings), we argue that a customer saves more and more stable than a customer who is not eligible for wop. Therefore, we hypothesize the following:

H3: *Both interest bonuses and wop eligibility lead to smoother and less volatile cash flows.*

Of further interest will be the interplay between the two reward mechanisms. Are wop and interest bonuses substitutes or complements? On the one hand, because wop sanctions a contract termination within seven years, one could expect an additional interest bonus, which sanctions a termination within four years, to not affect customer behavior given that wop already

[13] In the underwriting year, the basis interest falls short by 1.5% in comparison with the market rate, whereas an interest bonus contract falls short by 0.4%. During the contract's lifetime, the interest bonus contract returns exceeded, on average, the return on the savings bond by 0.2%, whereas the sole basis interest still falls short, on average, of the market-wide interest.

exhibits a strong effect. On the other hand, because both rewards work additively (i.e., increase the absolute amount of cash available to the retail customer), we expect the two incentives to act as complements.

H4: *For contracts with interest bonus features and wop eligibility, wop and the interest bonus will act as complements and thus increase the probability of saving persistence while decreasing cash flow volatility.*

In addition to the statistical significance the economic significance will be of major interest. This hypothesis directly relates to the bank's pricing behavior: Is it worth to offer a second, costly incentive for the customer or does the first reward already induce a changed customer behavior and the second does not alter the behavior any further? The question will be, whether and to what extent a combination of rewards influences the bank customers.

Finally, referring to the absolute value of the interest bonus defined in percentage points, we expect to find that the higher the interest bonus is, the greater the impact on saving behavior.

H5: *The higher the interest bonus is, the higher the probability of saving persistence and the lower the cash flow volatility.*

This last hypothesis relates to the question of the optimal reward pricing and thus provides insights into the bank's optimal pricing policies. If the customer terminates her saving contract too early she loses 'x'-percent of her invested capital. The higher the interest bonus, the higher should be the incentive to not terminate early. However, the bank would face a tradeoff between the stabilization of its funding structure and increasing interest expenses. Thus, it will be essential from a bank-wide management perspective whether saturation levels in interest bonus values are observable (i.e., is there an optimal level for this reward?).

4.2 Estimation strategy and addressing endogeneity

4.2.1 Overall estimation approach

To analyze saving persistence, we must define the point in time of a saving termination. After the contract has begun and the customer starts to save, we will refer to a contract as terminated if the following holds true: the customer has stopped saving and she draws on her deposited cash; and the customer does not switch the contract terms. While the first two conditions are

easily understood, we must explain the last one. Customers are allowed to change their contract terms (e.g., raise the agreed contract volume). In this case, the bank will assign a new identification number to that contract. Although the amount of deposited cash will not change for the bank, the bank treats the old contract as completed and labels the changed contract as new business. It is not possible to match these closed and newly introduced contracts. Therefore, we exclude all contracts that end or start because of contract amendments.[14] The time span from the contract's beginning until its termination will be regarded as the contract's saving duration.

The saving duration is of key interest for our analysis. To examine how the reward mechanisms impact the saving duration, we will first employ ordinary least squares (OLS) to control whether a main effect of interest bonuses and wop exists. By doing so, we determine whether the customer saves longer if contractual rewards are offered, and if so, by how much longer the customer saves for. We use indicator variables for the contractual rewards, which are equal to one if the customer receives interest bonuses or the government subsidy wop during the contract's duration.[15]

Whether the customer saves for more than four years or seven years is important for keeping the interest bonus and wop, respectively. Thus, in addition to OLS we employ logit models coding the dependent variable as 'one' if the customer terminates her contract early and 'zero' otherwise. The economic significance of our results will be shown by the average marginal effects for the independent variable, displaying the change in probability of an early contract termination. We then employ interaction effects to analyze the impact of rewards on saving behavior for various contract volumes and calculate marginal effects that are in line with Ai and Norton (2003) and Karaca-Mandic et al. (2012).

The second dependent variable is cash flow volatility (vola), depicting whether the customer provides funding on a smooth, regular, or volatile and irregular basis. For each contract, we calculate vola as the standard deviation of cash inflows normalized by the total cash inflows of that contract:

[14] In total, 210,950 contracts are dropped.

[15] We do not employ the actual EUR amount of interest bonus or wop. Because both rewards become larger as the saving duration increases, duration and EUR values will be highly correlated, and the results would be misleading.

$$vola_i = \frac{sd(cash\ inflows_i)}{\sum cash\ inflows_i}$$

where i refers to the number of each contract. Therefore, we establish comparability of saving patterns across contracts with different volumes because vola will be bounded between 0 (i.e., smooth, regular saving) and 1 (i.e., highly irregular saving).

The analysis of vola is based on OLS regressions. In addition, we use quantile regressions to show the impact of our independent variables on the 10%, 50% and 90% quantiles of the vola distribution. We perform these estimates because the bank and regulators may be interested in other parts of the distribution rather than the conditional mean, as it is the case for OLS. In particular, banks and regulators may be interested if the extreme volatility of cash flows is significantly reduced by interest bonuses and if wop helps in these aspects of the distribution.

The estimated models detect contract, customer-specific and macroeconomic information and are structured as follows:

$$\begin{aligned} dependent\ variable_i = {} & \alpha + \beta_1 interest\ bonus + \beta_2 wop \\ & + \sum_c \theta_c \cdot other\ contract\ characteristics \\ & + \sum_d \gamma_d \cdot customer\ characteristics \\ & + \sum_e \eta_e \cdot market\ characteristics + \varepsilon_i \end{aligned}$$

where the dependent variable of OLS models is either '$saving\ duration_i$' measured in years or vola. If logit models are estimated, the dependent variable is equal to zero if the contract duration is greater than the duration required to obtain the reward and one if the reward requirements are violated as a consequence of an early contract termination. '$interest\ bonus$' and 'wop' are the indicator variables described in the previous section. i is the contract number, and ε_i is the error term. We employ the following '$other\ contract\ characteristics$': indicator variables for the contract volume (eight volume buckets)[16], the offered deposit interest, the demanded but fixed loan interest relevant to the execution of the loan option, the recommended saving rate, and the contractual group (i.e., the return-optimized contract or the

[16] See Table 1 for the employed volume classes. The results are robust to a variation of classes.

mortgage-optimized contract). Return-optimized contracts are contract tariffs that exhibit different advertisements for their offered saving return. Last, the contract informs each customer about the shortest possible saving time before she may obtain a loan. We include this contractual feature as a control variable. In addition to these contract variables, saving behavior is influenced by customer characteristics: Therefore, we take advantage of the following characteristics in the main analysis: the customer's age at the start of the contract and her occupation.[17] Saving behavior is related to age because young people are not likely to have the same needs and saving behavior as middle-aged or elderly people (Ando and Modigliani, 1963). Second, the customer's occupation is collected by the bank and categorized into nine classes. Because the customer's occupation is linked to her savings capability and lifestyle, we expect the occupation to have a strong influence on saving persistence. We also control whether the customer has taken a loan after stopping her saving efforts. Finally, we include an indicator variable that detects whether the customer receives employer-based VL. These three variables are good proxies for income and allow us to focus on our main variables (i.e., interest bonus and wop).

We employ market data to control for the general macroeconomic environment during the contract's lifetime. Because most contracts are active for several years, it is essential to control for the interest level of the deposits and for the mortgage loan rates. We use the EURIBOR with three months' duration and a ten-year mortgage rate for the high-quality lenders. Further, we take advantage of the German DAX stock index as a proxy for competing non-bank investment opportunities. The GDP controls for the general state of the economy during the saving period.[18]

4.2.2 Addressing endogeneity

However, the above described approach might yield biased estimates because each customer chooses whether she signs a bonus contract or not. In particular, the main effect of an interest

[17] The robustness section (see section 6) provides evidence on additional customer characteristics such as gender for a subset of our main dataset.

[18] Publically available market-wide data is from Deutsche Bundesbank and the Federal Statistical Bureaus. Because the contracts may be terminated during the financial crises of 2003, 2008 or 2009 and thus impaired by uncommon market conditions, we include an indicator depicting contract termination during these years.

bonus (i.e., increasing saving persistence) would then be due to an unobservable self-selection effect of the customers leading to endogeneity concerns. In order to address endogeneity due to self-selection we follow the econometrics literature and employ the following three techniques 1) panel fixed effects estimators[19] 2) nearest-neighbor matching[20] and 3) recently developed instrumental variable estimators, which (amongst others) explore heteroskedasticity for identification[21].

All these three techniques are suitable to deal with the endogeneity issue. This is particularly valid if one wants to estimate the average treatment effect of a key variable -in our case the variable "interest bonus".

Turning to the first technique -panel fixed effects estimators- the bank provides additional information on the customer's identity for 1,503,738 contracts[22]. Thus, we identify 1,097,022 individual customers and can observe whether they have closed more than one contract from 1991 to 2010. We find that 19.28% have negotiated at least one other contract with the bank during the time frame of our study (max. 10 contracts per customer). By using customer fixed effects to control for unobserved customer heterogeneity, we can at least mitigate possible concerns regarding endogeneity (Li and Prabhala, 2007, Roberts and Whited, 2012).
However, on the other hand, controlling for unobserved customer heterogeneities using panel data with fixed effects requires customers to sign more than one contract with the bank. This requirement itself could produce a possible selection bias towards a certain product affirmative customer group.
Therefore, we also address the concern of endogeneity due to possible self-selection bias by using -secondly- various matching methods in which the group with interest bonus contracts serves as the 'treated' group and all other 'untreated' contracts do not have an interest bonus clause. The aim of this statistical method is to provide an unbiased estimation of the treatment effects, i.e., in our case, an unbiased effect of qualified interest payments on customer behavior (see Li and Prabhala, 2007; Autore et al., 2009; Wu, 2010; Wooldridge, 2010; Lu et al., 2012;

[19] See, e.g., Li and Prabhala (2007), chapter 4; Roberts and Whited (2012), chapter 5; Wooldridge (2010), chapter 21.
[20] See, e.g., Li and Prabhala (2007), chapter 5; Roberts and Whited (2012), chapter 6; Wooldridge (2010), chapter 21.
[21] See Millimet and Tchernis (2013) and Lewbel (2012).
[22] The identification is strictly anonymous (i.e., we do not obtain the customer names). It is not possible to obtain the identification information for all 2.2 million contracts.

