Deposit Competition Beyond Rates
(PRELIMINARY AND INCOMPLETE) *

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Abstract

We study competition and pass-through in the market for retail deposits. Federal funds rate increases are associated with only minimal increases in deposit rates. Leveraging new data on offers mailed by banks to households, we show that federal funds rate increases are strongly associated with changes in mail volumes, sign-up bonuses, and offers targeting new customers. These margins and not deposit rates are the primary ways in which interest rate changes affect the deposit market. We rationalize the use of these margins and not deposit rates in a simple model with active and sleepy depositors. Our model implies that the marginal value of a new depositor is insensitive to interest rates and that depositor heterogeneity and adverse selection, as opposed to market power, are the primary reasons why banks offer far less than the full present value of future rate spreads to depositors.

Keywords: Deposit Competition; Pass-through; Adverse Selection; Marketing

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1 Introduction

Major banks in the United States offer deposit rates of essentially zero on retail checking and savings accounts. When market interest rates, such as the federal funds rate (FFR), increase, these banks pass through little if any of the increase. This lack of pass-through has potentially important implications for competition in the banking market and for the conduct of monetary policy (Neumark and Sharpe, 1992; Drechsler et al., 2017; Wang et al., 2022).

However, banks can compete for depositors without offering higher interest rates. The most direct way to do this is by offering new depositors money for opening an account.[1] Figure 1 shows two offers mailed by Chase and Citizens to households offering cash payments in exchange for opening checking and saving accounts. Both offers clearly emphasize sign-up bonuses (of $500 and $600, respectively), while reporting the interest rate (1bps and 2bps) in very small font. These ads make apparent a fact we confirm in data: almost all checking deposits and many savings deposits earn zero or close to zero interest. At the same time, many banks offer cash bonuses for opening new accounts and advertise these offers via direct mails. The marketing volume and size of these bonuses vary across banks and over time. That is, in this market, the price through which competition occurs is the sign-up bonus, not the interest rate. Our contribution is to examine both empirically and theoretically this form of price competition in the market for checking and savings accounts and to study its implications for depositors behavior and banks franchise value.

In the first part of the paper, we document new facts on banks pricing, advertising, and targeting in the deposit market. To accomplish this, we obtained access to new data that allow us to measure the marketing efforts of large banks in the deposit market. We analyze images from about 2200 unique campaigns issued by 11 large lenders in the period 2014-2023. The lenders in our sample account for about 50% of the approximately $13 trillion of total deposits in domestic offices in the US as of 2019. We observe an estimated measure of total mail volume and dollar spent on campaigns, and we extracted information on signup bonuses from images of the mailings using a large language model.

First, we confirm that there is essentially no pass-through from the federal funds rate to the interest rates on checking and savings accounts, which are essentially zero over our sample period. The existing literature documents a non-zero (but far from complete) pass-through from the federal funds rate to banks' overall interest expense; this is driven by rates on certificates of deposits (CDs), wholesale deposit rates, and the like, as opposed to by checking and savings account rates.[2]

[1]Other ways for banks to compete include opening branches in new areas (Begenau and Stafford, 2023) and offering superior liquidity services (d'Avernas et al., 2023).

[2]We confirm a larger pass-through when looking at 12-months CDs in our data.

Figure 1: Sign-up bonuses and rates on mailed offers

Note: The figure shows the mailed offer for two banks in our sample. The left panel reports an offer from Chase, while the right panel reports an offer from Citizen bank.

Second, we document a large correlation of the federal funds rate with mail volumes, which we take as a measure of the extensive margin of advertising effort. That is, in a high rate environment, banks compete fiercely to attract new customers, while in a low rate environment they offer sign-up bonuses only to select prospects. We find that a 100-basis-points higher federal fund rate is associated to a 11% higher mail volumes for checking and savings accounts. The point estimate is larger for the most popular campaign for each bank and is driven by the banks paying the lowest rates on checking and savings accounts.

Third, we show that the average bonus for both checking and savings accounts is around $250 and its response to higher level of the federal funds rate, which we take as a measure of the intensive margin of advertising effort, is less pronounced than the response of mail volumes. We find that a 100-basis-points higher federal fund rate is associated to a \$16 (\$14) higher bonus for checking (savings) accounts.

Fourth, we study banks' targeting of offers to different markets and demographic groups and how targeting varies with the federal funds rate. We define a target group as the interaction of state, income bins, and age bins and compute the Herfindahl-Hirschman Index (HHI) as a measure of bank campaign concentration in certain target groups. We find that a 100-basis-point higher federal funds rate is associated with a 3 percentage point lower HHI, which corresponds to a 12% decline relative to the average HHI. Combining the extensive margin and the targeting facts, our results point to banks expanding their customer acquisition unconditionally when rates are high, and contracting it conditionally (i.e., focusing on specific groups) when rates are low.

Finally, we leverage three surveys from the same data providers to study depositor switching behavior. We find that a 100-basis-points higher federal fund rate is associated with a 10% higher switching rate for checking and savings accounts. While the point estimate is identified from only very limited time-series variation across survey waves, the direction of the relation is in line with work using detailed individual-level data on account openings and closures by Egan et al. (2025).

In the second part of the paper, we develop a model informed by our new facts to explain the use of these margins. Specifically, we develop a model that clarify why banks prefer to offer sign-up bonuses instead of high interest rates, why this bonus is sensitive to the level of rates, and why the extensive margin of advertising responds very strongly to the level of rates. Armed with such a model, we re-evaluate the degree of competition in the banking market for checking and savings accounts.

The key features of our model are as follows. First, we observe that deposits are "sticky", in the sense that many households do not change banks despite a financial incentive to do so. This creates the potential for bank franchise value. Second, we observe that bonus offers are well below this franchise value and are close to break-even in the event that the customer stays only for the minimum duration required to receive the bonus (usually 90 days). We interpret these findings as evidence of adverse selection; therefore, we model two types of depositors: "sleepy" and "active". Third, we observe that banks never offer very small (<\$50) sign-up bonuses (and that changing bank accounts is a hassle), both of which are consistent with switching costs. We build a model that incorporates these key ingredients and use it to estimate (1) the degree to which bonuses are below the value of the deposit to the bank and (2) the degree to which this difference is driven by adverse selection vs. market power.

Under certain simplifying assumptions, we are able to analytically characterize the equilibrium in our model. Specifically, we construct an equilibrium in which bonuses are constant over time and banks vary their marketing efforts as interest rates change. This can be viewed as capturing our key empirical facts in a stylized way. The key driver of these results is that mailing more offers is a constant marginal cost method of acquiring new depositors whereas increasing the size of the bonus offer has an increasing marginal cost, because the higher bonus must be paid to depositors who would have switched to the bank for a lower bonus. This point in conjunction with the observation that banks' marketing efforts are strategic substitutes (when other banks market more, the value of a new depositor falls) delivers the result.

We calibrate this model using survey data on the rates at which people switch bank accounts in conjunction with our data on bonus levels and marketing volumes. We focus our calibration on savings accounts, since deposit accounts might have other sources of revenue (maintenance fees) and costs (free debit card) that our model does not fully capture. The calibration delivers two key findings. First, the value of a deposit from a typical retail depositor is large as a fraction of the size of the deposit (more than 50%), as a consequence of the fact that banks can pay no interest on these deposits and that deposits switch bank accounts infrequently. Second, the value of a marginal depositor who is considering switching banks is far lower (about 6% of the deposit size), because these depositors are far more likely than the typical depositor to switch accounts again. Put another way, adverse selection explains about 90% of the gap between the value of a typical bank deposit and the bonus the bank offers; market power explains only about 10%.

In the last part of the paper (PRELIMINARY; TBD), we address the shortcomings that arise from the simplifying assumptions we use to characterize the solution and construct a quantitative version of our model. We confirm the findings from our calibration of the analytical model, in particular our conclusion that adverse selection accounts for the bulk of the difference between the deposit value and the bonus. We plan to study the impact of changing depositor composition and the extension of lock-in periods on the equilibrium in the deposit market through counterfactual analyses.

Related literature. Our paper contributes both empirically and theoretically to the large literature studying competition and pricing in banking more generally, and the deposit market more specifically.

First, a large body of literature has studied the role of banks market power in the limited pass-through of monetary policy changes to both credit and deposit markets (Hannan and Berger, 1991; Neumark and Sharpe, 1992; Scharfstein and Sunderam, 2016; Drechsler, Savov, and Schnabl, 2017; Benetton and Fantino, 2021; Wang, Whited, Wu, and Xiao, 2022; Buchak, Matvos, Piskorski, and Seru, 2024). Furthermore, market power on the deposit side has been identified as the key source of banks' franchise value, which varies with the level of the federal fund rate, potentially leading to financial fragility and runs (Egan, Hortaçsu, and Matvos, 2017; Drechsler, Savov, and Schnabl, 2021; Egan, Lewellen, and Sunderam, 2022; Drechsler, Savov, Schnabl, and Wang, 2023; DeMarzo, Krishnamurthy, and Nagel, 2024). Some recent papers have proposed heterogeneity across markets and banks' business models and leveraged new microdata on depositors'behavior to explain and better measure the drivers of depositors' demand (e.g., convenience value) and its (low) average sensitivity to rates (Begenau and Stafford, 2023; d'Avernas, Eisfeldt, Huang, Stanton, and Wallace, 2023; Blickle, Li, Lu, and Ma, 2024; Kundu, Muir, and Zhang, 2024; Lu, Song, and Zeng, 2024; Argyle, Iverson, Kotter, Nadauld, and Palmer, 2025).

We complement this literature by exploiting supply-side data on bank offers and marketing effort, thus providing novel evidence on margins of deposit competition that have been overlooked by previous work. Our model incorporates these new margins and shows how they can help disentangle the role of market power versus adverse selection for deposit pricing and banks' franchise value.

Second, a growing number of papers using tools from the industrial organization literature on differentiated products have been developing structural models to study bank deposit competition and financial fragility (Egan, Hortaçsu, and Matvos, 2017), monetary transmission through shadow banks (Xiao, 2020), the sources of bank value and synergies across markets in deposit taking and lending (Egan, Lewellen, and Sunderam, 2022; Aguirregabiria, Clark, and Wang, 2024), the impact of digital banking (Koont, 2023; Jiang, Yu, and Zhang, 2024), and the role of depositor sleepiness for bank's competition and stability (Egan, Hortaçsu, Kaplan, Sunderam, and Yao (2025), Lu and Wu (2025)).

The majority of these papers have focused on exogenous vertical and horizontal differentiation across banks as the source of market power and endogenous deposit rates as the key competition variable.[3] Our new facts and modeling approach contribute to this literature by adding targeted marketing and multi-dimensional pricing as important choice variables for bank competition, in line with some recent work studying the mortgage market (Gurun, Matvos, and Seru, 2016; Benetton, Gavazza, and Surico, 2025).

Third, the banking literature has extensively studied the role of asymmetric information and adverse selection on the asset side of banks' balance sheet (Einav, Jenkins, and Levin, 2012; Crawford, Pavanini, and Schivardi, 2018; Hertzberg, Liberman, and Paravisini, 2018; Nelson, 2018; Lester, Shourideh, Venkateswaran, and Zetlin-Jones, 2019; Matcham, 2024; Benetton and Buchak, 2024). In credit markets, increasing loan rates, decreasing downpayment requirements, and extending maturity

[3] Koont (2023) also endogenize technology adoption and Jiang, Yu, and Zhang (2024) also endogenize branch choice. Egan, Hortaçsu, Kaplan, Sunderam, and Yao (2025) study dynamic competition with heterogeneous banks and sleepy depositors.

attract borrowers that are more likely to default.

We show that adverse selection is an important friction also on the liability side of banks' balance sheet. Temporarily high deposit rates or sign-up bonuses attract depositors that are more likely to leave, and hence less valuable in present-value terms for banks. Our results show that equilibrium prices on banks' deposit side are jointly determined by market power and adverse selection, with implications for market structure (e.g., barriers to entry) and depositor welfare.

Overview. The result of the paper is organized as follows. Section 2 describes the new data we use and summary statistics. Section 3 presents the facts on deposit pricing and acquisition. Section 4 presents our model and a special case with an analytic solution. Section 5 presents an illustrative calibration; we intend to add a more detailed calibration in the future. Section 6 concludes.

2 Data and Summary Statistics

2.1 Data Sources

Our analysis exploits a rich database on offers for checking and saving accounts mailed by banks to households during the period 2014-2024. We complement our main database on mailed offers with additional data on banks' deposit rates, the federal fund rate, and households deposits.

Comperemedia. The Comperemedia Direct Mail dataset collected by Mintel is a comprehensive database that tracks and analyzes marketing campaigns in the United States sent through direct mail (and more recently via email) by companies across various industries, with a particular emphasis on financial services, telecommunications, insurance, and other consumer-focused sectors. The database is based on a panel of more than 17,000 households (15,000 rolling and 2,500 lifecycle), which are paid to collect all direct mailers and send the originals to Mintel. The company invite each month about 6,000-6,500 panelist to participate, balancing them by age, income, region and household size, and target a response rate of 50%. Similar data have been used in previous academic research on credit cards (Ru and Schoar, 2016; Han et al., 2018), while we are the first to exploit information about offers for deposit accounts (checking and savings).

We obtained access to the Comperemedia Archives which is a repository of all Comperemedia Direct campaign data collected from the last 10 years. Within the banking industry we obtained all the images captured from offers sent by the largest banks in the US between 2014 and 2024 under the categories categories checking and savings. We run all the images through a large language model

(LLM) to extract the relevant information on the offer: sign-up bonus, minimum deposit or balance requirement, minimum days. We also attempted to extract information on interest rate. However, in line with the evidence in Figure 1, interest rates are generally reported in very small font making it difficult to extract precise data. For this reason, we complement our rich information on contract offer with standard information on deposit rates from RateWatch.

The bonus offers sent to consumers are not standardized, and banks do not use a common vocabulary when describing the accounts they offer. For these reasons, building a structured dataset of comparable offers from the raw image data is a non-trivial endeavor. In Appendix A, we describe the classification schema we implement and the way in which we use the LLM to construct the dataset.

RateWatch - S&P Global Market Intelligence. For deposit rates we follow previous research and use data from RateWatch, which since 2018 has been acquired by S&P Global Market Intelligence. The S&P Capital IQ Pro platform provides a vast database containing deposit, loan and fee information for financial institutions across the US collected from over 96,000 branch locations. We focus on the same list of banks that we have data for based on the Comperemedia dataset and extract information on the two most popular deposit rate products in our sample: (i) interest checking with a minimum deposit of $2.500, and (ii) savings with a minimum deposit of $2.500.

FRED Economic Data. We obtained information on the federal fund rate (FFR) at the monthly level from the FRED, Federal Reserve Bank of St. Louis. The data can be downloaded here: `https://fred.stlouisfed.org/series/FEDFUNDS`.

Survey of Consumer Finances. We obtained information on households average deposits from the Survey of Consumer Finances. The data can be downloaded here: `https://www.federalreserve.gov/econres/scfindex.htm`.

2.2 Summary Statistics

Table 1 reports summary statistics on the main variables used in the analysis. Our main database is based on approximately 2200 unique campaigns issued by 11 lenders in the period 2014-2023. The lenders in our sample are the following: Bank of America, Capital One, Chase, Citibank, Citizens Bank, Discover, Fifth Third Bank, PNC, TD Bank, U.S. Bank, and Wells Fargo. Together, these banks account for about 50% of the about $13 trillions of total deposit in domestic offices in the US as of 2019.

Panel A of Table 1 reports these variables for the full sample. The average campaign is mailed to 1.1 million US households. The median campaign is sent to about 315 thousands households, but some popular ones are sent to more than 40 million households. These large numbers emphasize how physical mail is an important tool for banks' customers acquisition and retention.