Roberts and Whited, 2012). While we perform a variety of matching procedures (propensity score matching, nearest neighbor matching using Mahalanobis distance amongst others) on the complete sample of approximately 2.2 million contracts, we present nearest neighbor matching with one treated contract matched to at least three untreated ('1:3') contracts[23].

Thirdly, besides the above mentioned techniques we address endogeneity using the recent approach suggested by Millimet and Tchernis (2013) and Lewbel (2012). Millimet and Tchernis (2013, p. 982) nicely summarize the problems as follows "*However, when subjects self-select into the treatment group on the basis of attributes unobserved by the researcher, but correlated with the outcome of interest, the estimation of causal effects becomes difficult. The typical strategy is to rely on an instrumental variable (IV). However, a valid instrument is often unavailable. Moreover, even if one is available, it may identify an economically uninteresting parameter in the presence of heterogeneous treatment effects (Imbens and Angrist, 1994)*".

Thus, we follow Millimet and Tchernis (2013) and report a battery of estimators that do not rely on an exclusion restriction for identification in the main Table 3. Being precise, we use the following estimators as implemented in Millimet and Tchernis (2013): (1) Klein-Vella Instrumental Variable Estimator (KV), (2) Control function approach (CF), (3) Bivariate Normal Estimator (BVN), (4) Minimum Biased Estimator (MB), (5) Minimum Bias - Bias Corrected Estimator (MB-BC). In addition, we (6) employ the recent instrumental variable estimator by Lewbel (2012). This estimator is essentially an extension of the Klein-Vella Instrumental Variable Estimator mentioned above and also explores heteroskedasticity for identification. The results in the next section will show that the battery of these estimators will all yield qualitatively the same outcome.

[23] In a battery of robustness checks we employed other matching estimators, which yield qualitatively unchanged results and are available upon request. Carefully note, that we implement all matching estimates using Stata 13 "teffects" commands, because these procedures incorporate consistent standard-error estimators derived by Abadie and Imbens (2006, 2008, 2011, 2012).

5 Main Results

The models presented in Table 3 analyze the depositors' **saving duration** and the **cash flow volatility** being guided by contractual rewards:

------ Please insert Table 3 approximately here ------

First, turning to the analysis of **saving duration**, Table 3, Panel A, model (1) shows that interest bonuses have a significant positive impact on saving duration and that wop helps increasing it. Thus, the model generates the first evidence in support of hypothesis 1. The model provides a good model fit, as shown by the adjusted R-squared (adj. R^2) of 0.45. Apart from interest bonuses, the basis deposit rate positively influences saving duration. The customer characteristics add important information: For example, the effects on duration differ among the different age classes and among the different occupations. Model (2) shows results based on the panel methodology using customer fixed effects estimations explained in section 4.2.2. again confirming the OLS results.

Next, we turn to our second outcome variable, i.e., **cash flow volatility** as exhibited in Table 3, Panel A, models (3) and (4). Please note that regarding the market variables, we also control for the average volatility of market deposit rates during the contract's duration to detect the variation of competing deposit products. Furthermore, the data sample is slightly smaller than the one used in the analysis of saving duration because cash flow volatility requires cash inflows to appear several times.

Model (3) of Table 3 presents OLS results and shows that both interest bonus and wop negatively impact vola and smoothen cash flows for the bank. The effect of interest bonuses clearly outperforms the effect of wop (coefficient estimate of -0.237 vs. -0.054). A higher unconditional basic deposit rate lowers vola as well. This finding is as suggested (i.e., the higher the guaranteed deposit rate is, the more attractive the product is and the more competitive it is against other market products). With respect to customer characteristics, significant differences emerge, but these differences are economically small. The market-wide control variables exhibit a strong impact on vola such that the higher the competing deposit market rates are, the

higher the vola of cash flows. This finding could be due to a market environment in which more attractive deposit products compete with the possible savings in our observed contract. However, a high market deposit rate volatility seems to lead to more stable cash inflows to the observed contracts. It seems that in times of market stress and unsteadiness, the customer appreciates the offer of guaranteed interest on our contracts. Overall, the same pattern is observed for the fixed effects estimate in model (4) lending support to hypothesis 3.

While the panel fixed effects estimates [model (2) and model (4)] already provide assuring evidence that endogeneity is not biasing the results, additional confirming evidence is provided in Table 3, Panel B. In particular all seven estimators dealing with endogeneity described above show strong and significant support regarding that contractual rewards significantly increase a customer's saving duration (as predicted by hypothesis 1) and decreases cash volatility (as indicated by hypothesis 3).

However, from the bank’s perspective, it is important if the customer saves for more than four years or even seven years. Turning to the logit models in Table 4, we first present **the impact of interest bonuses** (i.e., we classify the contracts according to a contract lifetime of more or less than four years). Because failure (i.e., loss of the interest bonus) is coded as one, we expect to observe a negative coefficient of the interest bonus. We estimate four models. The first model presents the main effect of the interest bonus, the second model interacts the interest bonuses with the contract volume classes, the third model is estimated on all of the contracts that do not receive wop, and the last model presents the effects of interest bonuses and wop on the volume classes.

Model (1) of Table 4 clearly indicates that a saving duration of less than four years is less likely if an interest bonus is offered (interest bonus coefficient -2.53). Apart from the statistical significance, the economic impact is of special importance. We address this topic by estimating average marginal effects, which display the change in probability of early contract termination if an interest bonus is offered. Incorporating interest bonuses reduces early termination probability by 30%, thus supporting hypothesis 1 again.

------ Please insert Table 4 approximately here ------

Further, with respect to customer characteristics, we find that their inclusion is informative but impacts are predictable. For example, in comparison to blue-collar workers, the probability of short saving is 6% higher for self-employed people and lower for doctors. According to model (2) of Table 4, we find that the impact of interest bonuses does not differ among different contract volumes (i.e., the marginal effects ranging between -22% to -31% do not differ statistically significantly performing between coefficient tests). To better examine the relationship between interest bonuses and contract volume, we plot the evolution of the interest bonus impact across different volume classes. The first column of Panel A, Figure 3, displays the average marginal effects of an interest bonus across the different contract volume classes. The change in probability of early contract termination is presented on the y-axis. The results suggest that the impact of interest bonuses reduces the probability of early contract termination by approximately 30% and that this impact is stable for various contract volumes. Therefore, regarding the interest bonus, we find strong support for the first of hypothesis 2.

------ Please insert Figure 3 approximately here ------

Model (3) of Table 4 establishes a pure interest reward effect on bank customer behavior by suppressing all of the contracts that are eligible for wop. Thus, the behavior is not distorted by any subsidization effects. The effect of interest bonuses on the probability of early contract termination increases in this setting up to a change in probability of -42%. Thus, our first findings are underlined (i.e., the qualified interest reward guides the behavior of the bank's retail portfolio to a large extent). Overall, these findings may help banks to understand how deposit funding may be effectively stabilized via pricing incentives and thus how asset liability management (ALM) risks may be lowered.

Because a saving duration of less than four years is not only sanctioned by the interest bonus but also by wop, we also estimate the model using interaction effects for both interest bonuses and wop with volume classes. The results of model (4) in Table 4 are presented graphically in Panel B of Figure 3. It is worth noting that the effect of wop on the probability of early contract termination dominates the interest bonus effect in almost all of the contract volume classes.

This ex ante, unanticipated finding is especially interesting because a loss in the interest bonus for the high-volume contracts leads, on average, to a larger absolute loss than the loss of the wop subsidy.[24] Thus, we find that the interest bonus effect is dominated by the wop effect even if the value of the interest bonus exceeds the received wop.

We now conduct a comprehensive analysis of the **government subsidization wop** (i.e., we classify the contract as a failure if its duration is less than seven years). This allows us to analyze, whether the government saving subsidy may improve the welfare of the present biased agents because their consumption allocation is guided toward the future such that the customer saves more (Thaler, 1981; Green et al., 1994; Casari, 2009). Because the customer will be allowed to keep wop if she saves for a longer period of time, we expect negative coefficients of wop in the logit models.

Model (1) of Table 5 presents a marginal effect of -38% if the contract is wop eligible. That is, the probability of a contract termination within seven years is reduced by 38% if wop is received. Consistent with the interest bonus, wop influences customer behavior to a great degree (i.e., we find strong evidence consistent with hypothesis 1 for both the wop and the bonus). Model (3) of Table 5 presents the results for the wop effects on the contracts that do not have an interest bonus clause. Again, the effect of wop is highly economically significant.

The second model interacts wop with the contract volume classes. The results indicate that the wop effect clearly differs across the contract volumes. For the contracts between 10,000 EUR and 30,000 EUR, the wop effect is clearly larger than for all of the other volumes. This effect is graphically presented in column 2 of Panel A, Figure 3. The impact can be described as a strict convex, U-shaped function. Regarding hypothesis 2, we do not find a strictly decreasing impact of wop on saving duration in increasing contract volumes. The customers signing contract volumes between 10,000 EUR and 30,000 EUR are more strongly induced to save for longer periods of time than those with smaller contract volumes. However, although the realized returns due to wop are greater for smaller saving amounts[25], wop reduces the probability of early termination by approximately 25% even for the lowest volume class. For contracts of

[24] Up to a contract volume of 20,000 € (contract volume class no. 4), the average wop amount per contract is larger than the received interest bonuses. For all higher contract volumes, the average interest bonus is more valuable than the wop. See also the discussion in section 3. Institutional Background and Data.

[25] Recall the absolute upper-bounded value for wop subsidization.

30,000 EUR and more, the wop effect decreases as suggested but remains significantly negative. Put differently, wop exhibits strongly varying effects on saving behavior depending on the contract volumes chosen by people. From the bank management perspective these results may provide the basis to form customer groups exhibiting similar saving patterns. Thus, the generated insights contribute to topics, such as customer segmentation and customer relationship management. In addition, these results point to Krusell et al.'s (2010) theoretical predictions that a negative tax (i.e., a subsidy) can improve an individual's welfare.

------ Please insert Table 5 approximately here ------

We have yet to **analyze cash flow volatility in more detail**. Apart from the duration of saving, the smoothness of cash inflows is the second dimension of customer behavior considered in this study. To analyze vola, recall that we established in Table 3 that vola is significantly reduced by interest bonus contracts and wop contracts.

Apart from OLS, which estimates the conditional mean of vola, the estimation of certain quantiles of vola's distribution is of interest for banks. In other words, we estimate the quantile regressions for the 10% and 90% quantiles to analyze how the control variables affect the cash flow vola in extreme cases and report the results in Table 6. We take advantage of the robust quantile regressions, as noted by Angrist et al. (2006), Chamberlain (1994) and Powell (1984).

------ Please insert Table 6 approximately here ------

We find that the interest bonus in all of the quantiles effectively lowers cash flow volatility. This effect is most pronounced in the 90% quantile, where the point estimate of the interest bonus is -0.271 and much higher than in the 10% quantile (coefficient estimate -0.043). Thus, we provide support for hypothesis 3 by finding that both the interest bonus and wop lower the variability of cash inflows to the bank.

Summarizing the overall results in this section so far, we find that both pricing incentives can guide retail behavior. That is, the rewards stabilize the behavior by helping to generate longer saving durations and smoother cash flows. Regarding the newly proposed financial regulations (Basel III), the rewards offer opportunities to strengthen the quality of a bank's deposit funding. In the case of interest bonuses, the results can be transferred to other banking products that offer similar interest payment structures.

With respect to hypothesis 4, research, policymakers and bank practitioners are interested in the **additivity of both reward mechanisms**. Thus, does an interest bonus impact customer behavior if the contract is already wop eligible? If so, how large will the effect attributable to the second offered reward be? These considerations will be of capital importance if the bank designs contract tariffs and contractual features.

For saving persistence, the main results suggest that wop eligibility has a strong impact. Assuming that the customers who receive wop are actually compelled to save for more than seven years, an additional measurable effect of the interest bonus remains unclear. Because wop defines the stricter condition (i.e., the customer is required to save for at least seven years), we estimate the change in probability of early contract termination if the wop eligible contracts are equipped with an additional interest bonus clause.

------ Please insert Table 7 approximately here ------

As shown in model (1) of Table 7, we find that contracts equipped with both rewards exhibit the strongest effect on extended saving duration supporting hypothesis 4 (OLS coefficient estimate 5.27). Thus, depositors being guided by multiple rewards possess a saving behavior that strictly differs from the behavior of non-rewarded customers. Supported by the logit model (2) of Table 7 it becomes obvious that the interest bonus reduces the probability of early contract termination by another 16% during the first four years of saving. That is, the two rewards are not substitutes but complements. The impact of the two rewards seems to be sub additive on the duration of saving. Model (3) of Table 7 estimates the effects of additivity on cash flow vola and finds that vola is mostly reduced by the introduction of the interest bonus (coefficient

estimate of -0.10). However, the introduction of wop yields the same impact on vola regardless of whether the contract has an interest bonus. For vola, both rewards seem to have an additive effect. Therefore, the analysis of retail behavior finds strong evidence in support of hypothesis 4. For saving duration and vola we find that it may be beneficial for the bank to include an additional reward into the contract terms which is directly related to the bank's product design and its pricing policies.

Thus far, we have been silent on the costs of interest bonuses from the bank's perspective. This refers to **the absolute value of the interest bonuses** that range from 0.5% to 2.5% depending on the tariff. If the bank management wants to guide customer behavior by introducing interest bonuses, the bonus value gains attention. Then the following question arises: how will the customer behavior differ if the bank offers a 0.5% or 2.5% interest bonus (or interest rates in between)? We compare the impacts of different bonus values on saving persistence and cash flow volatility. Model (4) of Table 7 finds that a 0.5% bonus reduces the probability of early contract termination by approximately 16 percentage points. It is interesting that the measured impact remains stable for the interest bonuses with values ranging from 1.5% to 2.5% (i.e., the effect on customer behavior does not vary if the interest bonus exceeds 1.5%). Turning to model (5) of Table 7 , we find that the same pattern holds true for cash flow volatility. Thus, we reject hypothesis 5, which claims that the higher the offered interest bonuses the lower the cash flow volatility. This finding shows a saturation level from 1.5% onwards in interest incentives offered by the bank and could be used for pricing policies in banking practice. Thus, the bank could deliberately question how large the interest bonus' impact on its depositors is and might analyze how to achieve that effect with minimum possible costs. All other things being equal this relationship could be more thoroughly explored in future research to generate further insights into possible cost savings in terms of interest expense reductions from the banks perspective.

The next section provides robustness of our main results.

6 Robustness

The previous sections address the concern that the main independent variable, i.e., interest bonus, could suffer from endogeneity. In our case, endogeneity might arise due to unobserved customer characteristics affecting both, the interest bonus contract choice as well as the saving duration. Being precise, certain depositors may know ex ante that they will save for a long duration and thus choose an interest bonus contract. Then, the measured effects would be due to a customer self-selection into contract types - i.e., the interest bonus incentive would not be causal for longer saving durations. The employed panel fixed effects estimations as well as various matching procedures and the recent instrumental variable estimators revealed that the results are unlikely to suffer from endogeneity (recall the results from the main Table 3). However, in further robustness tests we again underline our main results by obtaining a more precise evaluation of each depositor.

From a bank's perspective it is desirable to evaluate each customer and her characteristics as well as possible. The deduction of certain behavioral patterns based on customer evaluation is of key importance to topics such as cash flow projections, risk management, customer clustering or relationship management. In this respect we were given the opportunity to assess a subpopulation of bank customers in more detail covering more information than just its age or occupation: For 561,197 contracts, which have been negotiated from 2001 onwards, it is possible to gather the information on each customer's gender, marital status, postal-code, household size, nationality and her academic degree.[26] Being precise, we were given the unique opportunity to assess all data the providing bank possesses of its customers.[27]

------ Please insert Table 8 approximately here ------

[26] It was not possible to obtain that kind of information for all 2.2 million contracts due to the bank's database limitations.

[27] All data is strictly anonymous. We do not know the names, complete mailing addresses or bank account data of the customers.

Table 8 presents summary statistics for the newly obtained customer data and provides information on its distribution. The customer based information seems capable to explain the contractual choices people make, thus suited to lower concerns of a potential interest bonus endogeneity: As exemplary indicated by contract volume, clear differences emerge if the customer is married or not (i.e., the average volume decreases by approximately 4,000 EUR). Turning to our main variables (i.e., saving duration and cash flow volatility), we find that the newly obtained customer characteristics seem to possess some explanatory power: Exemplary, households of 3 to 5 persons save on average for longer time periods than singles do. Married people save more regularly than singles do.

In sum, the additional customer classifications seem suited for our analysis to assess certain saving patterns. It remains to be explored, whether they alter any of our previous results regarding saving duration and cash flow volatility (i.e., we have to analyze whether any of our previous findings might be driven by the heretofore omission of more detailed customer related data).

Consequently, our multivariate models incorporate the additional customer information: To assess saving disparities of bank customers, the gender is an obvious attribute. Several studies in banking point out the different behavior of women compared to men (e.g., Hartmann-Wendels et al., 2009), such that controlling for gender seems worthwhile.

The ability for saving as well as its perceived importance will be driven by the social structure the customer lives in. As a proxy we include the household size to distinguish the different effects if the customer lives alone, with a partner or with children in a family. Additionally, the marital status will be included in our analyses since it is known to have an impact on the investments people undertake (e.g., Sundén and Surette, 1998). As education will influence saving behavior we include the information if the customer holds a doctorate or is a professor. Last, we control for regional effects and the national origin by including postal codes as indicator variables as well as the customer's nationality.

Estimating our main models (i.e., OLS and logit for saving persistence and OLS and quantile regressions for vola), the results in Table 9 still present a strong impact of interest bonus on saving duration and are qualitatively similar to our main results.[28]

------ Please insert Table 9 approximately here ------

7 Conclusion

Non-maturing deposits are one of the most important funding sources of European banks, exhibit a dynamic growth in the aftermath of the financial crises and pose major challenges to banks in their asset liability management (ALM) considerations because of their stochastic cash flow patterns. This study is the first to analyze the behavior of depositors in non-maturing deposit products on an individual customer level. Questioning to what extent banks can guide and influence their depositors' saving behavior, we find that contractual offered rewards in terms of pricing incentives influence the bank's deposit funding sustainably to a great extent. The pricing incentives lead to stabilized deposit funding, which exhibits extended capital commitment of approximately more than two years and smoothed deposit inflows to the bank. Our results are based on the complete cash flow and contract information as well as a large variety of customer related data, which have been provided by a German bank for the time period of 1991 until 2010 for 2.2 million contracts. The generated insights may be used for deposit cash flow projections and corresponding ALM risk management considerations. Depicting saturation effects in guided depositor behavior for reward values exceeding specific interest rate thresholds, optimal pricing strategies in practice turn important.

[28] The results for vola are in line with the results in the main section. Results not tabulated.