Comperemedia classifies emails into acquisition and retention. The former are defined as offers of a new product or service to a consumer who is not a current customer of the issuing bank, while the latter are new product or service offered to a current customer of the issuing bank in addition to the current product or service, without replacing the current product or service. An example of a retention offer is a mail to a Chase credit card account holder for opening a checking account with Chase. In our sample about 80% of the mail are classified as acquisition and the remaining ones as retention.

Panels B and C of Table 1 report variables for checking and saving offers, respectively. We treat these two product categories separately because they are typically associated with different types of bonus offers and may differ in terms of the revenues they create for banks. Checking accounts typically require a low or zero minimum deposit to receive the sign-up bonus, and instead require that the depositor set up direct deposit. Saving accounts generally require that the depositor maintain specified balance for a given amount of time (e.g. a $15,000 minimum deposit for at least 90 days).

Almost 90% of checking offers are for the acquisition of new customers, consistent with checking being an entry product for potentially future cross-selling. Indeed, according to the Survey of Consumer Finances in 2023, almost 95% of respondents have a checking account, while about 55% have a savings account. The average incentive is approximately $280, which is very similar to the median incentive of $300. The median minimum deposit for checking account is $500, while the average is much higher at $1500, due to some large outliers. Several offers require a minimum number of days that the checking account should be kept open, with the median being 90 days. Finally, the average rate is three basis points and the median rate is one basis point, in line with checking accounts paying close to zero interest.

Turning to saving accounts Panel C of Table 1 shows that about 80% of saving offers are for acquisition of new customers consistent with saving being a relatively less common than checking. The average incentive is approximately $215, which is very similar to the median incentive of $200. The average minimum balance for checking account is $16,000, which again is very similar to the median balance of $15,000. Using the bonus and the minimum balance, we compute an implied saving rate, which is defined as the incentive divided by the minimum balance. The median implied saving rate is 1.3%. Given a requirement to hold the minimum balance for at least 90 days, we can

Table 1: SUMMARY STATISTICS

	Observations	Mean	Std. Dev.	Minimum	P5	Median	P95	Maximum
Panel A: Full sample								
Mail volumes (.000)	3,970	1,291.79	2,825.76	38.50	70.83	359.51	5,591.83	44,707.12
Mail dollar (.000)	3,970	479.59	921.61	18.48	36.72	162.09	2,110.27	12,875.65
Acquisition (%)	3,970	85.59	35.12	0.00	0.00	100.00	100.00	100.00
Retention (%)	3,970	14.21	34.92	0.00	0.00	0.00	100.00	100.00
Federal Fund Rate (%)	3,970	1.65	1.58	0.05	0.08	1.21	5.08	5.33
Panel B: Checking								
Acquisition (%)	2,775	90.52	29.30	0.00	0.00	100.00	100.00	100.00
Retention (%)	2,775	9.23	28.94	0.00	0.00	0.00	100.00	100.00
Incentive ($)	2,775	278.67	84.08	0.00	150.00	300.00	400.00	600.00
Minimum deposit ($)	2,775	965.77	1,481.71	0.00	0.00	500.00	4,000.00	15,000.00
Minimum balance days	1,178	90.38	8.81	30.00	90.00	90.00	90.00	182.00
Rate (%)	944	0.03	0.06	0.00	0.01	0.01	0.20	0.30
Panel C: Saving								
Acquisition (%)	2,345	84.48	36.22	0.00	0.00	100.00	100.00	100.00
Retention (%)	2,345	15.52	36.22	0.00	0.00	0.00	100.00	100.00
Incentive ($)	2,345	218.11	118.82	0.00	100.00	200.00	400.00	2,500.00
Minimum balance ($)	2,345	16,002.13	13,163.21	5,000.00	5,000.00	15,000.00	25,000.00	250,000.00
Incentive - 15K min balance ($)	2,345	230.22	111.13	0.00	100.00	200.00	500.00	600.00
Minimum balance days	1,977	82.96	20.32	10.00	60.00	90.00	90.00	365.00
Rate (%)	1,039	0.27	0.70	0.01	0.01	0.01	1.75	4.35

Note: The Table shows the main variable in our analysis. Panel A reports statistics for the full sample of offers, Panel B focuses on offers for checking accounts, and Panel C focuses on offers for saving accounts. Mail volumes is the research panel's adjusted direct mail volume sent by a company in a given period for a specific campaign projected to the entire national population. Acquisition is a dummy for offers of a new product or service to a consumer who is not a current customer. Retention is a dummy for offers a new product or service to a current customer of the issuing bank. Incentive is the value in dollars of the sign-up bonus. Rate is the average rate from Ratewatch for checking and saving products.

interpret this implied rate as a quarterly return, under the assumption that the depositor re-optimize when the minimum balance days end. Finally, the rate on savings accounts is higher than on checking accounts, as expected. However, the median rate is still low at one basis point, while the average is about 27 basis points. This difference reflects heterogeneity in banks' strategies. Some of the banks in our sample (Capital One, Discover, Citizens) offer savings rates that co-move with the federal funds rate; the other banks in our sample offer savings rates that are essentially zero. In what follows, we will refer to the three aforementioned banks as "high-rate" banks.

3 Facts on Deposit Pricing and Acquisition

In this section we present several facts derived from the data just described. Our goal is to document the main patterns with respect to deposit pricing and competition in the US in the period

2014-2024. We begin by looking at deposit rates, which have been the primary object of analysis in the existing literature. We then pay special attention to our new outcome variables: marketing, sign-up bonuses, and targeting.

We first present our facts as a simple unconditional correlation of different variables capturing banks' deposit pricing and acquisition with the federal fund rate. We then provide conditional correlation controlling for time-invariant differences across banks and other time-varying factors affecting deposit pricing. The purpose of banks fixed effects is to show that our facts hold within banks over time and are not driven by bank composition effects as the federal fund rate changes. Most notably, using our monthly panel of campaigns over time, we estimate the following baseline regression:

$$y^k_{ilt} = \alpha^k FFR_t + \lambda^k X_{lt} + \gamma^k_l + \epsilon^k_{ilt}, \tag{1}$$

where k index the product (checking or saving), FFR_t is the federal fund rate (in percentage points), X_{lt} are lender and time (interacted) controls, and γ_l are lender fixed effects. The dependent variables y^k_{ilt} are: the interest rate (in basis points), total mail volumes and dollar spent (in log), sign-up bonus (in \$), and two measures of targeting which we discuss below. For rates and sign-up bonuses we estimate equation (1) separately for checking and saving offers. The key parameter of interest is α which captures the correlation of different margins of banks deposit pricing and competition with the federal fund rate.

3.1 Deposit Rates

We begin by looking at how banks adjust deposit rates on checking and saving accounts as a function of the federal fund rate. Figure 2a shows the federal fund rate from 2014 to 2024 as well as the average rate on the two most popular checking and saving products using the RateWatch - S&P Global Market Intelligence data. The average rate on checking accounts is close to zero and remarkably stable over time despite the large changes in the federal fund rate. The average rate on saving accounts is on average higher than the rate on deposit account and shows more variability over time. Most notably, as the federal fund rate increases also the rate on saving account increases, but the changes in the latter are much smaller than the changes in the former in line with the existing literature on imperfect deposit rate pass-through (Neumark and Sharpe, 1992; Drechsler et al., 2017).

Columns (1) and (2) of Table 2 show the results of equation (1) using the checking and saving rates as dependent variables. Column (1) shows that within bank a 100-basis-point higher federal fund rate is associated with less than 1-basis-point higher rate on checking accounts. The point estimate

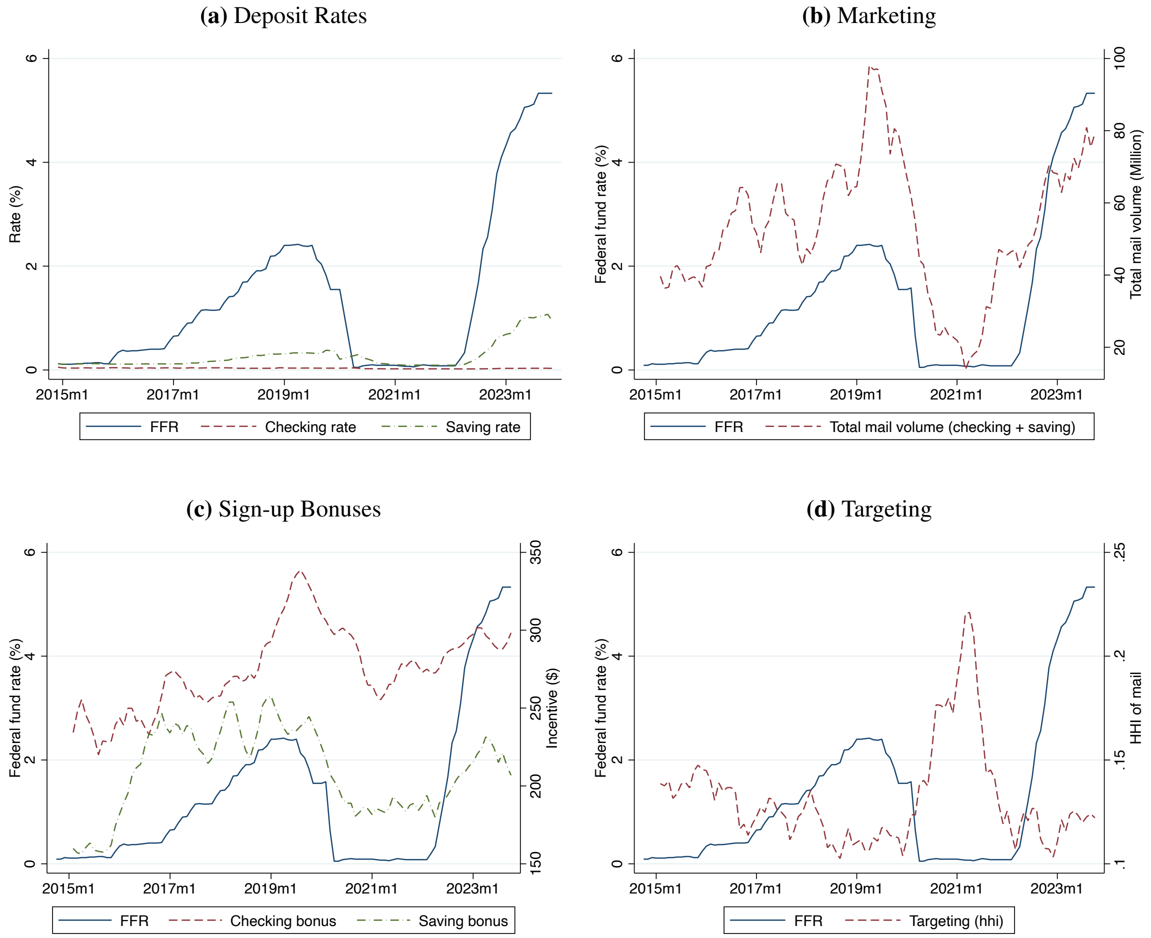


Figure 2: Pass-through on Checking and Savings Products - Rates, Mails, Bonuses and Targeting

Note: The figure plots the federal funds rate (2014–2024) alongside the following variables: (a) average checking and saving rates from RateWatch – S&P Global Market Intelligence; (b) total mail volume in millions of checking and saving offers using the Comperemedia data; (c) average sign-up bonus in dollars for checking and saving products using the Comperemedia data; (d) average Herfindahl-Hirschman Index (HHI) at the campaign-month based on the volume of mails sent to target groups defined as triplets of state, income, and age bins using the Comperemedia data.

in column (1) is statistically significant, but the magnitude is tiny at about 0.26 basis points. Turning to saving accounts, column (2) of Table 2 shows that a 100-basis-point higher federal fund rate is associated with a 13-basis-point higher rate on saving accounts. In line with the literature and the unconditional pattern from Figure 2a, the within-bank pass-through from the federal fund rate to the deposit rate is higher for saving accounts than checking accounts, but also for saving accounts, the change in rates is only a small fraction of the change in the federal fund rate.[4]

[4] We estimate the same specification for rates on 12-month certificate of deposits with an account size of $10,000 also using the RateWatch - S&P Global Market Intelligence data. We find a point estimate for the coefficient on the federal fund rate of about 30 basis points, again in line with the literature finding relatively larger but still imperfect pass-through for

Table 2: PASS-THROUGH ON CHECKING AND SAVINGS PRODUCTS - RATES, MAILS, BONUSES AND TARGETING

	Deposit Rates (bps)		Marketing (log)		Sign-up Bonus ($)		Targeting	
	Checking (1)	Saving (2)	Mail volume (3)	Dollar spent (4)	Checking (5)	Saving (6)	HHI (7)	Number of states (8)
Federal fund rate (%)	0.26***	12.55***	0.11***	0.11***	16.39***	13.40***	-0.02***	0.60***
	(0.05)	(1.45)	(0.02)	(0.02)	(1.51)	(2.18)	(0.00)	(0.13)
BANK F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BANK-TIME CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DEP. VAR. (MEAN)	3.27	26.84	13.43	12.64	276.92	214.51	0.25	10.24
DEP. VAR. (SD)	5.76	70.01	1.53	1.39	88.84	114.32	0.29	9.34
R^2	0.84	0.62	0.28	0.28	0.28	0.42	0.08	0.41
OBSERVATIONS	944	1,039	3,966	3,966	2,838	2,353	3,803	3,803

Note: The Table shows the results of equation (1). Deposit rates is the average deposit rate in basis points for checking and saving products from Ratewatch. Mail volume and dollar spent are the total across all banks in our sample of estimated direct mail volume and dollar spent from Comperemedia. Sign-up bonus is the average sign-up bonus in dollar for checking and saving offer from Comperedia. HHI is the Herfindahl-Hirschman Index (HHI) at the campaign-month based on the volume of mails sent to target groups defined as triplets of state, income, and age bins. Robust standard errors in parenthesis. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

In Appendix B we report additional analyses to test the robustness of our descriptive facts and explore some relevant dimensions of heterogeneity. The results are robust to excluding Chase, which is by far the largest advertiser in our sample, and the point estimates are only slightly larger when considering the cumulative effect of four months lags in the federal fund rate. Finally, we estimate (1) with an additional interaction between the federal fund rate and a dummy for banks with relatively higher rates throughout our sample period. We find that the larger correlation between the federal fund rate and the saving rate is driven by a specific set of banks, in line with the work by Kundu et al. (2024). When the federal fund rate is 100 basis points higher, the majority of large banks barely change their rate on saving accounts, while a few high-yield banks offer almost 50-basis-point higher saving rates. We summarize the findings on deposit rates, which we view as consistent with the existing literature, as follows.

Fact 1: Deposit rates. *A 100-basis-points higher federal fund rate is associated with a higher rate on checking account by less than 1 basis point and on savings accounts by about 13 basis points. The latter is driven by a few high-yield banks, while the majority of large banks do not change saving rates.*

3.2 Marketing via Direct Mail

Next we look at how banks adjust marketing effort in relation to the federal fund rate. We measure marketing effort using total mail volume and dollar spent only for campaigns to attract new depositors

time deposits (Drechsler et al., 2017).

for checking and savings accounts. Figure 2b shows that mail volume varies with the level of the federal fund rate. In 2015, when the federal fund rate is around zero, the total amount of mails sent monthly by banks is about 40 million. As the federal fund rate rose to more than 2% in 2019, the total amount of monthly mails peaked at around 100 million, before dropping below 30 million as the federal fund rate went back to zero in response to the Covid-19 Pandemic. Following the recent monetary policy tightening in 2022 to fight inflationary pressure, mail volume started rising again, reaching 80 million by 2023.

Overall, the correlation between the federal fund rate and the mail volume is about 0.7. Figure A1a in Appendix B shows a very similar correlation between the federal fund rate and the amount of dollar spent monthly on mails for checking and saving accounts offers, which was below 10 million in 2021 and rose above 30 million by 2023. Interestingly, Figure A1b in Appendix B shows that the volume of mail offers for mortgages displays a very different pattern, increasing when low rates incentivize refinancing. Bank-level measures of advertising expenditures thus fail to account heterogeneous responses across different products.

Columns (3) and (4) of Table 2 show the results of equation (1) using the total mail volumes and dollar spent for checking and saving offers as dependent variables. Column (3) shows that within bank a 100-basis-point higher federal fund rate is associated with a significant and large increase in mail volume and dollar spent. The point estimate is about 11%.

In Appendix B we show that the point estimates drop to 9% when excluding the Chase, but remain large and statistically significant (Table A1), and increase to 17%, when focusing on the largest campaign within each bank-time pair (Table A2) . The point estimates are also slightly larger at about 14% when considering the cumulative effect of four months lags in the federal fund rate (Table A3). Finally, we find that our baseline estimates in Table 2 are driven by the largest banks paying essentially zero rates on checking and savings accounts. Table A4 shows that when the federal fund rate is 100-basis-points higher, the majority of large banks increase their direct mail volume by about 14% (relative to our average estimate of 12%), while a few high-yield banks do not change their marketing effort (i.e., the interaction term is negative and equal in magnitude to the direct effect). We summarize these new findings on marketing via direct mail as follows.

Fact 2: Marketing. *A 100-basis-points higher federal fund rate is associated with a higher volume of mail offers for checking and saving accounts by 11-17%. The effect is driven by the largest banks paying essentially zero interest rate on checking and savings accounts.*

3.3 Sign-up Bonuses

Next we look at how banks adjust sign-up bonuses as a function of the federal fund rate. Since some banks do not mail bonus offers in each month, some of the time series variation is the result of banks moving in and out of the sample. To account for this compositional effect, we regress sign-up bonuses on bank and time fixed effects and then compute the average predicted sign-up bonuses using the estimated time fixed effects. Figure 2c reports the results. The average sign-up bonuses on both checking and saving accounts are positively correlated with the federal fund rate, but the correlation is less stark than the one of mail volumes shown in Figure 2b.

Columns (5) and (6) of Table 2 show the results of equation (1) using the average sign-up bonus for checking and saving offers as dependent variables. A 1-percentage-point increase in the FFR is associated with a \$16 increase in sign-up bonuses for checking accounts. Given an average sign-up bonus of about \$277, this corresponds to approximately a 6% increase relative to the mean. Turning to savings accounts, a 1-percentage-point increase in the federal fund rate is associated with a \$13 increase in sign-up bonuses, which corresponds to a 6% increase relative to an average sign-up bonus of about \$214.

In Appendix B we show that the point estimates are robust to excluding the Chase (Table A1), and slightly larger when focusing on the largest campaign within each bank-time pair (Table A2) and when considering the cumulative effect of four months lags in the federal fund rate (Table A3). Finally, we find that our baseline estimates in Table 2 are similar for checking accounts across all banks in our sample, while for savings accounts the increase in sign-up bonuses is driven by high-yield banks. Table A4 shows that when the federal fund rate is 100-basis-points higher, the majority of large banks increase sign-up bonuses for savings by only \$6 (3% relative to the mean), while a few high-yield banks increase sign-up bonuses for savings by almost \$30 (13% relative to the mean). We summarize these new findings on sign-up bonuses as follows.

Fact 3: Sign-up bonuses. *A 100-basis-points higher federal fund rate is associated with higher sign-up bonuses for checking and savings account by \$13-16, a 6% increase relative to their respective mean sign-up bonuses. The effect for checking accounts is similar across banks, while the effect for savings accounts is driven by a few high-yield banks, which increase sign-up bonuses by almost \$30 (13%) per 100-basis-points higher FFR.*

3.4 Targeting

Finally, we look at how banks target their marketing effort at different levels of the federal fund rate. We construct two simple proxies for targeting. First, we look at the number of unique states each campaign is sent to. Second, we construct target groups as triplets of state, income, and age bins and compute for each campaign-month the volume of mails sent to each group. We then sum across groups to compute the Herfindahl-Hirschman Index (HHI) at the campaign-month level as a measure of concentration in certain target groups. A campaign with an HHI of one is sent to only a specific target group (e.g., young households with low income living in California).

Figure 2d shows that the HHI varies with the level of the federal fund rate. In 2015, when the federal fund rate is around zero, the HHI was around 0.15. As the federal fund rate rose to more than 2% in 2019, the HHI decline to 0.10, before increasing to more than 0.20 in 2021 as the federal fund rate declined in response to the Covid-19 Pandemic. Following the recent monetary policy tightening in 2022, the HHI declined again to around 0.12 as large banks sought to acquire more profitable customers.

We provide additional evidence of time-varying targeting in Appendix B. Figure A2a reports the fraction of households receiving any mail for checking or saving offers relative to the total number of respondents. During the year 2020, only 5-7% of households received an offer, while following the monetary policy tightening by 2023, one in five households received an offer for a checking or saving product. Figure A2b exploits the split of offers into acquisition (entirely new customer for the bank) vs retention (existing customer solicited for a new product), as discussed in Section 2. Mail volume for acquiring new customers for checking and saving products strongly comoves with the federal fund rate, while mail volume for retaining existing customers is acyclical. Hence banks target specific depositors when rates are low (perhaps with cross-selling strategies), while they expand their reach when rates are high.

Columns (7) and (8) of Table 2 show the results of equation (1) using the our main proxies for targeting as dependent variables. Column (7) shows that within bank a 100-basis-point higher federal fund rate is associated with a significant decline in the HHI. The point estimate is 2 percentage points, which corresponds to a 8% decline relative to the average HHI. Column (8) shows that within bank a 100-basis-point higher federal fund rate is also associated with a significant increase in the number of different states where banks send mail offers. The average campaign is sent to 10 different states, and when the federal fund rate increase by about 175 basis points the campaign is sent to a new state.

In Appendix B we show that the point estimate for the HHI is remarkably stable. The point estimate for the number of states drops when excluding the Chase, but remains large and statistically significant, and increases when focusing on the largest campaign within each bank-time pair. Finally, we find that our baseline estimates in Table 2 for both the HHI and the number of states are driven by the largest banks paying essentially zero rates on checking and savings accounts (Table A4). We summarize these new findings on targeting as follows.

Fact 4: Targeting. *A 100-basis-points higher federal fund rate is associated with a 2-percentage-points lower concentration of mail offers, which corresponds to a 8% decline relative to the average. Large banks expand their customer acquisition unconditionally when rates are high, and contract their effort conditionally (i.e., focusing on specific groups) when rates are low.*

3.5 Depositors Switching

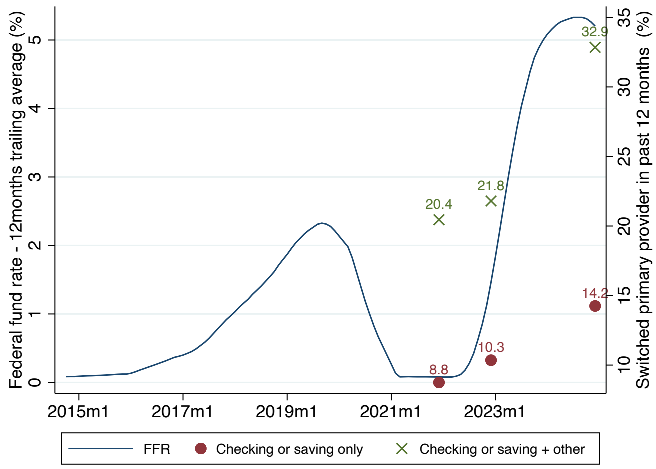
Our new facts focus on variables that are under the direct control of banks, such as rates and sign-up bonuses on checking and savings accounts, marketing volume, and targeting. We now look at depositors switching, which is the result of both banks' efforts (via sign-up bonuses, marketing, etc.) and depositors' actions. Most notably, we study the relation between the level of the federal fund rate and the fraction of households switching their primary checking or saving account provider. We capture the latter using three surveys from Comperemedia and the answer to the following question: *"For which of the following financial products have you switched your primary provider in the past 12 months?"*. We compute two measures of switching. Our first measure represents a lower bound on switching as it considers households who switched their primary checking or saving account and no other products. Our second measure represents an upper bound since it includes households switching checking or saving accounts plus any other products.[5]

Figure 3 shows that as the federal fund rate increased from close to zero in 2021 to about 5% in 2023 the fraction of households switching their primary checking or saving account provider also increased. While our time-series variation is limited to three surveys, we nonetheless regress the average fraction of households switching their main checking or saving account provider on a 12-months trailing average of the federal fund rates.[6] We find that a 100-basis-points higher federal fund rate is associated with one-percentage-point more switching when looking at checking and savings only, and 2.6-percentage-points when looking at checking and savings plus other products. In both cases the effect is statistically significant and corresponds to about 10% of the respective mean. While

[5]For example, banks might require a household opening a new credit card or taking a new mortgage to also open a checking account with the bank.

[6]The first two surveys where conducted on two different months so that our total number of months is five.

Figure 3: SWITCHING OF CHECKING AND SAVINGS ACCOUNTS



	Switched primary provider in past 12 months (%)	
	Checking or saving only	Checking or saving + other
	(1)	(2)
Federal fund rate (%)	1.01***	2.60***
	(0.06)	(0.25)
DEP. VAR. (MEAN)	10.39	22.76
DEP. VAR. (SD)	2.32	5.97
R^2	0.94	0.94
OBSERVATIONS	5	5

Note: The figure shows the 12-months trailing average of the federal fund rate and the fraction of respondents who switched their primary provider in the last 12 months. We report both the fraction that switched checking and saving accounts only and the fraction that switched checking and saving accounts plus any other product (e.g., mortgages, credit card). The Table shows the results of equation (1) estimated on our survey data. The dependent variables is the fraction of respondent who switched their primary provider in the past 12 months. Robust standard errors in parenthesis. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

the point estimate is identified from only very limited time-series variation across survey waves, the direction of the relation is in line with work using detailed individual-level data on account openings and closures by Egan et al. (2025).

We emphasize that our estimates in Figure 3 do not represent an elasticity of depositor demand to the deposit rate. Indeed we show that the deposit rate on checking and saving accounts barely moves with the federal fund rate (Fact 1). However, banks adjust other margins as the federal fund rate changes (Facts 2, 3 and 4). Hence the higher depositors switching rate at higher levels of the federal fund rate (Fact 5) could be the result of a multi-dimensional bank acquisition strategy. We summarize these new findings on switching as follows.

Fact 5: Switching. *A 100-basis-points higher federal fund rate is associated with 10% more switching for checking and saving accounts.*

4 Model

In this section, we develop a model that speaks to our evidence presented in the previous section. The primary purpose of this model is to explain why banks compete on the extensive margin (mailing more bonus offers) instead of on price margins (either by raising bonuses or by offering non-zero interest rates) as interest rates rise.

After developing the model, we will consider (1) its implications for the relationship between interest rates and franchise value and (2) the model's explanation for why bonuses are low relative to the net present value of net interest margins.

On the latter point, observe that a representative bonus offer for a savings account would involve a \$200 bonus that is earned by maintaining a \$15,000 balance for three months. If the market interest rate is 1% per quarter and the banks pays no interest on the account, the bonus is worth four months of net interest margin. If the average depositor switches accounts every sixteen years, the bonus represents only a small fraction of the value of the average depositor to the bank.

Our model incorporates two possible explanations for this gap:

1. Banks could have a large amount of market power.

2. Bonus offers could be subject to adverse selection, in that depositors who respond to the bonus offer are far more likely to be active than the average depositor.

We develop a model of competition within a single product/market. There are a continuum $j \in [0,1]$ of banks and a continuum of depositors $i \in [0,1]$. Each bank with mass dj can potentially serve a subset of depositors with mass Jdj, where $J > 1$. We will refer to the subset of these depositors that are not currently with the bank as the bank's potential depositors. We assume each depositor with mass di can be served by a subset of banks with mass $J^{-1}di$, and refer to these, excluding the depositor's current bank, as the depositor's potential banks.

The depositors can be of one of two fixed types, which we will call type S ("sleepy") and A ("active"). There is a mass μ_S of sleepy depositors and a mass $\mu_A = 1 - \mu_S$ of active depositors. The type of a depositor is known to the depositor but not the bank, and we assume for simplicity that it is fixed over time.

Time is continuous. At each time t, each depositor will hold a fixed amount of deposits w at a single bank. The bank will earn an interest rate r_t on these deposits. For now, we will assume that banks pay no interest to depositors, and justify this assumption in an extension below. Banks can offer sign-up bonuses $b_{jt} \geq 0$ to a fraction $\alpha_{jt} \in [0,1]$ of the population of its potential depositors to induce them to switch their deposits. These bonuses are proportional to the amount deposited, and are not available to existing customers of the bank.

The cost to bank j of offering a bonus to a fraction α_{jt} of potential depositors is proportional to α_{jt}. The constant of proportionality depends on the bank's ability to target its offers. A bank that is unable to target its offers faces a flow cost $\chi\alpha_{j,t}dt$. A bank that is perfectly able to target its offers to the portion of the population that will consider the offer pays a flow cost $\chi\alpha_{j,t}\psi^* A(\cdot)dt$, where

$A(\cdot)$ is the fraction of the population that will attend to the offer and is defined below. In our analytic results, we assume perfect targeting, which allows the model to generate sharper results at the expense of missing certain features of the data. In our quantitative analysis, we will consider an intermediate case in which the cost is a weighted average of the perfect and untargeted cases, which allows us to better fit our data.

In each instant dt, a fraction $\psi_A dt$ and $\psi_S dt$ of active and sleepy depositors will consider switching banks (be "awake"). Each of these depositors will choose between their current bank j and one other bank j', drawn in an endogenous way from the set of banks (excluding the depositors' current bank). If the depositor received a bonus offer from bank j', they will take the bonus $b_{j't}$ into account. If they did not receive a bonus offer, they will treat that bank as-if they received a bonus offer of zero.

Whether a particular depositor awakens is independent across time, depositor, and banks. The active depositors are awake more often than the sleepy depositors, $\psi_A > \psi_S$.

Depositors experience utility from consumption. As a simplification, we will assume depositors are ex-ante identical and that they consume the bonus payments they receive, so that the deposit wealth w_{it} remains constant, $w_{it} = w$ for all t. This simplification avoids the need to track a changing distribution of wealth across time. We will assume that the depositors' rate of time preference is equal to the interest rate, r_t, and that their utility is linear in their bonus income.[7] Implicitly, we have in mind that borrowers keep only the wealth required for transactions in deposit form, and that they are at least as impatient as the owners of the bank. This interpretation can also explain why the depositors' wealth is not sensitive to interest rates–depositors who are sensitive to interest rates have already minimized the share their wealth in non-interest-bearing accounts.

We will study a Markov equilibrium with time-variation in the log short rate banks earn on their investment, r_t. We assume that this rate is generated from a factor model with K factors $f_t \in \mathbf{F} \subset \mathbb{R}^K$ that follow a continuous Markov process. We assume that the set $\mathbf{F}$ is compact and that the short rate is a strictly positive continuous function of the factors, $r_t = r(f_t)$. Let $\mathbb{Q}$ denote the bank's risk-neutral measure. This measure, as opposed to the physical measure $\mathbb{P}$, will be the relevant measure in most of what follows.