Appendix 1: Variable description

variable	description	application
dependent variables		
saving duration	duration of saving until deposits are drawn on by customer. Measured in years.	saving persistence models
vola	standard deviation of cash inflows by contract normalized by total cash inflows per contract	cash flow models
independent variables		
contract terms		
interest bonus	indicator variable. '1' if contract has an interest bonus clause. This bonus is lost if the customers terminates saving within four years.	all models
wop subsidy	indicator variable. '1' if contract is wop eligible. Wop is lost if the customers terminates saving within seven years.	all models
return optimized contract	indicator variable. '1' if the contract is return optimized for saving purpose (i.e., the customer gains a higher deposit rate but faces a higher, possible loan rate). '0' if the contract is mortgage optimized.	all models
contract volume	the contract volume on which the contract is signed. Categorical variable. One value for each volume class. Classes in € are: '1': <5,000, '2': 5,000-10,000, '3': 10,000-20,000, '4': 20,000-30,000, '5': 30,000-40,000, '6': 40,000-50,000, '7': 50,000-100,000, '8': >100,000	all models
deposit rate	the offered basis interest. The customer receives this unconditional interest rate on his saved investment.	all models
agreed loan rate	the pre-agreed loan rate. If the customer fulfills all contractual conditions she will be offered a mortgage on this loan rate. She saves between 40% and 50% of contract volume and will be eligible to obtain a loan on the remaining 60% of contract volume paying the up-front agreed loan rate.	all models
takes loan	indicator variable. '1' if the customer has executed her loan option.	all models
recommended savings rate	information regarding the amount the customer optimally needs to save per year before she can draw on her contractually agreed credit sum. Recall, that building societies apply an allocation system, to determine when exactly the customer can use the credit option.	all models
waiting period	the minimum saving duration before the customer can obtain a loan. Measured in years.	all models
customer characteristics		
occupation	the customer's occupation at contract start. Categorical variable. Classes are: '1': blue collar worker, '2': self-employed, '3': white collar worker, '4': civil servant, '5': retiree, '6': doctor, '7': student/ apprentice/ pupil, '8': pensionary, '9': other	all models
age	the customer's age at contract start. Categorical variable. Classes are: '1': <18, '2': 18-24, '3': 25-44, '4': 45-65, '5': >65.	all models
employer benefits	indicator variable. '1' if the contract has cash inflows from employer based "Vermögenswirksame Leistungen". German employer can pay this aid. This benefit does not bind the customer to the saving contracts we analyze in this study. Put differently, the employee is also entitled to this allowance if she invests, e.g., in certain equity funds. The customer is free to switch and keep VL on her own. Thus, this reward will not be labeled as contractual reward in our analysis.	all models
marital status	indicator variable. The customer's marital status at contract start. '1' if she is single. '0' if married.	Table 9
household size	the number of persons with whom the customer lives together. Categorical variable counting the household size from 1 to 9 if stated. 'not specified' if the bank does not know the household size.	Table 9
academic title	indicator variable. '1' if the customer has a degree of 'Dr.' (i.e., she has a Phd), or even the title of a 'Prof.'. '0' if otherwise.	Table 9
gender	the customer's gender. Categorical variable. Classes are: '1': male, '2': female. '3': joint contract. The customers are allowed to sign a joint contract (i.e., the contract is signed by a customer and additionally by a co-contractor).	Table 9
nationality	indicator variable. '1' if the customer has foreign nationality and '0' if she is German.	Table 9
postal codes	indicator variables for different postal codes (6,250 different postal codes).	Table 9
economic conditions		
market deposit interest	average of EURIBOR with a duration of three months during the saving period of the contract	all models
market loan interest	average of the 10-year mortgage loan during the contract's saving period	all models
market interest volatility	volatility of market deposit rate during the saving period	vola models
stock index	average DAX value during the contract's saving period	all models
GDP	average GDP during the contract's saving period	all models
ending during crises	indicator variable. '1' if the contract ends in the years 2001, 2002 or 2008.	all models

Notes:
This table presents a short description of the employed model variables.

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Table 1: General summary statistics

Panel A: Summary statistics on contract information

		total sample	per contract			
		sum	mean	p50	min	max
contract volume	€	35,350,000,000	16,138	10,999	500	2,370,000
deposit inflows	€	11,010,000,000	5,027	3,398	1	886,682
deposit interest offered by contract	%		2	2	0.5	3
deposit interest paid	€	806,000,000	368	199	0	81,866
credit volume (16% of contracts have credit)	€	2,672,000,000	7,843	4,890	1	799,792
credit interest charged by contract	%		5	5	1.9	7
credit interest received	€	348,100,000	1,022	604	0	64,376
government saving subsidies (wop) (36% of contracts have subsidy)	€	213,300,000	267	227	1	1,596
interest bonus offered	%		1	2	0.5	2.5
interest bonus paid (20% of contracts have contract reward)	€	106,900,000	253	140	1	36,974

Panel B: Distribution of contracts according to characteristics among the sample

Distribution of contract volume

€ amount	# (thousands)	%
< 5,000	71	3.24
5,000 – 10,000	566	25.82
10,000 – 20,000	1,040	47.52
20,000 – 30,000	294	13.43
30,000 – 40,000	73	3.35
40,000 – 50,000	36	1.65
50,000 – 100,000	93	4.25
> 100,000	16	0.73

Distribution of rewards among contract volumes

	Percentage of contracts with:			average value per contract (€)		
€ amount	interest bonus	wop	bonus or wop	interest bonus		wop
< 5,000	17%	34%	44%	84	<	115
5,000 – 10,000	25%	37%	51%	153	<	188
10,000 – 20,000	21%	35%	47%	220	<	288
20,000 – 30,000	15%	37%	45%	363	>	332
30,000 – 40,000	9%	39%	44%	677	>>	320
40,000 – 50,000	5%	41%	44%	944	>>	321
50,000 – 100,000	3%	41%	42%	1,143	>>	335
> 100,000	2%	30%	31%	2,228	>>	300

Distribution of occupation

	# (thousands)	%
blue collar worker	460	21.00
self-employed	71	3.24
white collar worker	416	19.01
civil servant	15	0.69
retiree	396	18.06
doctor	3	0.13
student / apprentice / pupil	287	13.12
pensionary	2	0.1
others	540	24.67

Distribution of age

	# (ths.)	%
< 18	68	3.10
18 – 24	263	12.00
25 – 44	856	39.09
45 – 65	728	33.26
> 65	275	12.55

Panel C: evolution of data sample

year	1992	1995	1997	2000	2005	2010
no. active contracts (thousands)	85	312	678	1,086	1,101	169

Notes:
This table presents summary statistics on the main dataset. N = 2,182,743. Panel A presents summary statistics of contractual variables for the whole sample as well as information on the contract level (min, mean, median and max). Panel B presents summaries on the frequency of different contract volumes, the fraction of contracts that do have interest bonuses and wop eligibility. Further, we present average values of contractual rewards for each contract volume class. We show the distribution of customer's age at contract start and her occupation. Panel C describes the dynamic evolution of the data set.

Table 2: Summary statistics of saving duration and cash flow volatility

Panel A: Saving persistence

Average contract duration (in years)	mean	p50	min	max
average of all contracts	6.49	6	1	19
only saving	5.71	6	1	19
saving and loan taking	10.78	11	2	19

Distribution of duration acc. to critical saving's times

duration within the range of:	years	≤ 4	> 4 and ≤ 7	≤ 7
	%	32	26	59
	#	708,993	580,424	1,289,417

Average duration ordered by contractual rewards	interest bonus (yes / no)	wop (yes / no)	avr. Duration years	no. contracts #
	0	0	4.88	1,152,105
	1	1	8.14***	182,920
	1	1/0	6.71***	423,333
	1/0	1	8.91***	797,936
	0	1	9.15***	615,016
	1	0	5.68***	240,413

Panel B: Cash Flow volatility

Average cash flow volatility	mean	p50	min	max
All contracts	0.13	0.06	0	0.71
Contracts				
with interest bonus	0.10***	0.06	0	0.71
without interest bonus	0.15	0.09	0	0.71
with wop	0.08***	0.05	0	0.71
without wop	0.16	0.10	0	0.71

Notes:
This table presents summary statistics of our two key outcome variables, 1) saving persistence, i.e., the duration of each saving contract, and 2) cash flow volatility, i.e., the smoothness of cash inflows.
Panel A presents at first average contract durations. Hereafter the fraction of contracts, which end 4 or 7 years after the contract's beginning are presented. Those critical durations would cause sanctions with regard to the loss of interest bonus if offered by the contractual setting ('4 years') or could cause the loss of the governmental saving subsidy wop if the contract is eligible ('7 years'). Further, average contract durations are presented with respect to the two contractual reward mechanisms. Each reward facilitates longer saving on average which is underlined by an univariate sample mean comparison test.
Panel B presents summary statistics on the volatility of cash flows as calculated by the standard deviation of cash flows by contract. 'vola' is winsorized on the 1% level. Univariate sample mean comparison tests yield first evidence that contracts with interest bonus or contracts eligible for wop exhibit lower cash flow volatility. *, **, *** indicate that the coefficient differs from zero at the 10%, 5%, and 1% level (using a two-sided test), respectively.