Let $Q_t \in \Delta(\{A, S\} \times [0, 1])$ be the density of active and sleepy households at each bank $j \in [0, 1]$ at time t, and let $Q_{Ajt} = Q_t(A, j)$ and $Q_{Sjt} = Q_{St}(S, j)$ be the population at bank j. The population density Q_t and the term structure factors f_t are the aggregate state variables of the model.

[7] Our results would extend readily to the case in which depositors are less patient than the bank. If depositors were more patient than the bank, there would be gains from paying them slowly over time via interest rates instead of upfront via bonuses.

We will construct a symmetric Markov equilibrium in which the bonuses b_{jt} and offer volumes α_{jt} are functions of the factors f_t only and $Q_{Xt}(j) = \mu_X$ for $X \in \{A, S\}$. The key to this construction is that each bank is infinitesimal, and treats the population of potential depositors at other banks as fixed. This rules out strategic interactions that are in our view second-order.[8]

We will first describe the depositor's problem, and then the bank's problem.

4.1 The Depositor's Problem

Depositors have a rate of time preference r_t and experience locally linear utility from the bonus income and non-pecuniary benefits they receive when switching to bank j'. At each time t, the depositor holds wealth w at some bank j.

Depositors awaken each period with probability ψ_X. When awake, they make their switching decision in two stages. First, they select a bank that is not their current bank to consider. Then, they decide whether or not to switch from their current bank to the selected bank.

In the equilibria we study, from the perspective of a individual depositor, all banks are identical apart from the bonuses they offer. For this reason, even though in principle the depositor's problem is forward-looking, nothing in the choices the depositor makes today affects their future opportunities. The depositor's problem can thus be re-cast as a static optimization. In the main text, we summarize the equations that determine depositor choice; their derivations can be found in Appendix Section C.

Suppose a borrower is considering switching from bank j to bank j' and has been offered a bonus of $b \cdot w$. If the borrower switches, she has to pay a switching cost $\delta \cdot w$ and will enjoy a utility (in monetary units) of $\sigma\epsilon_{ij't}$ per unit wealth. If the borrower stays, they will instead enjoy utility $\sigma\epsilon_{ijt}$. The random utilities ϵ_{ijt} and $\epsilon_{ij't}$ are type-1 extreme value distributed and I.I.D. across agents, banks, and time. Let $D(b)$ denote the probability under these circumstances. Given our assumptions,

$$D(b) = \frac{\exp(\sigma^{-1}(b - \delta))}{1 + \exp(\sigma^{-1}(b - \delta))}. \tag{2}$$

Let us now consider how the depositor selects a bank j' to consider. Each depositor is a potential depositor for a mass J^{-1} of banks. Suppose that two of these banks have offered bonuses b and b'. We assume a functional form that implies that the relative likelihood of the depositor considering these two banks is $(1 - D(b))^{-\sigma\theta}/(1 - D(b'))^{-\sigma\theta}$.

[8] One example is the following: each sleepy depositor the bank attracts makes the future population it could attract slightly more likely to be active, which slightly reduces the value of attracting a sleepy depositor. We eliminate this effect by making the bank infinitesimal, so that it treats the population of depositors at other banks as exogenous.

The intuition behind this functional form is that borrowers are more likely to consider banks that offer them higher expected utility (again, see Appendix Section C for details). The parameter θ controls the extent to which this is the case. When $\theta = 0$, borrowers are equally likely to consider all banks. In this case, banks trying to attract new depositors must compete only against the depositor's current bank, which cannot offer a bonus but benefits from the switching cost. When $\theta = \sigma^{-1}$, the model is equivalent to a standard logit model with a continuum of choices, and features a constant elasticity. As θ becomes arbitrarily large, to be considered, a bank must offer more value (i.e. a higher bonus) than any other bank. The parameter θ can thus be understood as indexing the degree to which depositors consider a single bonus offer or multiple competing bonus offers.

Now suppose that one bank has offered a bonus of b, a share α^* of the potential banks have offered a bonus b^*, and the rest have not sent bonus offers (which is equivalent to offering a bonus of zero). Under these circumstances, the PDF that defines the likelihood of the depositor considering the bank that offered a bonus of b is

$$A(b, \alpha^*, b^*) = \frac{(1 - D(b))^{-\sigma\theta}}{\alpha^*(1 - D(b^*))^{-\sigma\theta} + (1 - \alpha^*)(1 - D(0))^{-\sigma\theta}}. \tag{3}$$

If the bank offering b chooses to send that offer to a fraction α of potential depositors, the average switching density (i.e. the demand curve) will be

$$D(\alpha, b, \alpha^*, b^*) = \alpha D(b)A(b, \alpha^*, b^*) + (1 - \alpha)D(0)A(0, \alpha^*, b^*). \tag{4}$$

This demand curve is the key determinant of bank behavior (i.e. the bank's choice of (α, b)), which is the main focus of our model. Note that sleepy and active households have the same demand curves conditional on being awake; they differ only in their probability of being awake.

4.2 A Bank's Problem

Now consider the problem of the bank in a Markov (in (f_t, Q_t)) equilibrium in which the policies of other banks are to offer bonuses $b^*(f_t, Q_t)$ to a randomly selected share $\alpha^*(f_t, Q_t)$ of their potential depositors. The density of type X at bank j evolves as

$$dQ_{Xjt} = \underbrace{\mu_X \psi_X D(\alpha, b, \alpha^*(f_t, Q_t), b^*(f_t, Q_t))dt}_{\text{New Depositors}} - \underbrace{Q_{Xjt} \psi_X D^*(f_t, Q_t)dt}_{\text{Departing Depositors}}, \tag{5}$$

where b is the bonus set by bank j, α is share of potential depositors of bank j receiving offers, and

$$D^*(f_t, Q_t) = D(\alpha^*(f_t, Q_t), b^*(f_t, Q_t), \alpha^*(f_t, Q_t), b^*(f_t, Q_t)).$$

On the path of the symmetric equilibrium, this density will be constant and equal to μ_X.

We assume that the bank earns the interest rate r_t and has no ongoing costs associated with the deposit account. Implicitly, we treat the costs of branches, employees, mobile apps, etc... as sunk, and focus on the value of a marginal depositor. Despite this assumption, our model will feature two distinct notions of franchise value: the value of the current and future population and the value of a marginal depositor attracted from another bank. The latter is relevant for the bank's bonus decision, while the former determines the overall value of the bank.

The bank's problem is to choose processes for $\alpha_t \in [0, 1]$ and $b_t \in \mathbb{R}_+$ to maximize the net presentive value of net interest margins less customer acquisition costs. Let $\mathcal{A}$ be the set of admissible policies.[9] Let $\psi^* = \sum_{X \in \{A,S\}} \psi_X \mu_X$ be the population-average rate at which depositors awaken. The problem of the bank in the Markov equilibrium is

$$\begin{aligned} V^B(f_0, Q_{Aj0}, Q_{Sj0}, Q_0) = \sup_{\{\alpha_t, b_t\}_{t\in\mathbb{R}_+} \in \mathcal{A}} & \underbrace{w\mathbb{E}^{\mathbb{Q}}[\int_0^\infty e^{-\int_0^t r(f_s)ds} r(f_t)(Q_{Ajt} + Q_{Sjt})dt]}_{\text{NPV of Net Interest Margin}} \\ & \underbrace{- \chi\mathbb{E}^{\mathbb{Q}}[\int_0^\infty e^{-\int_0^t r(f_s)ds} \alpha_t(1 - \omega + \omega\psi^* A(\bar{b}, \alpha^*(f_t, Q_t), b^*(f_t, Q_t)))dt]}_{\text{NPV of Bonus Marketing Costs}} \\ & \underbrace{- w\mathbb{E}^{\mathbb{Q}}[\int_0^\infty e^{-\int_0^t r(f_s)ds} \psi^* \alpha_t b_t D(b_t) A(b_t, \alpha^*(f_t, Q_t), b^*(f_t, Q_t))dt]}_{\text{NPV of Bonus Payments}}, \end{aligned} \tag{6}$$

subject to (5).

Bonuses are paid only to depositors who have received bonus offers, and not to all new depositors.[10] The bank pay a cost of advertising that is proportional to the quantity of depositors it advertises bonuses to, α. The constant of proportionality depends on the scale parameter χ and bank's ability

[9] I.e. let $(\Omega, \mathcal{F}, \{\mathcal{F}_t\}_{t\in\mathbb{R}_+}, \mathbb{Q})$ be the filtered probability space satisfying the usual conditions that describes the bank's information set, with the exogenous state variables (f_t, Q_t) and initial conditions (Q_{Aj0}, Q_{Sj0}) adapted to this filtration. The set of admissible controls is the set of processes for $\alpha_t \in [0, 1]$ and $b_t \in \mathbb{R}_+$ that are progressively measurable with respect to this filtration.

[10] This is consistent with the observation that many bonus offers in our dataset have coupon codes or other mechanisms to restrict the offer to the depositor who received the mailing. There are, however, some banks who make their offers available to all potential depositors, by e.g. advertising the offer on a poster outside the bank.

to target offers, as measured by the parameter $\omega \in [0,1]$. When the bank cannot target offers, $\omega = 0$, and it must pay a cost per household mailed regardless of whether that household will consider the bank's offer. When $\omega = 1$, the bank is able to perfectly predict which households would consider a bonus offer of $\bar{b}$, and mail only those households. Note that the cost is proportional to the attention paid given a bonus offer of $\bar{b}$, rather than the actual bonus offer. We make this assumption to avoid the implication that the bank should consider how changing its bonus offer affects its ability to target offers when choosing the optimal bonus level.[11]

Because of the linearity of the bank's problem, we can decompose the value function into the value of the existing depositors and the value of new depositors.

Lemma 1 *The value function satisfies*

$$V^B(f_t, Q_{Ajt}, Q_{Sjt}, Q_t) = \underbrace{V_0^B(f_t, Q_t)}_{\text{Value of New Depositors}} + \underbrace{Q_{Ajt}V_A^B(f_t, Q_t) + Q_{Sjt}V_S^B(f_t, Q_t)}_{\text{Value of Existing Depositors}}, \tag{7}$$

where the marginal values $V_X^B(f_t, Q_t)$ *satisfy*

$$V_X^B(f_t, Q_t) = w\mathbb{E}_t^{\mathbb{Q}}[\int_t^\infty e^{-\int_t^s (r(f_u)+\psi_X D^*(f_u,Q_u))du} r(f_s)ds]. \tag{8}$$

Proof. See Appendix Section D.1. ■

The intuition behind the marginal values $V_X^B(\cdot)$ is straightforward. Attracting a depositor allows the bank to earn the interest spread $r(f)$. This benefit is discounted with the effective discount rate $r(f) + \psi_X D^*(f, Q)$, which reflects the interest rate and the rate at which the depositor will leave. Active depositors leave at a higher rate than sleepy depositors ($\psi_A > \psi_S$), and hence are less valuable ($V_A^B(\cdot) < V_S^B(\cdot)$).

The weighted-average value of a marginal depositor (scaled by the size of the deposit) can be defined as

$$MV(f_t, Q_t) = \frac{\sum_{X\in\{A,S\}} \psi_X \mu_X V_X^B(f_t, Q_t)}{w\psi^*}. \tag{9}$$

Note that active types are over-represented in this weighted average, relative to their population share (i.e. the weights are $\psi_X \mu_X$, not μ_X). This over-representation of less-valuable active types among marginal depositors is how the model captures adverse selection.[12]

[11] In principle, such an effect could exist; a bank might know more about the marginal borrower who would consider a \$200 bonus offer than the one who would consider a \$400 bonus offer. Our view is that such effects are not likely to be quantitatively significant and omitting them simplifies our analysis.

[12] The population of awake depositors is adversely selected relative to the entire population, but there is no adverse

The optimal (but possibly negative) value of b conditional on offering a bonus, $b^+(MV)$, can be derived from the first-order condition as

$$b^+(MV) = \underbrace{MV}_{\text{Marginal Value}} - \underbrace{\frac{D(1, b^+(MV), \cdot, \cdot)}{\frac{\partial}{\partial b} D'(1, b, \cdot, \cdot)|_{b=b^+(MV)}}}_{\text{Optimal Markdown = Inverse Elasticity}} \tag{10}$$

$$= MV - (\sigma^{-1}(1 - D(b^+(MV))) + \theta D(b^+(MV)))^{-1}.$$

The optimal bonus (when positive) is equal to the value of a marginal depositor (a weighted average of V_A^B and V_S^B) and the optimal markdown, which is the inverse of the demand elasticity.

The demand elasticity with respect the bonus offer is a weighted average of σ^{-1} and θ. When the bonus offered is less than the switching cost δ, $D(b) < \frac{1}{2}$, and the demand elasticity is driven primarily by the depositor's choice between the considered bank and their current bank, as captured by the elasticity σ^{-1}. When the bonus is greater than δ, $D(b) > \frac{1}{2}$, and the key elasticity is instead the comparison between the considered banks and other banks that might have been considered, as captured by the elasticity θ. In a limit in which both σ^{-1} and θ become infinitely large, the depositor will always consider only the largest bonus offer and switch if and only this offer exceeds the switching cost. This case captures the perfect competition limit, and the optimal bonus in this case converges to the marginal value less the cost of the new account.

Now consider the first-order condition for the offer volume α, given the optimal bonus b^*. Let α^* denote an optimal policy. If this optimal policy is interior ($\alpha^* \in (0, 1)$), and all other banks employ the strategy $(\alpha^*(f_t, Q_t), b^*(f_t, Q_t))$, we must have

$$0 = \underbrace{(MV(f_t, Q_t) - b^*)(\frac{D(b^*)A(b^*, \alpha^*(f_t, Q_t), b^*(f_t, Q_t))}{D(0)A(0, \alpha^*(f_t, Q_t), b^*(f_t, Q_t)))} - 1)}_{\text{Marginal Value of Additional New Depositors per Inframarginal Depositor}}$$

$$- \underbrace{b^*}_{\text{Cost of Bonuses to Inframarginal New Depositors}} - \underbrace{\frac{\chi}{w} \frac{1 - \omega + \omega \psi^* A(\bar{b}, \alpha^*(f_t, Q_t), b^*(f_t, Q_t))}{\psi^* D(0) A(0, \alpha^*(f_t, Q_t), b^*(f_t, Q_t))}}_{\text{Marginal Marketing Cost per Inframarginal Depositor}}.$$

If $\alpha^* = 1$ (resp. $= 0$), the right-hand side must be ≥ 0 (resp. $\leq$). Using the structure of the $A(\cdot)$

selection within the population of awake depositors (active and sleepy types make identical decisions conditional on being awake).

function from equation (3), we can simplify this as

$$0 = h(b^*, MV, A_0) = (MV - b^*)(\frac{D(b^*)(1 - D(b^*))^{-\sigma\theta}}{D(0)(1 - D(0))^{-\sigma\theta}} - 1) - b^* \\ - \chi\omega \frac{(1 - D(\bar{b}))^{-\sigma\theta}}{\psi^* D(0)(1 - D(0))^{-\sigma\theta}} - (1 - \omega)\frac{\chi}{wD(0)A_0}. \tag{11}$$

The bank trades off the benefit of acquiring additional customers against the costs of making the offer. The benefit consists of the value of the new depositors less the bonus paid and costs associated with new deposits, $w(MV(\cdot) - b^+(\cdot))$, multiplied by the number of additional depositors attracted by the bonus. The latter value relative to quantity of inframarginal new depositors can be viewed as an elasticity. If this elasticity and the one in (10) are small, the markdown is large, and attracting new customers is profitable ($MV - b^+(\cdot)$ is large) but difficult (because the elasticity is low). If the elasticities are instead large, the optimal markdown is small, but it is possible to attract a significant share of new customers by offering bonuses.