Table 3: Main results for saving persistence and cash flow volatility

Panel A: Regression Estimates based on OLS and Panel-Fixed effects

Dependent variable	**saving duration**	**vola**		
	model (1) - OLS	model (2) - Panel-FE	model (3) - OLS	model (4) – Panel-FE
interest bonus	**3.023*****	**4.236*****	**-0.237*****	**-0.216*****
wop subsidy	**2.394*****	**1.952*****	**-0.054*****	**-0.036*****
return optimized contract	-1.723***	-1.271***	0.258***	0.245***
contract volume (ref.: < 5,000)				
5,000 – 10,000	0.028	0.062**	-0.021***	-0.023***
10,000 – 20,000	0.175	0.143***	-0.021***	-0.031***
20,000 – 30,000	0.250*	0.0481***	-0.008*	-0.021***
30,000 – 40,000	0.329**	0.098***	0.015*	-0.004***
40,000 – 50,000	0.465***	0.221***	0.023**	-0.001
50,000 – 100,000	0.716***	0.395***	0.018**	-0.010***
> 100,000	0.690***	0.219***	0.051***	0.020***
deposit rate	2.659***	2.833***	-0.047***	-0.053***
agreed loan rate	-0.004	-0.438***	-0.025***	-0.032***
takes loan	0.152	-0.305***	0.004	0.013***
recommended savings rate	3.415***	2.927***	-0.617***	-0.671***
waiting period	-0.322**	-0.559***	-0.001	-0.001*
occupation (ref.: b.c. worker)				
self-employed	-0.381***	-1.756***	-0.001	0.001
white collar worker	0.026	-0.423	-0.002*	-0.006
civil servant	0.122**	0.288	-0.016***	0.010
retiree	-0.028	0.009*	-0.008***	-0.022***
doctor	0.791***	0.266	-0.012***	-0.052
student/ apprentice/ pupil	0.184***	-0.773***	0.001	0.019
pensionary	-0.585**	0.818	-0.010**	-0.040
other	-0.604***	-2.650***	0.006**	-0.009***
age (ref.: < 18)				
18 – 24	-0.409***	-1.002***	0.015***	0.032***
25 – 44	-0.165***	-2.101***	-0.005**	0.052***
45 – 65	-0.292***	-3.129***	-0.010***	0.058***
> 65	-0.744***	-4.242***	-0.009**	0.072***
employer benefits	0.600***	0.650***	-0.030***	-0.027***
economic conditions				
market deposit rate vola	(-)	(-)	-0.089***	-0.064***
market deposit interest	0.114	0.256***	0.035	0.056***
market loan interest	1.204	0.729***	-0.093*	-0.073***
stock index	-0.000	-0.000***	-0.000	0.000***
GDP	0.406**	0.309***	-0.000	-0.006***
ending during crises	-0.049	-0.0923***	-0.008	0.853***
constant	-47.435**	-30.727***	3.158**	1.726***
Adjusted R^2 (OLS) / Overall R^2 (Fixed Effects)	0.453	0.360	0.221	0.196
N-obs (number of total obs.)	2,182,743	1,503,738	1,841,555	1,272,909
N-groups (number of groups)		1,097,022		965,956

This table is continued on the next page.

Table 3 continued.

Panel B: Treatment effect models

	saving duration		vola	
	Average Treatment Effect on the Treated (ATET) [95% Conf. Interval]	Average Treatment Effect (ATE) [95% Conf. Interval]	Average Treatment Effect on the Treated (ATET) [95% Conf. Interval]	Average Treatment Effect (ATE) [95% Conf. Interval]
(1) Nearest Neighbor Matching (NNM)	2.508*** [2.450; 2.564]	1.747*** [1.687; 1.807]	-0.314*** [-0.319; -0.309]	-0.199*** [-0.202; -0.196]
Estimators according to Millimet and Tchernis (2013)				
(2) Klein-Vella Instrumental Variable Estimator (KV)	4.616 [4.58; 4.67]	4.616 [4.58; 4.67]	-0.08 [-0.086; -0.078]	-0.08 [-0.086; -0.078]
(3) Control function approach (CF)	7.265 [7.186; 7.296]	7.246 [7.192; 7.287]	-0.056 [-0.057; -0.049]	-0.056 [-0.063; -0.054]
(4) Bivariate Normal Estimator (BVN)	4.838 [4.803; 4.888]	5.308 [5.266; 5.365]	-0.082 [-0.087; -0.080]	-0.083 [-0.089; -0.081]
(5) Minimum Biased Estimator (MB)	2.941 [2.922; 2.949]	3.386 [3.385; 3.416]	-0.311 [-0.314; -0.308]	-0.282 [-0.285; -0.278]
(6) Minimum Bias - Bias Corrected Estimator (MB-BC)	4.755 [4.716; 4.799]	5.632 [5.598; 5.702]	-0.151 [-0.156; -0.148]	-0.281 [-0.285; -0.278]
Estimator according to Lewbel (2012)				
(7) Lewbel Instrumental Variable Estimator (Lew-IV)	1.893*** [1.8767; 1.908]	1.893*** [1.8767; 1.908]	-0.039*** [-0.041; -0.379]	-0.039*** [-0.041; -0.038]

Notes:

Panel A shows OLS and Panel Fixed effects (FE) estimates of our key outcome variables saving persistence and vola. The dependent variable of models 1-2 is the saving duration measured in years. Positive coefficients are expected for interest bonus and wop. Models 3-4 use cash flow volatility ('vola') as dependent variable. Negative coefficients are expected for interest bonus and wop. 'OLS' denotes ordinary least square estimates and 'Panel- FE' are panel fixed effects models. The fixed effects models explore the fact that some customers have more than one contract during the sample period allowing us to address endogeneity concerns (at least partly) by the customer fixed effects. Significance is calculated using robust (Huber/White) standard errors clustered by the time dimension (i.e., contract start; see Petersen, 2009). We report "Adjusted R^2" for the OLS estimates and "Overall R^2" for the Panel Fixed effects results. 'N' is the number of observations. *, **, *** indicate significance at the 10%, 5%, and 1% level (using a two-sided test), respectively.

Panel B shows the results for various treatment models to control for endogeneity. Being precise, we report average treatment effect on the treated (ATET) results and average treatment effects (ATE). Estimator 1 (NNM) reports results based on nearest neighbor matching. The results reported are based on at least a 1:3 match and we implement the bias adjustment using all independent variables (see Abadie and Imbens 2006, 2008, 2011, 2012). Reported confidence bounds (given in square brackets below the point estimate) as well as robust standard errors are also based on Abadie and Imbens (2006, 2008, 2011, 2012). Estimators (2) - (6) are implemented based on Millimet and Tchernis (2013). These estimators are suitable if one estimates treatment effects without an exclusion restriction. Again, 95% confidence bounds for significance are given in square brackets below the point estimates based on 100 bootstrap replications. Lastly, estimator (7) (Lew-IV) is the instrumental variable estimator based on Lewbel (2012). For the implementation of this estimator see Baum et al. (2012).

Table 4: Logit results for saving persistence – focus on *interest bonus*

	model (1)		model (2)		model (3)		model (4)	
	coef	Δ prob (%)	coef	Δ prob (%)	coef	prob (%)	coef	Δ prob (%)
interest bonus	**-2.53*****	**-0.30*****	**-2.35*****	**-0.30*****	**-2.92*****	**-0.42*****	**-2.40*****	**-0.30*****
wop subsidy	-2.34***	-0.34***	-2.34***	-0.34***	(-)	(-)	-1.37***	-0.34***
return optimized contract	1.47***	0.19***	1.47***	0.19***	1.46***	0.24***	1.46***	0.19***
contract volume (ref.: < 5,000)								
5,000 – 10,000	-0.19*	-0.03*	-0.15**	-0.03	-0.06	-0.01	-0.03	-0.03**
10,000 – 20,000	-0.18	-0.03	-0.14*	-0.03	0.03	0.01	0.07	-0.03*
20,000 – 30,000	-0.16	-0.02	-0.12	-0.02	0.04	0.01	0.06	-0.03
30,000 – 40,000	-0.21	-0.03	-0.19*	-0.03	-0.08	-0.00	-0.07	-0.03*
40,000 – 50,000	-0.34**	-0.05**	-0.32***	-0.05**	-0.21*	-0.03	-0.21*	-0.05***
50,000 – 100,000	-0.57***	-0.08***	-0.56***	-0.07***	-0.44***	-0.06***	-0.44***	-0.08***
> 100,000	-0.64***	-0.09***	-0.62***	-0.08***	-0.55***	-0.07***	-0.55***	-0.08***
bonus * contract volume								
5,000 – 10,000	(-)	(-)	**-0.21**	**-0.31*****	**0.06**	**-0.43*****	**-0.16**	**-0.31*****
10,000 – 20,000	(-)	(-)	**-0.19**	**-0.30*****	**0.17**	**-0.42*****	**-0.13**	**-0.30*****
20,000 – 30,000	(-)	(-)	**-0.19**	**-0.31*****	**0.19**	**-0.42*****	**-0.14**	**-0.30*****
30,000 – 40,000	(-)	(-)	**-0.05**	**-0.29*****	**0.36**	**-0.40*****	**0.00**	**-0.30*****
40,000 – 50,000	(-)	(-)	**0.03**	**-0.28*****	**0.40**	**-0.38*****	**0.08**	**-0.28*****
50,000 – 100,000	(-)	(-)	**0.32**	**-0.24*****	**0.71*****	**-0.33*****	**0.38**	**-0.24*****
> 100,000	(-)	(-)	**0.44**	**-0.22*****	**0.88*****	**-0.31*****	**0.50**	**-0.23*****
wop subsidy * contract volume								
5,000 – 10,000	(-)	(-)	(-)	(-)	(-)	(-)	-0.64***	-0.30***
10,000 – 20,000	(-)	(-)	(-)	(-)	(-)	(-)	-1.36***	-0.37***
20,000 – 30,000	(-)	(-)	(-)	(-)	(-)	(-)	-1.04***	-0.35***
30,000 – 40,000	(-)	(-)	(-)	(-)	(-)	(-)	-0.67***	-0.30***
40,000 – 50,000	(-)	(-)	(-)	(-)	(-)	(-)	-0.64***	-0.29***
50,000 – 100,000	(-)	(-)	(-)	(-)	(-)	(-)	-0.64***	-0.27***
> 100,000	(-)	(-)	(-)	(-)	(-)	(-)	-0.33	-0.24***
deposit rate	-2.29***	-0.33***	-2.29***	-0.33***	-2.39***	-0.46***	-2.29***	-0.33***
agreed loan rate	-0.14	-0.02	-0.14	-0.02	-0.04	-0.01	-0.14	-0.02
takes loan	-0.76***	-0.11***	-0.76***	-0.11***	-1.21***	-0.23***	-0.76***	-0.11***
recommended savings rate	-2.62***	-0.38***	-2.62***	-0.38***	-3.72***	-0.72***	-2.65***	-0.38***
waiting period	0.30***	0.04***	0.30***	0.04***	0.34***	0.07***	0.30***	0.04***
occupation (ref.: worker)								
self employed	0.42***	0.06***	0.42***	0.06***	0.46***	0.09***	0.42***	0.06***
white collar worker	0.03	0.00	0.03	0.00	0.04	0.01	0.03	0.00
civil servant	-0.05	-0.01	-0.05	-0.01	-0.04	-0.01	-0.05	-0.01
retiree	-0.10**	-0.01**	-0.10**	-0.01**	-0.15***	-0.03***	-0.10**	-0.01**
doctor	-0.54***	-0.07***	-0.53***	-0.07***	-0.47***	-0.09***	-0.52***	-0.07***
student /apprentice/ pupil	-0.12***	-0.02***	-0.12***	-0.02***	-0.13***	-0.02***	-0.11***	-0.02**
pensionary	0.50	0.07	0.50	0.07	0.51	0.10	0.50	0.07
other	0.72***	0.11***	0.72***	0.11***	0.76***	0.15***	0.72***	0.11***
age (ref.: < 18)								
18 – 24	0.49***	0.07***	0.49***	0.07***	0.50***	0.10***	0.49***	0.07***
25 – 44	0.20***	0.03***	0.20***	0.03***	0.18***	0.04***	0.20***	0.03***
45 – 65	0.16**	0.02**	0.15**	0.02**	0.09	0.02	0.16**	0.02**
> 65	0.58***	0.08***	0.58***	0.08***	0.56***	0.11***	0.58***	0.08***
employer benefits	-0.67***	-0.10***	-0.67***	-0.10***	-0.70***	-0.14***	-0.67***	-0.10***
economic conditions								
market deposit interest	0.11	0.02	0.10	0.02	0.06	0.01	0.11	0.02
market loan interest	-1.21	-0.18	-1.21	-0.18	-1.04	-0.20	-1.20	-0.17
stock index	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GDP	-0.37*	-0.05*	-0.37*	-0.05*	-0.34	-0.06	-0.37	-0.05*
ending during crises	-0.22	-0.03	-0.22	-0.03	-0.27	-0.05	-0.23	-0.03
constant	47.58*		47.53*		43.58		47.01*	
Pseudo R^2	0.31		0.31		0.18		0.31	
N	2,182,743		2,182,743		1,384,807		2,182,743	