The function $h(b^*, MV, A_0)$ is the marginal profit from sending an additional bonus offer to a borrower per inframarginal borrower (i.e. the quantity of borrowers who would come to the bank even with no bonus offer). It depends on the stragies of the other banks in two ways. First, it depends on $(\alpha^*(f_t, Q_t), b^*(f_t, Q_t))$ in the current period through the competition for inframarginal borrowers' consideration choices, $A_0 = A(0, \alpha^*(f_t, Q_t), b^*(f_t, Q_t))$. If the bank cannot target its offers ($\omega = 0$), when others banks market aggressively, each offer the bank sends is less effective because it is less likely to be considered. Targeting can solve this problem; when $\omega = 1$, the bank can avoid this form of competition, and the strategies of the other banks in the current period are irrelevant. However, the marginal value of a new depositor still depends on other banks' future strategies, $(\alpha^*(f_{t+s}, Q_{t+s}), b^*(f_{t+s}, Q_{t+s}))$ for $s > t$, because those strategies determine the rate at which a newly acquired depositor will leave the bank in the future. Our model thus features "dynamic strategic substitutability," in that the more a bank expects other banks to aggressively market in the future, the less incentive the bank has to market today.

The following lemma summarizes some basic properties of the functions $b^+(\cdot)$ and $h(\cdot)$ that describe the first-order conditions.

Lemma 2 *(Properties of b^+ and h) $b^+(MV)$ is the unique solution to (10), is strictly increasing, and satisfies, for all A_0,*

$$\max(b^+(MV), 0) = \arg\max_{b \geq 0} h(b, MV, A_0).$$

Proof. See Appendix Section D.2. ■

In our analytic model, we will assume $\omega = 1$, which is to say the bank can perfectly target its offers. In our quantitative model, with $\omega < 0$, the cost of mailing per inframaginal new depositor depends on the number of inframarginal new depositors, which in turn depends on the marketing strategies of the other banks in the current period. Through the lens of (11), it is "as-if" the cost of marketing per inframarginal depositor rises when other banks compete more aggressively.

The following lemma summarizes the necessary first-order conditions.

Lemma 3 *(Necessity and Sufficiency of the FOCs) A Markov policy $(\alpha(f_t, Q_t), b(f_t, Q_t))$ is optimal given $(\alpha^*(f_t, Q_t), b^*(f_t, Q_t))$ if and only if:*

- *if $\alpha(f_t, Q_t) > 0$, then $b(f_t, Q_t) = \max\{b^+(MV(f_t, Q_t)), 0\}$,*
- *$h(b(f_t, Q_t), MV(f_t, Q_t), A(0, \alpha^*(f_t, Q_t), b^*(f_t, Q_t)) > 0$ only if $\alpha(f_t, Q_t) = 1$, and*
- *$h(b(f_t, Q_t), MV(f_t, Q_t), A(0, \alpha^*(f_t, Q_t), b^*(f_t, Q_t)) < 0$ only if $\alpha(f_t, Q_t) = 0$.*

Proof. See Appendix Section D.3. ■

4.3 Analytic Results

We next provide some analytic results under the assumption that $\omega = 1$. Observe that the best response to $(\alpha^*(f_t), b^*(f_t))$ (a policy that does not depend on Q_t) is a policy that does not depend on Q_t (because $V_X^B(\cdot)$ does not depend on Q_t in this case). We define a symmetric Markov equilibrium as a pair of functions $\alpha^* : \mathbf{F} \to [0, 1]$ and $b^* : \mathbf{F} \to \mathbb{R}_+$ such that, if all other banks are assumed to play the strategy (α^*, b^*), each bank has a best response of (α^*, b^*).

We first observe that there is a minimum marginal value, MV_{min}, such that if marginal values fall below this level, bonuses will never be offered in equilibrium.

Lemma 4 *(Uniqueness and Positivity of MV_{min}) There is a unique strictly positive value of MV, MV_{min}, with $b^+(MV_{min}) = b_{min} > 0$, that satisfies*

$$h(b^+(MV_{min}), MV_{min}, 1) = 0.$$

If $MV(f_t, Q_t) < MV_{min}$, then it is strictly sub-optimal to send bonus offers.

Proof. See Appendix Section D.4. ■

If $MV_{min} \geq 1$, then bonuses will never be offered in equilibrium. We henceforth rule out this possibility.

Assumption 1 $MV_{min} < 1$.

This assumption can be expressed in terms of the primitive parameters $(\sigma, \theta, \delta, \chi, w)$, in which case it is equivalent to the assumption that χ (the cost of sending offers) is not too large relative to the other parameters. This ensures it is profitable to send bonus offers if the marginal value of a new depositor is sufficiently large.

Note that, combining Lemmas 2 and 4, it follows that a bonus less than $b_{min} > 0$ will never be offered in equilibrium. Low bonuses imply low marginal values ($b^+(MV)$ is increasing in MV), and for sufficiently low marginal values the fixed costs do not justify sending offers.

We next define a constant λ. This constant can be thought of as the weighted-average departure rate of a marginal new depositor, conditional on being awake, assuming that departure rate is constant and that the optimal bonus is b_{min}.

Lemma 5 *(Uniqueness and Positivity of λ) Under Assumption 1, there is a unique value of $\lambda > 0$ that satisfies*

$$MV_{min} = \sum_{x \in \{A,S\}} \frac{\mu_X \psi_X}{\psi^*} \frac{1}{1 + \lambda \psi_X}.$$

Proof. See Appendix Section D.5. ■

Armed with these definitions, we can characterize an equilibrium of our model.

Proposition 1 *Under Assumption 1, there is a symmetric Markov equilibrium in f_t in which:*

- *If $r(f_t) \leq \lambda^{-1} D(0)$, $\alpha^*(f_t) = 0$.*
- *If $r(f_t) \geq \lambda^{-1} D(b_{min})$, $\alpha^*(f_t) = 1$ and $b^*(f_t) \geq b_{min}$.*
- *If $r(f_t) \in (\lambda^{-1} D(0), \lambda^{-1} D(b_{min}))$, $b^*(f_t) = b_{min}$ and $\alpha^*(f_t) \in (0, 1)$ is the unique solution to*

$$D(\alpha^*(f_t), b_{min}, \alpha^*(f_t), b_{min}) = \lambda r(f_t).$$

Proof. See Appendix Section D.6. ■

The first result in this proposition says that if interest rates are low, then it is not worth offering bonuses, even if other banks are not offering bonuses and the departure rate conditional on a depositor being awake is $D(0)$. The second result says that if interest rate high, it is always worth offering bonuses, even if all of the other banks are offering a bonus of b_{min} and hence the departure rate conditional on being awake is $D(b_{min})$. The third result says that if interest rates lie in an intermediate interval, bonuses will be constant, banks will send offers to some but not all of the population, and the departure rate will vary linearly with the short-term interest rate. This last result, in a stylized way, is what we find in our data.

To understand why this is an equilibrium, consider the problem of the bank when the interest rate is slightly above $\lambda^{-1}D(0)$. The bank finds it (weakly) profitable to send bonus offers. Now suppose it wants to attract some additional new depositors. Mailing offers to more borrowers (increasing α) has a constant marginal cost. In contrast, raising its bonus offer b has an increasing marginal cost– the higher bonus level must be paid not only to the additional depositors the bank attracts but also to all the depositors the bank would have attracted even at the lower bonus level. Put another way, mailing more offers is a linear cost technology for attracting new depositors, whereas raising bonuses is a convex cost technology for attracting new depositors. Starting from a point where the two marginal costs are equal, as the incentive to acquire more customers increases (i.e. rates rise), the bank will first exhaust its linear cost technology before turning to its convex cost technology.

This partial equilibrium logic explains why banks first respond on the extensive margin (mailing more offers) as rates rise, and only increase their bonus offers once they are sending offers to the all potential depositors. If the departure rate of depositors were constant or an exogenous function of interest rates, the bank would instantly transition between sending no offers and sending offers to the entire population. However, because the departure rate endogenously depends on the extent to which other banks are sending offers, there is an additional general equilibrium consideration. When interest rates are above $\lambda^{-1}D(0)$ but below $\lambda^{-1}D(b_{min})$, if no other bank were sending offers ($\alpha^*(f_t) = 0$), an individual bank would strictly prefer to send offers to all depositors ($\alpha = 1$). Likewise, if all banks were sending offers ($\alpha^*(f_t) = 1$, an individual bank would strictly prefer not to send offers ($\alpha = 0$). In this sense, banks' actions are strategic substitutes. The only symmetric equilibrium in this case is if each bank sends offers to an intermediate share of the population.[13]

To sustain this equilibrium, the marginal value of a new depositor must lie exactly at the banks' indifference threshold, $MV(f_t) = MV_{min}$, and hence the bonus offer is $b(f_t) = b_{min}$. Lemma 5 shows that the marginal value will equal MV_{min} if $V_X^B(f_t) = (1 + \lambda\psi_X)^{-1}$. It is straightforward to show that this is consistent with the definition of the marginal values, (8), if $D^*(f_t, Q_t) = \lambda r(f_t)$. That is, as interest rates rise, competition intensifies in response to rising rates, in a way that exactly offsets the increase in interest margins.

One striking aspect of the result is the observation that the degree of extensive margin competition

[13] By the same logic, there are also asymmetric equilibria in which α represents a mixing probability rather than the share of population receiving offers.

($\alpha^*(f_t)$) depends only on the level of the short rate. We consider an arbitrary factor model as opposed to e.g. an AR(1) interest process to emphasize that this finding is not mechanical. It is perfectly possible in our model for forward rates to move without the current short-rate moving. Our results show that, in the intermediate rate region, such movements do not change the value of a marginal depositor, the level of the bonus, or the degree of extensive margin competition ($\alpha^*(f_t)$), nor do they change the boundaries that region.[14]

Our model predicts that, in the intermediate region, the marginal value of a depositor is constant. This does not imply that franchise value is small, or even that it is constant, because the franchise value also includes the value of future depositors. The following corollary characterizes the portion of franchise value that comes from future depositors, under the assumption that interest rates always remain in the intermediate region.

Corollary 1 *Under Assumption 1 and assuming $r(f_t) \in [\lambda^{-1}D(0), \lambda^{-1}D(b_{min})]$ with probability one, the net present value of future depositors, $V_0^B(f_t)$ as defined in Lemma 1, is the net present value of a consol bond with a flow coupon $\psi^* D(0) MV_{min} dt$.*

Proof. See the appendix, ... ■

In the intermediate region, the bank receives $\psi^* D(0)dt$ new depositors each instant "for free", even if it does not mail any bonus offers, and the value of these depositors is MV_{min}. The bank might choose to send out bonus offers, but the marginal benefit of doing so is exactly equal to the marginal cost, and as a result the value of future depositors can be computed as-if the bank did not send out bonus offers. It follows that if interest rates remain in the intermediate region forever, the value of future depositors is equal to the net present value of a perpetuity.

An immediate consequence of this result is that, subject to the assumption of Corollary 1, the bank's overall franchise value is a *positive* duration asset. In this equilibrium, the value of the bank's existing population of depositors could be large, but has no interest rate sensitivity (since depositors marginal values are constant), and the value of the bank's future depositors ($V_0^B(f_t)$) decreases as interest rates increase.

Discussion. It is useful to place these results in the context of the literature on deposit franchise value and its interest rate risk. With regards to the value of new depositors, our model is intermediate between Drechsler et al. (2023) (who assume the value of new depositors is zero) and DeMarzo et al.

[14]This is result can be contrasted with the result of models with fixed departure rates. With a fixed departure rate, the net present value of a depositor depends primarily on long-maturity discount rates (see remark 3 in Drechsler et al. (2023)).

(2024) (who assume new and existing depositors are equally valuable); our quantification in Section 5 will be closer to Drechsler et al. (2023).

With regards to interest rate risk, the lack of rate sensitivity for the marginal value of a deposit is closer to the result of DeMarzo et al. (2024) than to Drechsler et al. (2023), but operates through a different mechanism. That mechanism can be thought of as what Drechsler et al. (2023) call "rate-driven outflows" (see also Xiao (2020)). In the intermediate rate region, such outflows arise endogenously through bank competition, as a result of banks sending more bonus offers in response to higher interest rates. Those authors instead emphasize an exogenous substitution between banks and money market funds.[15] These rate-driven outflows must be strong enough to cancel out the effect of rising rates, because otherwise banks would be tempted to advertise to more borrowers. If they did so, this would increase the quantity of rate-driven outflows, reducing the value of a new depositor (who might soon be stolen away by another bank). This reduction in value in turn reduces the incentive to advertise. Equilibrium is reached when the increase in rate-driven outflows induced by advertising exactly offsets the increase in value that comes from rising interest rates.

Finally, the literature on franchise value considers aspects of franchise value (e.g., costs, franchise value from lending) that our model does not address. Even if we restrict attention only to the deposit franchise value and exclude costs, it may well be the case that most of the deposit franchise value comes from high-balance corporate and individual accounts, as opposed to the mass-market retail accounts our model captures (the evidence of Argyle et al. (2025) points in this direction). Setting all of these issues aside, our intermediate equilibrium features a weak negative relationship between interest rates and deposit franchise value. The value of existing depositors is not interest rate sensitive and is likely to capture the lion's share of bank value. The value of future depositors is the only rate-sensitive component (it has positive duration), but it is a relatively small component of the overall value.

These results hold under special assumptions (perfect targeting and an intermediate rate regime). In the next section, we calibrate a quantitative model without imposing these assumptions [PRELIMINARY: TBD], and find results that are qualitatively consistent with our analytic results.

[15] Our baseline model does not include this kind of substitution. A straightforward extension of our model with exogenous departures to outside the banking system generates almost identical results (an intermediate equilibrium in which the total departure rate is linear in rates with coefficient λ and the marginal depositor values are constant), with a different mapping between the total departure rate and α.

4.4 Why Not Pay Interest?

Before turning to our calibration, we revisit the question of why banks offer bonuses instead of paying interest to their depositors. First, we should caveat that we view offers with temporarily high interest rates for new depositors as equivalent to bonus offers.[16] The question of this subsection is why banks do not offer non-trivial interest rates to their existing depositors, so as to prevent them from leaving.

We begin with the equilibrium described above, in which all banks are assumed not to pay interest, and consider the problem of a single bank who can both pay bonuses and pay interest.

We will allow the bank to commit, in one instant, to paying interest to its current depositors. The structure of this is as follows. At time t, the bank offers all of its current depositors an interest rate $\beta r(f_s)$ for all $s \in [t, t+\Delta)$, provided they remain at the bank. The time period length Δ is meant the capture the bank's limited ability to commit to offering interest.

We will assume this offer is not available to new depositors, as a simplification. As discussed above, offering some NPV of interest to new depositors is equivalent to a offering a bonus.[17]

If the depositor stays at the bank until time $t+\Delta$, the bank's offer is worth $\beta(1 - e^{\int_t^{t+\Delta} r(f_s)ds})$ in NPV terms. Because the depositor might leave before earning interest all of this interest, the bank's offer is worth less than this amount. Let $\hat{D}(f, \alpha^*(f), b^*(f), \beta)$ be the departure rate in equilibrium given the offer β, noting that this potentially depends on the current f, because the depositor is receiving interest payments $\beta r(f)$.