Notes:

This table presents logit estimates on the probability of saving duration being **less than 4 years** ('default'). The dependent variable in each model is '1' if the duration is less than 4 years and '0' otherwise. For a complete variable description see Appendix 1. Since interest bonus is lost due to a saving termination within this period the bonus-coefficient is expected to be negative. We estimate four different models: The first one without interactions terms, the second interacts bonus eligibility with different contract volumes. For the third model all contracts having wop eligibility are dropped to eliminate possible disturbing effects of a second reward. The last model presents interactions of interest bonus and wop with contract volume classes. Negative coefficients are expected for interest bonus and wop. For each model the coefficient as well as the average marginal effects are reported (or discrete effects for the categorical variables). Significance is calculated using robust (Huber/White) standard errors clustered by the time dimension, i.e., contract start. We report Pseudo-R^2. 'N' is the number of observations. *, **, *** indicate that the coefficient differs from zero at the 10%, 5%, and 1% level (using a two-sided test), respectively.

Table 5: Logit results for saving persistence – focus on *wop*

	model (1)		model (2)		model (3)	
	coef	Δ prob (%)	coef	Δ prob (%)	coef	Δ prob (%)
interest bonus	-2.54***	-0.39***	-2.55***	-0.39***	(-)	(-)
wop subsidy	**-2.07*** **	**-0.38*** **	**-1.37*** **	**-0.38*** **	**-1.38*** **	**-0.34*** **
return optimized contract	1.53***	0.22***	1.52***	0.22***	1.44***	0.19***
contract volume (ref.: < 5,000)						
5,000 – 10,000	-0.03	-0.00	0.09	-0.02*	0.15**	-0.00
10,000 – 20,000	-0.40***	-0.06***	-0.04	-0.07***	0.00	-0.05***
20,000 – 30,000	-0.56***	-0.08***	-0.16*	-0.09***	-0.11	-0.07***
30,000 – 40,000	-0.53***	-0.08***	-0.26***	-0.09***	-0.25**	-0.08***
40,000 – 50,000	-0.68***	-0.10***	-0.44***	-0.12***	-0.44***	-0.11***
50,000 – 100,000	-0.91***	-0.14***	-0.70***	-0.16***	-0.65***	-0.14***
> 100,000	-0.69***	-0.11***	-0.61***	-0.12***	-0.61***	-0.11***
wop subsidy * contract volume						
5,000 – 10,000	(-)	(-)	**-0.39*** **	**-0.31*** **	**-0.35*** **	**-0.28*** **
10,000 – 20,000	(-)	(-)	**-0.88*** **	**-0.41*** **	**-0.73*** **	**-0.36*** **
20,000 – 30,000	(-)	(-)	**-0.96*** **	**-0.43*** **	**-0.84*** **	**-0.39*** **
30,000 – 40,000	(-)	(-)	**-0.69*** **	**-0.39*** **	**-0.60*** **	**-0.35*** **
40,000 – 50,000	(-)	(-)	**-0.65*** **	**-0.39*** **	**-0.62*** **	**-0.36*** **
50,000 – 100,000	(-)	(-)	**-0.57*** **	**-0.37*** **	**-0.57*** **	**-0.36*** **
> 100,000	(-)	(-)	**-0.27*** **	**-0.32*** **	**-0.28*** **	**-0.30*** **
deposit rate	-2.29***	-0.35***	-2.28***	-0.35***	-4.32***	-0.61***
agreed loan rate	-0.32	-0.05	-0.31	-0.05	0.95*	0.13**
takes loan	0.50***	0.08***	0.51***	0.08***	0.59***	0.08***
recommended savings rate	-2.27**	-0.34**	-2.26**	-0.34**	-0.88	-0.12
waiting period	0.45***	0.07***	0.45***	0.07***	1.47***	0.21***
occupation (ref.: b.c. worker)						
self-employed	0.49***	0.07***	0.49***	0.07***	0.20***	0.03***
white collar worker	0.01	0.00	0.01	0.00	-0.04*	-0.01*
civil servant	-0.08*	-0.01*	-0.09*	-0.01*	-0.15***	-0.02***
retiree	0.04	0.01	0.03	0.00	-0.09	-0.01
doctor	-0.51***	-0.08***	-0.50***	-0.08***	-0.54***	-0.08***
student/ apprentice/ pupil	-0.23***	-0.04***	-0.23***	-0.04***	-0.14***	-0.02***
pensionary	-0.01	-0.00	-0.02	-0.00	0.04	0.01
other	0.48***	0.07***	0.48***	0.07***	0.35***	0.05***
age (ref.: < 18)						
18 – 24	0.23***	0.04***	0.23***	0.03***	0.35***	0.05***
25 – 44	0.02	0.00	0.01	0.00	0.23***	0.03***
45 – 65	0.22***	0.03***	0.22***	0.03***	0.49***	0.07***
> 65	0.58***	0.09***	0.58***	0.09***	0.96***	0.13***
employer benefits	-0.51***	-0.08***	-0.51***	-0.08***	-0.48***	-0.07***
economic conditions						
market deposit interest	0.02	0.00	0.02	0.00	0.17	0.02
market loan interest	-1.46*	-0.22**	-1.45*	-0.22**	-1.44**	-0.20**
stock index	0.00	0.00	0.00	0.00	0.00	0.00
GDP	-0.44***	-0.07***	-0.44***	-0.07***	-0.48***	-0.07***
ending during crises	0.42	0.06	0.42	0.06	0.45	0.06
constant	59.04***	-0.39***	58.47***	-0.39***	57.58***	
Pseudo R^2	0.28		0.28		0.31	
N	2,182,743		2,182,743		1,759,410	

Notes:
This table presents logit estimates on the probability of saving duration being **less than 7 years** ('default'). The dependent variable in each model is '1' if the duration is less than 7 years and '0' otherwise. For a complete variable description see appendix 1. Since wop subsidy is lost within this saving period the wop-coefficient is thought to be negative. We estimate three different models: The first one without interactions terms, the second interacts wop eligibility with different contract-volume classes. For the last model all contracts having interest bonus clauses are dropped. Negative coefficients are expected for interest bonus and wop. For each model the coefficient as well as the average marginal effects are reported (or discrete effects for the categorical variables). Significance is calculated using robust (Huber/White) standard errors clustered by the time dimension, i.e., contract start (see Petersen, 2009). We report Pseudo-R^2. 'N' is the number of observations. *, **, *** indicate that the coefficient differs from zero at the 10%, 5%, and 1% level (using a two-sided test), respectively.

Table 6: Quantile regression results for cash flow volatility

	quantile regressions		
	model (1)	model (2)	model (3)
	10%	50%	90%
	coef	coef	coef
interest bonus	-0.043***	-0.210***	-0.271***
wop subsidy	-0.002***	-0.030***	-0.125***
return optimized contract	0.047***	0.230***	0.299***
contract volume (ref.: < 5,000)			
5,000 – 10,000	-0.003***	-0.017***	-0.039***
10,000 – 20,000	-0.004***	-0.023***	-0.041***
20,000 – 30,000	-0.004***	-0.020***	-0.001
30,000 – 40,000	-0.001***	-0.007***	0.049***
40,000 – 50,000	-0.003***	-0.001	0.065***
50,000 – 100,000	-0.001***	-0.001	0.051***
> 100,000	0.001	0.029***	0.108***
deposit rate	-0.007***	-0.036***	-0.072***
agreed loan rate	-0.008***	-0.023***	-0.041***
takes loan	0.004***	0.018***	0.006***
recommended savings rate	-0.100***	-0.547***	-0.674***
waiting period	0.001***	-0.001**	0.008***
occupation (ref.: worker)			
self employed	0.000	0.002***	0.007***
white collar worker	0.000	-0.001***	-0.000
civil servant	-0.003***	-0.009***	-0.019***
retiree	-0.002***	-0.002***	-0.013***
doctor	-0.001	-0.005**	-0.028***
student /apprentice/ pupil	0.001***	-0.000	-0.000
pensionary	-0.002**	-0.002	-0.009
other	0.001***	0.004***	0.014***
age (ref.: < 18)			
18 – 24	-0.000	0.007***	0.032***
25 – 44	-0.008***	-0.008***	0.009***
45 – 65	-0.009***	-0.010***	0.004***
> 65	-0.010***	-0.013***	0.015***
employer benefits	0.006***	-0.007***	-0.067***
economic conditions			
market deposit rate vola	-0.004***	-0.059***	-0.170***
market deposit interest	0.002***	0.044***	0.095***
market loan interest	-0.010***	-0.108***	-0.230***
stock index	-0.000***	-0.000***	-0.000***
GDP	-0.001***	-0.005***	0.003***
ending during crises	0.002***	0.001***	-0.017***
constant	0.376***	3.137***	7.000***
Pseudo R^2	0.09	0.20	0.22
N	1,841,555	1,841,555	1,841,555

Notes:
This table presents quantile regression estimates for cash flow volatility of each contract ('vola'). The dependent variable is the standard deviation of cash inflows per contract. For a complete variable description see appendix 1. We choose the 10%, 50% and 90% quantile for estimation. Negative coefficients are expected for interest bonus and wop. We report coefficients and adj. R^2. Significance is calculated using robust standard errors. 'N' is the number of observations. *, **, *** indicate that the coefficient differs from zero at the 10%, 5%, and 1% level (using a two-sided test), respectively.