If bank j contemplates offering interest at time zero, its problem is

$$
\begin{aligned}
&\hat{V}^B(f_0, Q_{Aj0}, Q_{Sj0}, Q_0) = \sup_{\beta \geq 0} V^B(f_0, Q_{Aj0}, Q_{Sj0}, Q_0) \\
&+ \sum_{X \in \{A,S\}} Q_{Xj0} \mathbb{E}^{\mathbb{Q}} \left[e^{-\int_0^{\Delta} (r(f_s) + \psi_X \hat{D}(f_s, \alpha^*(f_s), b^*(f_s), \beta)) ds} V^B(f_\Delta) dt \right] \\
&- \sum_{X \in \{A,S\}} Q_{Xj0} \mathbb{E}^{\mathbb{Q}} \left[e^{-\int_0^{\Delta} (r(f_s) + \psi_X \hat{D}(f_s, \alpha^*(f_s), b^*(f_s), 0)) ds} V^B(f_\Delta) dt \right] \\
&- w\beta \sum_{X \in \{A,S\}} Q_{Xj0} \mathbb{E}^{\mathbb{Q}} \left[\int_0^{\Delta} e^{-\int_0^{s} (r(f_s) + \psi_X \hat{D}(f_s, \alpha^*(f_s), b^*(f_s), \beta)) ds} r(f_t) dt \right].
\end{aligned}
$$

[16] There are several examples of such offers in our data. However, they are far less common than offers a cash bonus. We speculate that a depositor with \$10,000 to deposit might respond more strongly to a \$200 cash bonus to a 4% higher annualized interest rate for six months, for behavioral or other reasons.

[17] We assume it is equally costly to advertise a bonus and a temporarily high interest rate. If the temporary rate is available only to depositors who receive an offer, it is equivalent to a bonus. A rate that is available to all new depositors is weakly dominated by a bonus, and strictly dominated if $\alpha_{jt} < 1$.

That is, the bank receives its usual equilibrium payoff, plus the benefit of a lower departure rate through time Δ, less the NPV of the promised interest payments it makes to depositors.

The following result provides a condition under which, for Δ sufficiently small, it will not be optimal to offer interest rates.

Proposition 2 *If* $\Delta^{-1} \geq \frac{\sum_{X\in\{A,S\}} \psi_X Q_{Xjt}}{\sum_{X\in\{A,S\}} Q_{Xjt}} \max\{\sigma^{-1}, \theta\}$*, it is optimal not to pay interest (*$\beta^* = 0$*).*

Proof. See the appendix, ... ■

This expression is not the tightest possible bound; we employ it because it transparently captures the key forces. Specifically, the length of required commitment (Δ) to justify paying interest is decreasing in the elasticity (as captured by the maximum of σ^{-1} and θ) and in the attentiveness of the bank's current population. The role of elasticity in this expression is intuitive: the more sensitive depositors are to the interest rate offered, the shorter the length of commitment required to make offering them interest profitable.

The role of the population-weighted average of ψ_X highlights the key reason bonus payments to new depositors are superior to interest payments to existing depositors as a method of growing the deposit base. With bonus payments, some money is "wasted" on new depositors who would have switched to the bank even without a bonus. With interest rates for existing depositors, some money is "wasted" on existing depositors who would not have switched away from the bank even with zero interest. The former population is much smaller than the latter in the presence of inattention and/or switching costs. This can also be expressed in terms of markdowns and elasticities: the bank's current depositors are much less responsive to the offers of other banks than the bank's already awake potential depositors are to the bank's offers. Consequently, the optimal markdown on deposit rates is much larger than the optimal markdown on bonuses.

However, the strength of these effects can differ radically depending on the composition of the depositor base. A representative bank in our calibration will have a weighted-average value of ψ_X equal to $\psi^* \approx 0.1$. A bank with entirely active depositors, by contrast, would have a weighted-average value above one. Thus, a bank with entirely active depositors requires a commitment period that is less than one-tenth the commitment period required for a typical bank. We do not fully explore this kind of asymmetric equilibria in the present paper. However, we note that there are some pronounced differences in deposit rates between recent large entrants to the deposit market (e.g. Capital One, Discover, American Express, Ally) and more established competitors (Chase, Citibank, Wells Fargo, Bank of America). These differences might be explained by the newer entrants having a more active depositor base than their established competitors.

Lastly, we should note that our bound is derived by observing that the marginal value of a depositor considering leaving the bank must be less than w, which is to say that it implicitly considers the case of infinite interest rates. In our quantitative analysis, we estimate the marginal value for a representative bank given typical interest rates as roughly one tenth of the deposit size. As a result, our bound is conservative by a factor of roughly ten for the typical bank, which is to say that the actual commitment period required to justify paying interest is substantially larger than the one given by our bound in most circumstances.

5 Preliminary Quantitative Analysis

We next discuss an illustrative calibration of the equilibrium described in Proposition 1. We will calibrate the model under the assumption that in 2024, interest rates were in the interior region described in Proposition 1, with $\alpha^*(\cdot) \in (0, 1)$ and $b = b_{min}$. This is consistent with our data, in particular Figure 2b, which shows that marketing volumes rose rapidly along with short-term interest rates, while the change in bonuses was more muted, as shown in Figure 2c.

Our calibration can be divided into two steps. To illustrate the role of adverse selection vs. market power, it is sufficient to calibrate a subset of the parameters of our model to match a relatively small number of moments. We will then consider what additional moments can tell us about the remainder of our parameters. We calibrate the model using our data on savings offers. We choose savings offers as opposed to checking offers because, consistent with the model, we believe that the primary source of income a bank derives from savings deposits is the interest it is able to earn on those deposits. For checking deposits, overdraft fees, debit interchange fees, and related types of income are potentially significant sources of revenue for the bank, even in a zero interest rate environment.

Table 3 lists the subset of moments we use to consider the question of adverse selection vs. market power, their associated data sources, and the interpretation of the moment in the context of the model. The average savings account bonus in our data is close to \$200. A common minimum balance required to earn the savings account bonus is \$15,000, which also happens to be close to the median savings account balance in the SCF. We calibrate the wealth w to this value.

We use the 2024 Mintel survey data, combined with the average interest rate for 2024, to calibrate the model. The average Federal Funds rate for 2024, converted to a quarterly rate, was 1.26%. In the Mintel survey 2024, 32.9% of depositors reported switching their bank account in the last twelve months, which translates to a quarterly rate of 9.5%. We calibrate the half-life of a depositor relationship to sixteen years, consistent with the average length of a banking relationship reported in

Table 3: Illustrative Calibration: Moments

No.	Moment	Value	Data source	Model interpretation
1	Average bonus ($)	200	Mintel Comperemedia	$b_{min}w$
2	Median wealth in saving account ($)	15,000	SCF	w
3	2024 avg. quarterly interest rate ($\bar{r}$,%)	1.26	FRED (Avg. FFR for 2024)	$\bar{r} = r(f_{2024})$
4	Quarterly departure rate in 2024	9.5	Mintel Survey 2024	$\psi^* D^*(f_{2024})$
5	Half life of depositor at $f_t = f_{2024}$ (n, quarters)	64	SCF	$\frac{1}{2} = \mu_A \exp(-\psi_A D^*(f_{2024})n)$ $+(1-\mu_A)\exp(-\psi_S D^*(f_{2024})n$
6	Half life of active depositor in 2024	1	Mintel Comperemedia	$\frac{1}{2} = \exp(-\psi_A D^*(f_{2024}))$

the SCF. This value will depend, of course, on the entire history of interest rates; when we translate this half-life in the context of the model, we assume that this half-life is consistent with the level of interest rates observed in 2024. Lastly, we assume the half-life of an active depositor is one quarter, consistent with the practice for savings accounts of requiring the balance to be maintained for that time period to receive the bonus.

Armed with these moments, we calibrate the key parameters of the model. Note that these moments are not sufficient to distinguish between inattention and switching costs. As a result, we will be able to identify e.g. $\psi_A D^*(f_{2024})$, but not ψ_A and $D^*(f_{2024})$ separately at this point. Despite this limitation, we will be able to compute marginal values, markdowns, and other moments of interest. Intuitively, the net present value of a depositor depends on the rate at which the depositor leaves for another bank, but not on whether that rate is governed primarily by inattention or switching costs.

Table 4 shows our calibrated parameters, μ_A, $\psi_S D^*(f_{2024})$, and $\psi_A D^*(f_{2024})$. The last of these can be directly calculated from our half-life of active depositor assumption, moment 6. The first (μ_A), must be a value that is slightly smaller than $9.5/(\psi_A D^*(f_{2024}))$. Intuitively, most of the 9.5% quarterly departure rate must come from active types, as very few sleepy types will depart in a single quarter. Given that active types depart at the rate $\psi_A D^*(f_{2024})$, their population must be close to the overall departure rate divided by the active departure rate. The second parameter, the departure rate of

Table 4: Illustrative Calibration: Parameters

Parameter	Value	Relevant Moments
μ_A	12.6%	4, 6
$\psi_S D^*(f_{2024})$	0.87%	4, 5, 6
$\psi_A D^*(f_{2024})$	69%	6

sleepy types, can be inferred from their population share and the population half-life of 64 quarters. Because almost all active types will have departed well before 64 quarters, the departure rate of the sleepy types must be roughly 1/64th of $ln(2)$, divided by their population share.

The exact values listed in Table 4 are close to the ones given by these approximation arguments. The point of these approximations is to illustrate that any calibration featuring (1) a relatively high short-term departure rate and (2) a relatively long half-life will inevitably reach similar conclusions.

Given this calibration, we can compute the value of each type of depositor, the value of an awake depositor, and the value of a representative depositor. The difference between these last two is that active types are over-represented in the population of awake depositors; we interpret this difference in value as measure of adverse selection. We can also compute the difference between the value of an awake depositor and the bonus, which is to say the markdown. This is a measure of market power and (scaled appropriately) the inverse of the demand elasticity).

The key to these computations is the result that, in the equilibrium described by Proposition 1, $\lambda^{-1}D^*(f_{2024}) = r(f_{2024})$, combined with the observation that $\lambda^{-1}D^*(f_{2024})$ and $\psi_X D^*(f_{2024})$ are together sufficient to compute $V_X^B(f_{2024})$ in the intermediate region. It follows that we are able to compute the marginal values of the active and sleepy types, and hence the marginal and average values of a depositor, without needing to separately identify the degree of inattention and scale of switching costs. We report these derived quantities in Table 5.

We find that the value of a sleepy depositor is roughly \$8,800, which corresponds to about 60% of the size the median deposit (\$15,000). Intuitively, if the bank pays the depositor zero interest and the depositor never leaves, it is as-if the bank owned an infinite-maturity floating rate bond. The value of such a bond is always equal to its face value, which is to say that the bank captures the entire value of the deposit in this case. That the sleepy depositor will leave eventually reduces the value of the bank's claim, but given that the half-life is 16 years, it is not surprising that the bank's claim is most of the deposit's value.

In contrast, the value of an active depositor is about \$270, which is roughly 1.4 quarters worth

Table 5: Illustrative Calibration: Derived Values

Name	Model Expression	Value
Value of sleepy type	$V_S^B(f_{2024})$	\$8863
Value of active type	$V_A^B(f_{2024})$	\$268
Value of awake depositor	$MV(f_{2024}) * w$	\$958
Value of representative depositor	$\mu_A V_A^B(f_{2024}) + \mu_S V_S^B(f_{2024})$	\$7779
Difference btw. rep. and awake	$\mu_A V_A^B(f_{2024}) + \mu_S V_S^B(f_{2024}) - MV(f_{2024}) * w$	\$6822
Markdown (\$)	$w(MV(f_{2024}) - b_{min})$	\$758
Implied Demand Elasticity	$(\sigma^{-1}(1 - D(b_{min})) + \theta D(b_{min}))^{-1}$	19.8

of interest when the quarterly interest rate is 1.26% and the deposit is \$15,000. Recall that in our equilibrium, this value is constant, meaning that an active depositor is worth e.g. roughly 3.6 quarters of interest at a 0.5% quarterly interest rate. That is, holding interest rates fixed, the bonus can be thought of as compensation for some time period's worth of interest. However, it is the length of that time period and not the value of the bonus that changes as interest rates change, which is why we prefer not to conceptualize the bonus as equivalent to temporarily receiving the market interest rate.

Active depositors are not worth very much to the bank, because they are likely leave and take the bonus offer of another bank shortly after arriving. Note, however, that their value exceeds the size of the bonus. In a perfectly competitive equilibrium with adverse selection (e.g. the "shrouding" model of Gabaix and Laibson (2006)), banks would lose money serving active types while earning profits on sleepy types, so that their profits overall were zero. With imperfect competition, the predicted sign of the profits of serving active depositors is ambiguous. Our calibration suggests small but positive profits, which is consistent with the observation that banks do not attempt to screen out active depositors and rarely refuse new deposits. Banks would prefer to attract sleepy rather than active depositors, but they will accept both types.

Given that banks profit from serving both types of depositors, it is not surprising that they enjoy substantial markdowns. Our estimate is that the marginal awake depositor is worth \$958 to the bank, and hence the bank earns of a profit of \$758 after paying the \$200 bonus. Note, however, that this profit is small relative to the value of a representative depositor (\$7779). Market power accounts for about 10% of the difference between the value of a representative depositor and the bonus paid by banks; about 90% is the result of adverse selection (the difference in value between the representative depositor and the average awake depositor).

The markdown we recover is consistent with a substantial demand elasticity. The elasticity of roughly 20 recovered from our calibration implies that if a bank offered an additional 1% of the deposit size as a bonus (i.e. if the bonus changed from \$200 to \$350), it would capture an additional 20% of *awake* depositors who consider switching. Put another way, consistent with introspection, the large national banks in our sample offer savings accounts that are close substitutes for the accounts offered by other banks. The problem, from the bank's perspective, is that few depositors consider switching, and those that do are far less valuable than the typical depositor.

Discussion. We should also emphasize a shortcoming of this quantification. By construction, the bonus is completely constant in the intermediate region of this equilibrium. In our fully calibrated model (described below), this intermediate region exists when the annualized short rate is between 2.9% and 7%.[18] In our data, there is a small but positive relationship between bonus levels and interest rates. We anticipate that a quantitative version of the model with $\omega < 1$ can capture this fact, and intend to explore this point in the future.

Finally, there are a number of parameters that are not identified in the calibration just described. In particular, we have said nothing about the scale of the switching costs δ, nor have we taken a stand on the offer volume in 2024, $\alpha^*(f_{2024})$. To verify that our model can in fact be fully calibrated to be consistent with the results presented above, we assume $\alpha^*(f_{2024}) = \frac{1}{2}$ and calibrate δ to match $D(0) = 40\%$. Our choice of these values is entirely arbitrary, apart from $D(0) < \frac{1}{2}$ so as to imply positive switching costs. In selecting these values, we are implicitly taking a stand on (1) the relative role of inattention and switching costs and (2) the mapping between the offer volume α^* in our model and our mail volume data. We have little evidence on either of these, and therefore prefer to emphasize aspects of our quantitative results that are independent of our assumptions on these points.

Given these two assumptions, we can introduce an additional moment (the switching rate in a low-rate environment) and use this to separately identified the roles that σ^{-1} and θ play in determining the demand elasticity. Specifically, given $D(0)$ and $\alpha^*(f_{2024})$, we can choose values of σ^{-1} and θ to simultaneously match our estimated elasticity in Table 5 and the 2021 Mintel Survey quarterly departure rate of 5.5%. The resulting values of σ^{-1} and θ are roughly 266 and 8.3, respectively. The product $\sigma\theta$ is roughly 0.03, indicating that the calibrated model is close to one in which the considered bank is chosen arbitrarily. However, this conclusion, in contrast to the ones presented above, depends on moments ($D(0)$ and $\alpha^*(f_{2024})$) about which we have little evidence, and are computed under assumed values of 40% and 50% respectively. These computations should be understood only as

[18] The approximate symmetry of this interval around $\bar{r}$ is a consequence of our assumption that $\alpha^*(f_{2024}) = \frac{1}{2}$, and hence is arbitrary.

demonstrating that our model can be fully calibrated.

6 Conclusion

This paper studies competition in the deposit market. We provide novel descriptive evidence on how large US banks price discriminate between existing and new depositors using a combination of rates, bonuses, and targeted advertising. We also show, in line with the existing literature, very limited pass-through of market interest rates into deposit rates, but document a novel large pass-through to marketing, specifically the mail volume of sign-up bonuses.

The descriptive analysis motivates us to develop and estimate a dynamic equilibrium model with multi-dimensional customer acquisition and unobservable depositor heterogeneity. We use the estimated model to quantify the frictions affecting banks franchise value and the imperfect pass-through of market rates to depositor rates. Our model rationalizes the use of targeted bonuses rather than rates when a large fraction of existing customers are sleepy. Banks respond to rising rates by first increasing the volume of offers they send out, and increase the size of the bonus they offer only after exhausting their ability to increase offer volume. That banks respond first on the extensive margin is both consistent with our new data and implies that the value of a marginal depositor is constant as interest rates rise. Our quantitative estimates indicate that adverse selection, rather than market power, explains the majority of the difference between the value of a representative depositor and the bonus paid by banks, thus preserving banks' franchise value.

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Online Appendix

In this online appendix we report additional figures and tables about results on the facts and structural model. Appendix A describe the classification schema we implement and the way in which we use the LLM to construct the dataset. Appendix B provides supplementary figures and tables for the data and setting. Appendix C provides additional details on the model in relation to the depositor problem. Appendix D provides proofs for the results given in the main text.

A Additional Detail on Data Construction

In this section we describe the classification schema we implement and the way in which we use the LLM to construct the dataset.

B Additional Results on Facts

In this section we report additional figures and tables in relation to the facts.

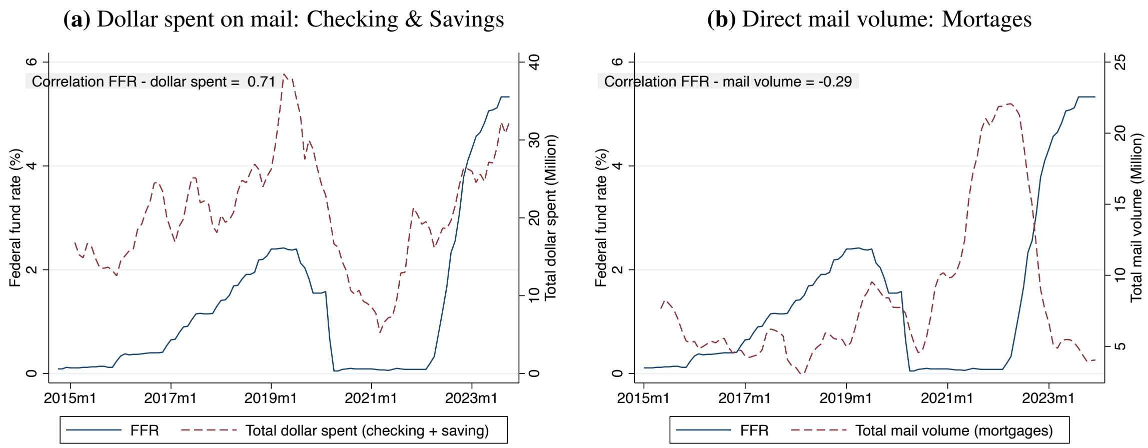

Figure A1: Pass-through on Checking and Savings Products - Marketing Extra
Note: The figure plots the federal funds rate (2014–2024) alongside the following variables: (a) total dollar spent in millions for checking and saving offers using the Comperemedia data; (b) total mail volume for mortgage offers.

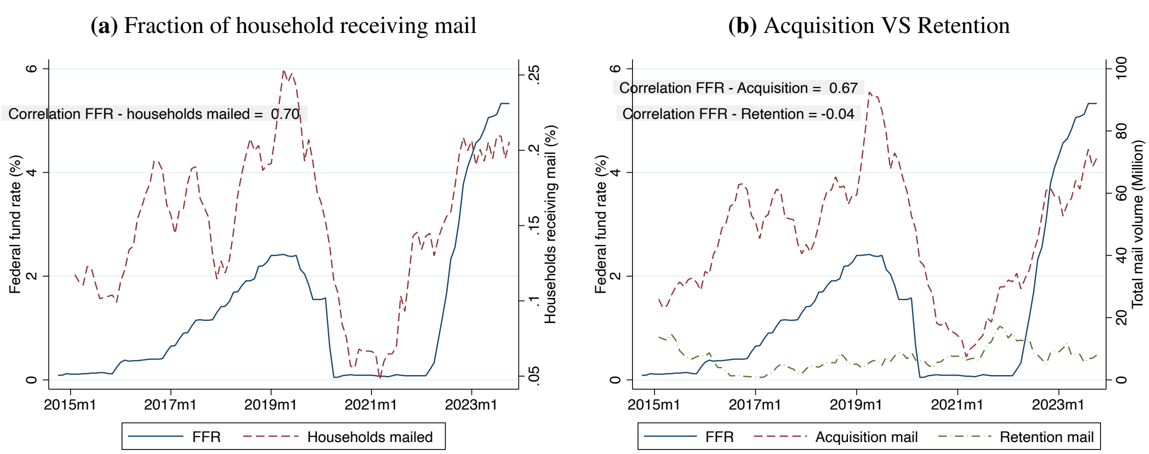

Figure A2: Pass-through on Checking and Savings Products - Targeting Extra
Note: The figure plots the federal funds rate (2014–2024) alongside the following variables: (a) total dollar spent in millions for checking and saving offers using the Comperemedia data; (b) total mail volume for mortgage offers.

Table A1: PASS-THROUGH ON CHECKING AND SAVINGS PRODUCTS - EXCLUDING CHASE

	Deposit Rates (bps)		Marketing (log)		Sign-up Bonus ($)		Targeting	
	Checking (1)	Saving (2)	Mail volume (3)	Dollar spent (4)	Checking (5)	Saving (6)	HHI (7)	Number of states (8)
Federal fund rate (%)	0.30***	13.63***	0.09***	0.09***	17.22***	15.29***	-0.02***	0.28**
	(0.05)	(1.55)	(0.03)	(0.02)	(1.72)	(2.64)	(0.00)	(0.13)
BANK F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BANK-TIME CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DEP. VAR. (MEAN)	3.55	29.71	13.19	12.44	276.98	219.79	0.27	8.55
DEP. VAR. (SD)	6.06	73.24	1.36	1.28	95.66	128.59	0.30	8.02
R^2	0.84	0.63	0.15	0.20	0.32	0.43	0.06	0.29
OBSERVATIONS	839	935	2,767	2,767	1,849	1,389	2,620	2,620

Note: The Table shows the results of equation (1) excluding Chase. Deposit rates is the average deposit rate in basis points for checking and saving products from Ratewatch. Mail volume and dollar spent are the total across all banks in our sample of estimated direct mail volume and dollar spent from Comperemedia. Sign-up bonus is the average sign-up bonus in dollar for checking and saving offer from Comperedia. HHI is the Herfindahl-Hirschman Index (HHI) at the campaign-month based on the volume of mails sent to target groups defined as triplets of state, income, and age bins. Robust standard errors in parenthesis. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table A2: PASS-THROUGH ON CHECKING AND SAVINGS PRODUCTS - LARGEST CAMPAIGN

	Marketing (log)		Sign-up Bonus ($)		Targeting	
	Mail volume (1)	Dollar spent (2)	Checking (3)	Saving (4)	HHI (5)	Number of states (6)
Federal fund rate (%)	0.16***	0.16***	17.33***	16.81***	-0.02***	0.72***
	(0.04)	(0.03)	(2.27)	(3.50)	(0.01)	(0.19)
BANK F.E.	Yes	Yes	Yes	Yes	Yes	Yes
BANK-TIME CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes
DEP. VAR. (MEAN)	13.52	12.73	272.55	214.41	0.25	10.47
DEP. VAR. (SD)	1.58	1.45	90.29	120.36	0.29	9.73
R^2	0.30	0.31	0.28	0.45	0.09	0.47
OBSERVATIONS	802	802	600	373	786	786

Note: The Table shows the results of equation (1) focusing on the largest campaign by number of volume for each bank-month. Deposit rates is the average deposit rate in basis points for checking and saving products from Ratewatch. Mail volume and dollar spent are the total across all banks in our sample of estimated direct mail volume and dollar spent from Comperemedia. Sign-up bonus is the average sign-up bonus in dollar for checking and saving offer from Comperedia. HHI is the Herfindahl-Hirschman Index (HHI) at the campaign-month based on the volume of mails sent to target groups defined as triplets of state, income, and age bins. Robust standard errors in parenthesis. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table A3: PASS-THROUGH ON CHECKING AND SAVINGS PRODUCTS - CUMULATIVE EFFECT

	Deposit Rates (bps)		Marketing (log)		Sign-up Bonus ($)		Targeting	
	Checking (1)	Saving (2)	Mail volume (3)	Dollar spent (4)	Checking (5)	Saving (6)	HHI (7)	Number of states (8)
Cumulative federal fund rate (%)	0.30***	13.93***	0.13***	0.13***	19.75***	13.90***	-0.02***	0.66***
	(0.06)	(1.78)	(0.03)	(0.03)	(1.82)	(2.55)	(0.01)	(0.15)
BANK F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BANK-TIME CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DEP. VAR. (MEAN)	3.27	26.84	12.99	12.17	280.14	214.78	0.29	8.84
DEP. VAR. (SD)	5.76	70.01	1.38	1.26	82.54	108.04	0.31	8.42
R^2	.84	.62	.28	.28	.29	.42	.09	.41
OBSERVATIONS	944	1,039	3,966	3,966	2,838	2,353	3,803	3,803

Note: The Table shows the results of equation (1) modified to include four lags federal fund rate and report the cumulative effect. Deposit rates is the average deposit rate in basis points for checking and saving products from Ratewatch. Mail volume and dollar spent are the total across all banks in our sample of estimated direct mail volume and dollar spent from Comperemedia. Sign-up bonus is the average sign-up bonus in dollar for checking and saving offer from Comperedia. HHI is the Herfindahl-Hirschman Index (HHI) at the campaign-month based on the volume of mails sent to target groups defined as triplets of state, income, and age bins. Robust standard errors in parenthesis. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table A4: PASS-THROUGH ON CHECKING AND SAVINGS PRODUCTS - HETEROGENEITY

	Deposit Rates (bps)		Marketing (log)		Sign-up Bonus ($)		Targeting	
	Checking (1)	Saving (2)	Mail volume (3)	Dollar spent (4)	Checking (5)	Saving (6)	HHI (7)	Number of states (8)
Federal fund rate (%)	0.30***	0.07	0.13***	0.13***	15.82***	5.87**	-0.02***	0.76***
	(0.03)	(0.26)	(0.03)	(0.02)	(1.63)	(2.41)	(0.00)	(0.13)
Federal fund rate (%) × High-rate bank	-0.24	49.55***	-0.12**	-0.11**	4.27	27.01***	0.02*	-0.86**
	(0.22)	(2.73)	(0.06)	(0.05)	(4.88)	(4.26)	(0.01)	(0.36)
BANK F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BANK-TIME CONTROLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DEP. VAR. (MEAN)	3.27	26.84	13.43	12.64	276.92	214.51	0.25	10.24
DEP. VAR. (SD)	5.76	70.01	1.53	1.39	88.84	114.32	0.29	9.34
R^2	0.84	0.86	0.28	0.28	0.28	0.44	0.09	0.41
OBSERVATIONS	944	1,039	3,966	3,966	2,838	2,353	3,803	3,803

Note: The Table shows the results of equation (1) with an additional interaction for high-rate banks (Capital One, Discover, Citizens). Deposit rates is the average deposit rate in basis points for checking and saving products from Ratewatch. Mail volume and dollar spent are the total across all banks in our sample of estimated direct mail volume and dollar spent from Comperemedia. Sign-up bonus is the average sign-up bonus in dollar for checking and saving offer from Comperedia. HHI is the Herfindahl-Hirschman Index (HHI) at the campaign-month based on the volume of mails sent to target groups defined as triplets of state, income, and age bins. Robust standard errors in parenthesis. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

C Derivations of the Depositors' Choice Probabilities

Let $V^X(f, Q, j)$ be the depositor's value function given the aggregate state (f, Q) if the depositor currently uses bank j. Now imagine a depositor who is considering switching to bank j' and has been offered bonus b (scaled by the deposit size w). If the depositor switches to bank j', they will receive bw but pay a switching cost δw and experience non-pecuniary utility $w\sigma\epsilon_{ij't}$. If the depositor stays at their current bank j, they will not receive a bonus or pay a switching cost, and will experience non-pecuniary utility $w\sigma\epsilon_{ijt}$.

The expected value of considering a switch to bank j' at time t, if that bank has offered the depositor a bonus b, is

$$\begin{aligned}\bar{V}^X(f_t, Q_t, j, j', b) = \int \max_{j'' \in \{j, j'\}} \{&\mathbf{1}\{j'' \neq j\}(b - \delta)w + \sigma w \epsilon_{i,j'',t} \\ &+ V^X(f_t, Q_t, j'')\} dg(\epsilon_{ijt}, \epsilon_{i,j',t}),\end{aligned}$$

where the expectation is taken over possible realizations of the non-pecuniary utility shocks, whose joint probability measure is $g(\cdot)$.

We assume that depositors are more likely to consider switching to bank j' when the value of doing so is higher. Let $\mathbf{B}$ be the set of functions from $[0, J^{-1}]$ to $\mathbb{R}_+$. The function $\mathbf{b}_i \in \mathbf{B}$ describes the set of bonus offers received by household i from the banks for which it is a potential depositor (we refer to the latter as the "potential banks" of the depositor). Given these offers, we define the density for depositor i of considering bank j' (relative to the Lebesgue measure over the set of potential banks) as $A(\cdot)$. This can depend in principle on the current bank j, aggregate state (f, Q), and entire set of bonus offers to depositor i,

$$A(j'; \mathbf{b}_i, j, f, Q) = \frac{e^{\theta \bar{V}^X(f, Q, j, j', \mathbf{b}_i(j'))}}{\int_0^1 e^{\theta \bar{V}^X(f, Q, j, j'', \mathbf{b}_i(j''))} dj''}. \qquad (12)$$

$V^X(\cdot)$ is the depositor's value function. If the borrower does not awaken, they receive zero flow payoff (the banks pay no interest). If they awaken, they consider bank j' with probability $A(j'; \cdot)$ and then decide between that bank and their current bank. Avoiding the details of how (f_t, Q_t) evolve over time, we can write the depositor's HJB equation as

$$r(f_t)V^X(f_t, Q_t, j) = \lim_{h\downarrow 0} h^{-1}\mathbb{E}^{\mathbb{P}}[V^X(f_{t+h}, Q_{t+h}, j) - V^X(f_t, Q_t, j)]$$
$$+ \psi_X \mathbb{E}^{\mathbb{P}}[\int_0^1 \bar{V}^X(f_t, Q_t, j, j', \mathbf{b}_i(j'))A(j'; \mathbf{b}_i, j, f_t, Q_t)dj'],$$

where the expectation in the second line is taken over the set of offers $\mathbf{b}_i$ the depositor will receive.