Table 7: OLS and Logit results on additivity and the value of interest bonuses

	additivity of rewards				**value of interest bonus**		
	saving persistence			vola	saving persistence		vola
	model (1) - OLS	model (2) - Logit		model (3) - OLS	model (4) - Logit		model (5) - OLS
	coef	coef	Δ prob (%)	coef	coef	Δ prob (%)	coef
interest bonus and wop (ref.: no reward)							
1 0	**2.47*****	**-2.51*****	**-0.38*****	**-0.10*****	(-)	(-)	(-)
0 1	**3.17*****	**-2.33*****	**-0.36*****	**-0.05*****	(-)	(-)	(-)
1 1	**5.27*****	**-4.92*****	**-0.52*****	**-0.15*****	(-)	(-)	(-)
value of interest bonus (ref.: 0%)							
0.50%	(-)	(-)	(-)	(-)	**-1.45****	**-0.16*****	**-0.05*****
1.50%	(-)	(-)	(-)	(-)	**-5.56*****	**-0.39*****	**-0.15*****
2.00%	(-)	(-)	(-)	(-)	**-6.86*****	**-0.43*****	**-0.16*****
2.50%	(-)	(-)	(-)	(-)	**-6.04*****	**-0.41*****	**-0.14****
wop subsidy	(-)	(-)	(-)	(-)	-2.32***	-0.32***	-0.05***
(all other covariates as in the main table)	(yes)	(yes)	(yes)	(yes)	(yes)	(yes)	(yes)
Pseudo R^2 / adjusted R^2	0.45	0.31		0.19	0.32		0.19
N	2,182,743	2,182,743		1,841,555	2,182,743		1,841,555

Notes:

This table presents OLS and logit estimates on the additivity of both contractual rewards as well as the influence of different values of interest bonus on customer behavior. For the logit model we estimate the probability of saving duration being **less than 4 years** ('default'). Models (1) - (3) classify the contracts according to the existence of either interest bonus or wop or both. Model (1) presents OLS results, model (2) logit coefficients as well as average marginal effects. The dependent variable of model (3) is the standard deviation of cash flows per contract ('vola'). Models (4) and (5) include indicator variables classifying the interest bonus contracts by the absolute percentage of the contractual reward. Model (4) presents logit coefficients as well as average marginal effects. The dependent variable of model (5) is the standard deviation of cash flow per contract (vola). Negative coefficients are expected for interest bonus and wop. Significance is calculated using robust (Huber/White) standard errors clustered by the time dimension (i.e., contract start; see Petersen, 2009). We report Pseudo-R^2 and adjusted R^2. 'N' is the number of observations. *, **, *** indicate significance at the 10%, 5%, and 1% level (using a two-sided test), respectively.

Table 8: Summary statistics for additional customer characteristics

customer characteristic	value and frequency	contract volume		age at contract start		saving duration		cash flow volatility	
		mean	median	mean	median	mean	median	mean	median
gender	male (35%)	15,448	11,000	39	36	3.79	3	0.19	0.12
	female (43%)	13,671	10,000	48	48	3.87	3	0.18	0.11
	joint contract (22%)	20,038	15,000	54	54	4.48	4	0.15	0.08
marital status	married (43%)	17,869	13,000	51	51	4.28	4	0.15	0.09
	single (57%)	14,062	10,999	42	39	3.75	3	0.19	0.12
household size	1 (19%)	14,344	11,000	48	49	3.85	3	0.18	0.11
	2 (23%)	16,383	12,999	54	56	4.22	4	0.15	0.09
	3-5 (16%)	18,360	12,999	40	40	4.19	4	0.17	0.10
	6-10 (1%)	17,894	12,999	40	40	3.68	3	0.22	0.15
nationality	German (83%)	15,818	12,000	47	46	3.74	3	0.18	0.11
	foreign (17%)	15,467	11,000	44	43	5.03	5	0.15	0.08
academic title	Dr./ Prof. (0.5%)	28,827	20,000	59	61	4.38	4	0.18	0.10
	none (99.5%)	15,684	12,000	46	46	3.98	4	0.17	0.10

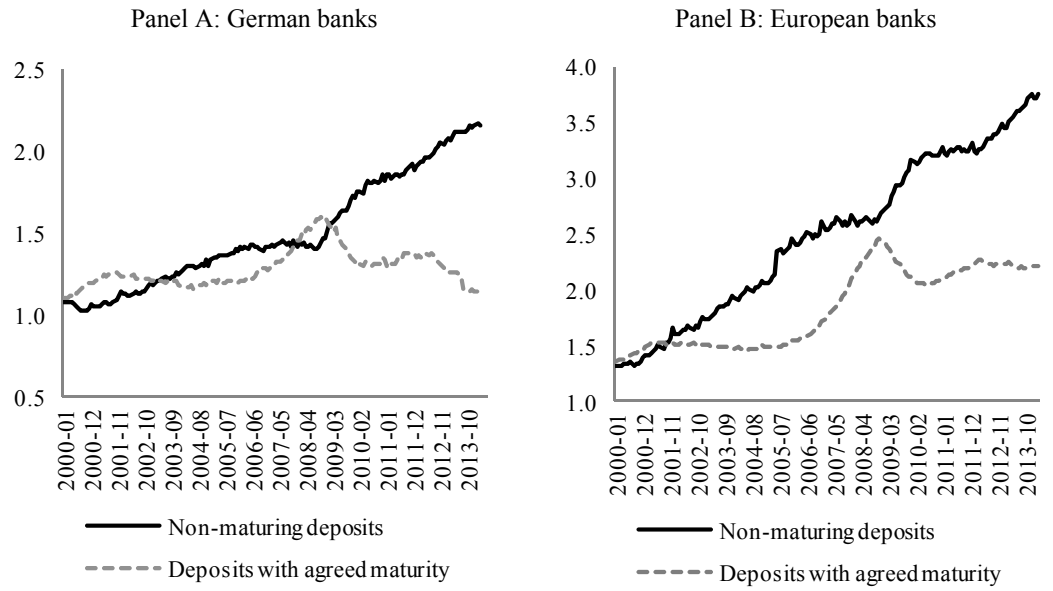
Notes:
This table presents summary statistics of additional customer characteristics for 561,197 contracts negotiated from 2001 onwards. Column 2 presents observable values and frequencies in parentheses. For the contract volume, customer's age at contract's start, the savings duration as well as the cash flow volatility mean and median values are tabulated. For all contracts the customer's postal code is additionally obtained.

Table 9: Detailed customer characteristics – *saving persistence*

	model (1)	model (2)	
	OLS	Logit	
	coef	coef	Δ prob (%)
interest bonus	**2.79*** **	**-4.82*** **	**-0.58*** **
wop subsidy	**1.75*** **	**-2.02*** **	**-0.31*** **
return optimized contract	-0.16	0.45	0.06
contract volume (ref.: < 5,000)			
5,000 – 10,000	-0.19	0.13	0.02
10,000 – 20,000	-0.33***	0.36	0.06**
20,000 – 30,000	-0.33***	0.39*	0.06**
30,000 – 40,000	-0.24**	0.23	0.03
40,000 – 50,000	-0.11	0.02	0.00
50,000 – 100,000	0.02	-0.21	-0.02
> 100,000	0.02	-0.19	-0.01
deposit rate	1.50***	-3.13***	-0.43***
agreed loan rate	-0.48***	0.81***	0.11***
takes loan	1.59***	-2.10***	-0.29***
recommended savings rate	0.79	-3.12***	-0.43***
waiting period	-0.17**	0.41***	0.06***
occupation (ref.: b.c. worker)			
self-employed	0.16***	-0.31***	-0.04***
white collar worker	0.02	-0.04	-0.01
civil servant	0.08	-0.11*	-0.02*
retiree	0.14**	-0.24***	-0.03***
doctor	0.22***	-0.40***	-0.06***
student/apprentice/ pupil	-0.14*	0.14	0.02
pensionary	0.09	-0.02	-0.00
other	-0.15***	0.22***	0.03***
age (ref.: < 18)			
18 – 24	-0.55***	0.83***	0.12***
25 – 44	-0.52***	0.79***	0.11***
45 – 65	-0.55***	0.76***	0.11***
> 65	-0.81***	1.04***	0.15***
employer benefits	0.65***	-0.87***	-0.12***
marital status (ref.: married)			
single	**-0.19*** **	**0.29*** **	**0.04*** **
household size (ref.: 1)			
2	**-0.05*** **	**0.06*** **	**0.01*** **
3	**-0.05*** **	**0.09*** **	**0.01*** **
4	**-0.02***	**0.03*** *	**0.00*** *
5	**-0.13*** **	**0.19*** **	**0.03*** **
6	**-0.25*** **	**0.43*** **	**0.06*** **
7	**-0.26*** **	**0.47*** **	**0.06*** **
8	**-0.21*** *	**0.37*** *	**0.05*** **
9	**-0.33***	**0.31**	**0.04***
not specified	**-0.09***	**0.14*** *	**0.02*** *
academic title(ref.: none)	**0.24*** **	**-0.33*** **	**-0.05*** **
gender (ref.: male)			
female	**0.02*** **	**-0.03*** **	**-0.00*** **
joint contract	**0.18*** **	**-0.34*** **	**-0.05*** **
nationality (ref.:German)			
foreign	**-0.28*** *	**0.39*** *	**0.05***
postal codes - dummies	**(yes)**	**(yes)**	**(yes)**
economic conditions			
market deposit interest	1.64**	-1.86	-0.26
market loan interest	-2.39	3.25	0.45
stock index	-0.00	0.00	0.00
GDP	-0.43	0.45	0.06
ending during crises	1.27***	-1.60***	-0.22***
constant	56.23	-55.39	
adjusted R^2/ Pseudo R^2	0.60	0.36	
N	561,197	561,197	

Notes:
This table presents OLS and logit estimates for saving persistence. The dependent variable of model (2) is '1' if the duration if less than 4 years and '0' otherwise. For model (1) we report coefficients and adjusted R2; for the logit model the coefficients as well as the average marginal effects. We report Pseudo-R^2. Significance calculated using robust (Huber/White) standard errors clustered by the time dimension (i.e., contract start; see Petersen, 2009). 'N' is the number of observations. *, **, *** indicate significance at the 10%,

Figure 1: Deposit volume evolution

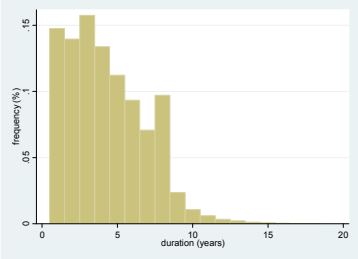


Notes:
This figure displays aggregate deposit volumes from 01.2000 to 03.2014 for all German banks (acc. to Deutsche Bundesbank) in Panel A and for all European banks (acc. to ECB statistics) in Panel B. The graphs represent non-bank depositors and show volumes in trillion EUR.

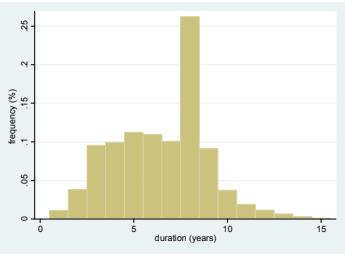
Figure 2: Contract duration of savers and cash flow volatility

Panel A: Distribution of contract durations according to contract design

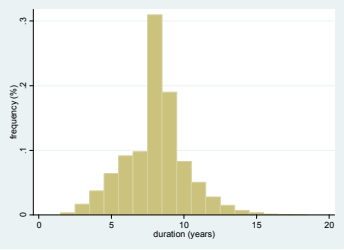
Contracts without bonus and wop



Contracts with interest bonus

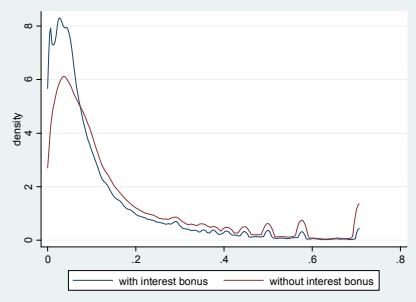


Contracts with wop

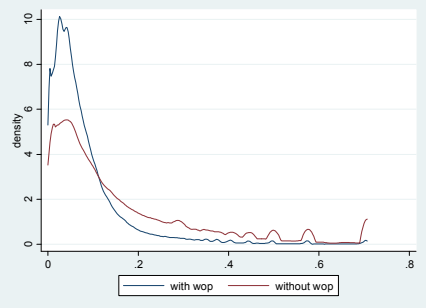


Panel B: Distribution of cash flow volatility according to contract design and market conditions

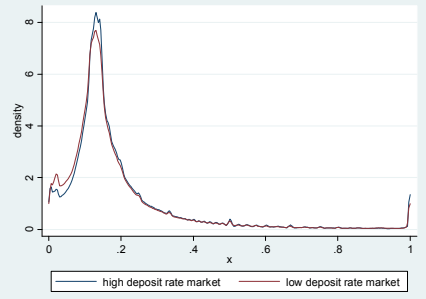
'vola' of contracts with/ without bonus



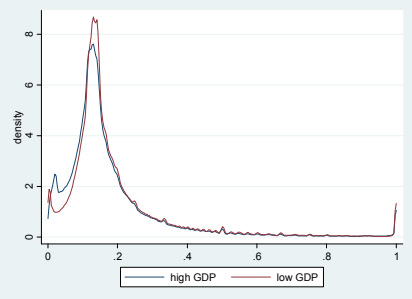
'vola' of contracts with/ without wop



'vola' of contracts high-/ low yield deposit markets



'vola' of contracts in high- / low GDP times



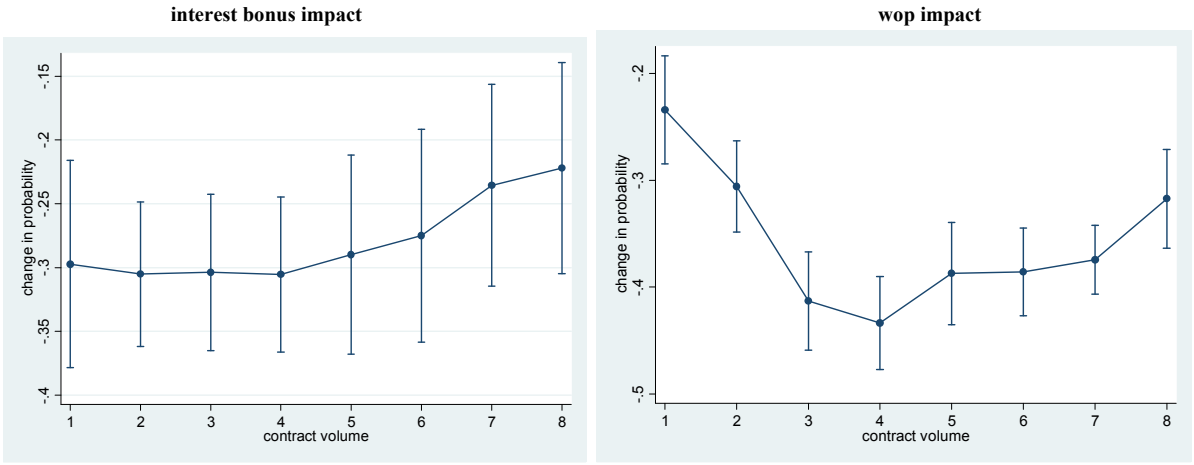
Notes:

Panel A shows the discrete, empirical distribution of all contractual savings durations for contracts that have neither interest bonus nor wop eligibility, contracts with interest bonus clauses as well as contracts with wop. All durations in years.

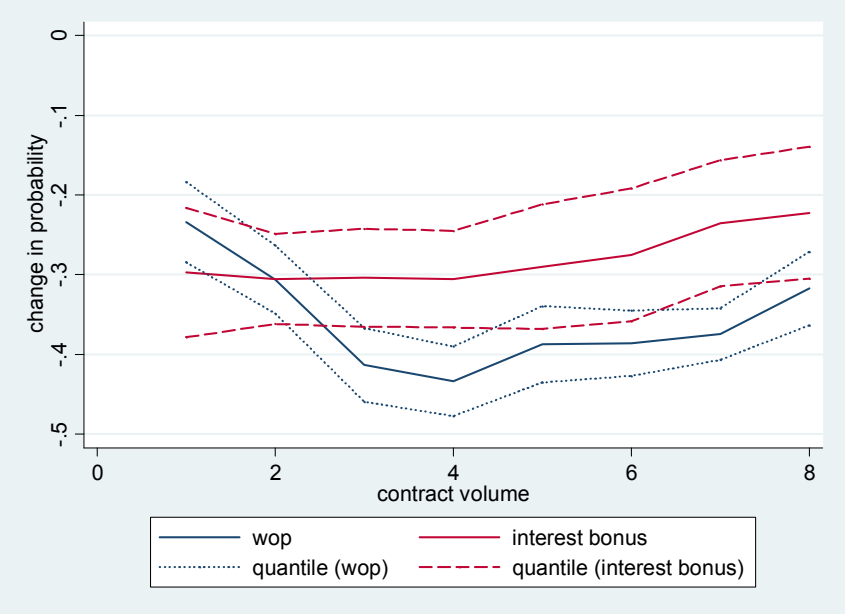
Panel B presents the continuous distribution of cash flow volatility per contract ('vola'). Contracts with interest bonus or wop exhibit lower 'vola' than those without bonus or wop respectively. 'vola' does not seem to differ largely when the contracts' lifetime is during high- and low deposit markets or high- and low GPD market times. Graphs are qualitatively equal if plotted for unemployment or loan rate levels.

Figure 3: Impact of bonus and wop on termination probabilities

Panel A: interest bonus- and wop impact



Panel B: relative impact



Notes:
The first column of Panel A presents the average marginal effects from Table 4, model (2). The change in probability of early contract termination is shown for different contract volume classes if interest bonuses are employed and sanction early contract termination within 4 years. Column 2 of Panel A presents the change in probability for a contract termination within 7 years if the contract is wop eligible (see Table 5, model (2)). The solid lines are estimated average marginal effects, the vertical line present the 95% confidence interval. Panel B presents the change in probability for Table 4, model (4), if interest bonus as well as wop are interacted with contract volume. The dashed lines present the 95% confidence interval. The contract volume classes are defined in € as followed: '1': <5,000, '2': 5,000-10,000, '3': 10,000-20,000, '4': 20,000-30,000, '5': 30,000-40,000, '6': 40,000-50,000, '7': 50,000-100,000, '8': >100,000.