The functional form of $A(\cdot)$, (12), can be justified as arising from the optimal allocation of attention to bank offers subject to a constraint on mutual information, in the style of Sims (2010) and Matějka and McKay (2015). Specifically, the Bellman equation we study is equivalent to the problem of maximizing utility over the set of all possible attention strategies subject to a constraint on mutual information and given an exchangeable prior over banks (i.e. one in which banks are symmetric). That is,

$$r(f_t)V^X(f_t, Q_t, j) = \sup_{p\in\mathcal{P}} \lim_{h\downarrow 0} h^{-1}\mathbb{E}^{\mathbb{P}}[V^X(f_{t+h}, Q_{t+h}, j) - V^X(f_t, Q_t, j)]$$
$$+ \psi_X \mathbb{E}^{\mathbb{P}}[\int_0^1 \bar{V}^X(f_t, Q_t, j, j', \mathbf{b}_i(j'))p(j'; \mathbf{b}_i)dj']$$
$$- \psi_X \theta^{-1}\mathbb{E}^{\mathbb{P}}[\int_0^1 p(j'; \mathbf{b_i})\ln(p(j'; \mathbf{b_i}))dj']$$

where $\mathcal{P}$ is the set of functions from $\mathbf{B}$ to probability densities on $[0, 1]$ satisfying, for any j', j'', $\mathbb{E}^{\mathbb{P}}[p(j'; \mathbf{b}_i)] = \mathbb{E}^{\mathbb{P}}[p(j''; \mathbf{b}_i)]$, and θ^{-1} is the cost of attending to banks' offers, paid only when awake. The attention policy A described above is the optimal p in this problem. We can thus understand the $\theta \to \infty$ limit as one in which it is costless for the depositor to consider only the bank with the best offer, and the $\theta \to 0$ as one in which the depositor randomly searches for a new bank without knowing which banks are offering bonuses. Intermediate cases can be understood as ones in which depositors have partial but imperfect awareness of the terms banks are offering, and consider the bank that is offering the best deal in expectation under the depositor's beliefs.[19]

We can simplify the depositor's problem by observing that all banks are identical after the bonus has been paid. We further simplify by assuming that the non-pecuniary taste shocks have a type-1 extreme value distribution with mean zero and standard deviation one , which leads to the usual logit

[19]It will be apparent in what follows that we could have described both choice stages as arising from type-1 extreme value taste shocks or both as arising from rational inattention. There is nothing in behavior that can distinguish between unobserved preference shocks and inattention. Our choice to describe the selection of which bank to consider as "inattention" and the choice to switch to the considered bank or stay at the current bank as "preferences" suits our priors but is not essential.

demand, with σ as parameter that governs the elasticity. These assumptions yield the functional form for $D(b)$ in the main text.

Moreover, under these assumptions, the value function in the consideration stage is the "inclusive value," which up to a constant can be written as

$$\bar{V}^X(f_t, Q_t, j, j', b) = -\sigma \ln(1 - D(b)).$$

This, combined with our definition of $A(\cdot)$, yields the functional form given in the main text. The demand curve is then derived by considering a single bank that offers a bonus of b if a fraction α^* of potential banks offer a bonus of b^*, and the remainder offer no bonus.[20]

[20] There are some subtleties here with respect to the rational inattention microfoundation of A if this contemplated configuration of bonuses lies outside the support of the depositor's prior (see Ravid (2020)). We view these issues as outside the scope of the present paper.

D Proofs

D.1 Proof of Lemma 1

Using (5),

$$d(Q_{Xjt}e^{\int_0^t \psi_X D^*(f_s,Q_s)ds}) = \mu_X \psi_X e^{\int_0^t \psi_X D^*(f_s,Q_s)ds} D(\alpha_t, b_t, \alpha^*(f_t,Q_t), b^*(f_t,Q_t))dt$$

from which it follows that

$$\begin{aligned} Q_{Xjt} = \mu_X \psi_X \int_0^t & e^{-\int_s^t \psi_X D^*(f_l,Q_l)dl} D(\alpha_s, b_s, \alpha^*(f_s,Q_s), b^*(f_s,Q_s))ds \\ & + e^{-\int_0^t \psi_X D^*(f_s,Q_s)ds} Q_{Xj0}. \end{aligned}$$

Plugging this into the sequence problem of the bank, the NPV of the net interest margin is

$$\begin{aligned} w\mathbb{E}^{\mathbb{Q}}[\int_0^\infty e^{-\int_0^t r(f_s)ds} r(f_t)(Q_{Ajt}+Q_{Sjt})dt] &= wQ_{Aj0}\mathbb{E}^{\mathbb{Q}}[\int_0^\infty e^{-\int_0^t (r(f_s)+\psi_A D^*(f_s,Q_s))ds} r(f_t))dt] \\ &\quad + wQ_{Sj0}\mathbb{E}^{\mathbb{Q}}[\int_0^\infty e^{-\int_0^t (r(f_s)+\psi_S D^*(f_s,Q_s))ds} r(f_t))dt] \\ + w \sum_{X\in\{A,S\}} \mu_X \psi_X \mathbb{E}^{\mathbb{Q}}[\int_0^\infty e^{-\int_0^t r(f_s)ds} r(f_t) & \int_0^t e^{-\int_s^t \psi_X D^*(f_l,Q_l)dl} D(\alpha_s, b_s, \alpha^*(f_s,Q_s), b^*(f_s,Q_s))ds]. \end{aligned}$$

The result follows from the observation that the other components of the sequence problem (the NPV of bonus payments and marketing costs) do not depend on (Q_{Aj0}, Q_{Sj0}).

D.2 Proof of Lemma 2

Define the function $FOC : \mathbb{R} \to \mathbb{R}$ by

$$FOC(b) = b + \sigma(1 + (\sigma\theta - 1)D(b))^{-1},$$

noting that the first-order condition is $MV = FOC(b)$. Observe that this function is continuously differentiable, with

$$\begin{aligned} FOC'(b) &= 1 - (\sigma\theta - 1)\frac{D(b)(1-D(b))}{(1+(\sigma\theta-1)D(b))^2} \\ &= \frac{1 + (1+D(b))(\sigma\theta-1)D(b) + (\sigma\theta-1)^2 D(b)^2}{(1+(\sigma\theta-1)D(b))^2} \end{aligned}$$

If $\sigma\theta \geq 1$, $FOC'(b) > 0$ is immediate from the second line by $D(b) \in (0,1)$. If $\sigma\theta \in (0,1)$, $FOC'(b) > 0$ is immediate from the first line. It follows by the inverse function theorem that the inverse function, $b^+(MV)$, exists and is strictly increasing.

Observe that

$$\frac{\partial h(b, MV, A_0)}{\partial b} \propto MV \frac{\partial}{\partial b}(D(b)(1 - D(b))^{-\sigma\theta}) - \frac{\partial}{\partial b} b(D(b)(1 - D(b))^{-\sigma\theta}) \propto MV - FOC(b).$$

It follows that $\max(b^+(MV(f_t, Q_t)), 0)$ is the unique maximizer of $\alpha h(b, MV, A_0)$ on $b \geq 0$ given any $\alpha > 0$.

D.3 Proof of Lemma 3

First observe that the policy-dependent portion of the bank's Bellman equation, under the linearity conjecture, is proportional to $\alpha h(b, MV, A_0)$. By Lemma 2, $b(f_t, Q_t) = max(b^+(MV(f_t, Q_t), 0)$ is necessary and sufficient to establish the optimality of $b(\cdot)$ given $\alpha(\cdot) > 0$.

The necessity of $h(b(f_t, Q_t), MV, A_0) > 0$ only if $\alpha(f_t, Q_t) = 1$ and $h(b(f_t, Q_t), MV, A_0) < 0$ only if $\alpha(f_t, Q_t) = 0$ are immediate via the first-order condition for α. We prove sufficiency by contradiction. Suppose, given (MV, A_0), there is some alternative policy $(\tilde{\alpha}, \tilde{b})$ that is strictly superior to the policy (α, b) satisfying the conditions of Lemma 1. If $h(\tilde{b}, MV, A_0) > 0$, we must have $h(b, MV, A_0) \geq h(\tilde{b}, MV, A_0) > 0$, as b is a maximizer by the argument above. This implies $\alpha = 1$, and therefore $\alpha h(b, MV, A_0) \geq \tilde{\alpha} h(\tilde{b}, MV, A_0)$, contradicting strict optimality. If $h(\tilde{b}, MV, A_0) \leq 0$, then $0 \geq \tilde{\alpha} h(\tilde{b}, MV, A_0) > \alpha h(b, MV, A_0)$ requires $\alpha > 0$ and $h(b, MV, A_0) < 0$, contradicting the conditions of Lemma 1. It follows that the conditions of Lemma 1 are necessary and sufficient to establish the optimality of (α, b).

D.4 Proof of Lemma 4

Observe that under the assumption of $\omega = 1$, $h(b, MV, A_0)$ does not depend on A_0. In what follows, we omit the A_0 argument to emphasize this.

Observe by the envelope theorem that

$$\frac{\partial}{\partial MV} \max_{b \in \mathbb{R}} h(b, MV) = \frac{D(b^+(MV))(1 - D(b^+(MV)))^{-\theta\sigma}}{D(0)(1 - D(0))^{-\theta\sigma}} - 1.$$

This is strictly positive wherever $b^+(MV) > 0$.

Define $MV_0 = \sigma(1 + (\sigma\theta - 1)D(0)))^{-1}$, and observe that $b^+(MV_0) = 0$. We have

$$h(b^+(MV_0), MV_0) = -\chi \frac{(1 - D(\bar{b}))^{-\sigma\theta}}{D(0)(1 - D(0))^{-\sigma\theta}} < 0.$$

Now observe that, for any arbitrary $b > 0$, $h(b^+(MV), MV) \geq h(b, MV)$ and $\lim_{MV \to \infty} h(b, MV) = \infty$, from which it follows that there exists a value of MV such that $h(b^+(MV), MV) > 0$, and hence by continuity some $MV_{min} > MV_0 > 0$ such that $h(b^+(MV), MV) = 0$. Defining $b_{min} = b^+(MV_{min})$, the uniqueness and non-negativity of b_{min} follow from Lemma 2.

D.5 Proof of Lemma 5

We can rewrite this equation as

$$(1 + \lambda\psi_A)(1 + \lambda\psi_S)MV_{min} - \frac{\mu_S\psi_S}{\psi^*}(1 + \lambda\psi_A) - \frac{\mu_A\psi_A}{\psi^*}(1 + \lambda\psi_S) = 0,$$

which can be further refined to

$$c_2\lambda^2 + c_1\lambda + c_0 = 0,$$

where

$$\begin{aligned} c_2 &= \psi_A\psi_S MV, \\ c_1 &= (\psi_A + \psi_S)MV - \frac{\psi_A\psi_S}{\psi^*}, \\ c_0 &= MV - 1. \end{aligned}$$

Noting that, by $c_0 < 0$ and $c_2 > 0$,

$$c_1^2 - 4c_2c_0 > c_1^2 > 0,$$

it follows that this quadratic equation has two solutions,

$$\lambda = \frac{-c_1 + \sqrt{c_1^2 - 4c_2c_0}}{2c_2} > 0$$

and

$$\frac{-c_1 - \sqrt{c_1^2 - 4c_2c_0}}{2c_2} < 0,$$

from which the claim follows.

D.6 Proof of Proposition 1

NOTE: This proof is incomplete and should be viewed as a proof sketch

We first construction the marginal value functions $V_X^B(f_t)$. We start by defining $V_X^B(f_t) = \frac{w}{1+\psi_X\lambda}$ for values of f_t such that $r(f_t) \in (\lambda^{-1}D(0), \lambda^{-1}D(b_{min}))$.

Define $\alpha^*(f_t)$ as the solution to

$$D(\alpha^*(f_t), b_{min}, \alpha^*(f_t), b_{min}) = \lambda r(f_t).$$

(TODO: verify this is well-defined on the relevant interval using intermediate value theorem)

Observe that, for any ψ, it solves

$$[r(f_t) + \psi D(\alpha^*(f_t), b_{min}, \alpha^*(f_t), b_{min})]\frac{w}{1+\psi\lambda} = wr(f_t).$$

Define $\mathcal{L}^f$ as the generator associated with f. It follows that the PDE for the marginal value function associated with intermediate region,

$$(r(f_t) + \psi_X D(\alpha^*(f_t), b_{min}, \alpha^*(f_t), b_{min}))\frac{w}{1+\psi_X\lambda} = wr(f_t) + \mathcal{L}^f\frac{w}{1+\psi_X\lambda},$$

is satisfied on $r(f_t) \in (\lambda^{-1}D(0), \lambda^{-1}D(b_{min}))$.

We next consider the low rate region. For f_t such that $r(f_t) < \lambda^{-1}D(0)$, define $V_X^B(f_t)$ by

$$V_X^B(f_t) = w\mathbb{E}_t[e^{-\int_t^\tau (r(f_s)+\psi_X D(0))ds}\frac{1}{1+\psi_X\lambda} + \int_t^\tau e^{-\int_t^s (r(f_l)+\psi_X D(0))dl} r(f_s)ds]$$

where $\tau = \inf\{s \geq t : r(f_s) \geq \lambda^{-1}(D_0)\}$.

By assumption, the generator for f is uniformly elliptic with Holder-continuous coefficients. Under mild conditions (TBD), the region $r(f_t) < \lambda^{-1}D(0)$ satisfies the exterior sphere property, and by assumption $r(f_s) + \psi_X D(0)$ is continuous. It follows by KS Chapter 5 remark 7.5 that $V_X^B(f_t)$ exists, is $\mathcal{C}^2$ on $\{f_t \in B : r(f_t) < \lambda^{-1}D(0)\}$ and is continuous and satisfies $V^B(f_t) = \frac{w}{\psi_X\lambda}$ when $r(f_t) = \lambda^{-1}D(0)$.

Now differentiate the inside the expectation with respect to any arbitrary $\tau' < \tau$:

$$\frac{\partial}{\partial \tau'}[e^{-\int_t^{\tau'}(r(f_s)+\psi_X D(0))ds}\frac{1}{1+\psi_X\lambda} + \int_t^{\tau'} e^{-\int_t^s(r(f_l)+\psi_X D(0))dl} r(f_s)ds] =$$
$$e^{-\int_t^{\tau'}(r(f_s)+\psi_X D(0))ds}[-\frac{r(f_{\tau'})+\psi_X D(0)}{1+\psi_X\lambda} + r(f_{\tau'})] \leq$$
$$e^{-\int_t^{\tau'}(r(f_s)+\psi_X D(0))ds}[\frac{\psi_X D(0)}{1+\psi_X\lambda} + \frac{\lambda^{-1}D(0)(1+\psi_X\lambda-1)}{1+\psi_X\lambda}] = 0,$$

using $r(f_{\tau'}) \leq \lambda^{-1}D(0)$ by the continuity of the process for f. It follows that

$$V_X^B(f_t) \leq w\mathbb{E}[(e^{-\int_t^{\tau'}(r(f_s)+\psi_X D(0))ds}\frac{1}{1+\psi_X\lambda} + \int_t^{\tau'} e^{-\int_t^s(r(f_l)+\psi_X D(0))dl} r(f_s)ds)|_{\tau'=0}]$$
$$= \frac{w}{1+\psi_X\lambda},$$

strictly if $r(f_t) < \lambda^{-1}D(0)$.

Now consider the high interest rate case, $r(f_t) > \lambda^{-1}D(b_{min})$. To show the a pure strategy equilibrium exists, we rely on the follow lemma establishing the existence of a fixed point.

Lemma 6 *There exists a function $b^*(f_t)$ and functions $V_X^B(f_t)$ such that*

$$V_X^B(f_t) = w\mathbb{E}_t[e^{-\int_t^{\tau}(r(f_s)+\psi_X D(b^*(f_s)))ds}\frac{1}{1+\psi_X\lambda} + \int_t^{\tau} e^{-\int_t^s(r(f_l)+\psi_X D(b^*(f_l)))dl} r(f_s)ds]$$

where $\tau = \inf\{s \geq t : r(f_s) \leq \lambda^{-1}(D(b_{min}))\}$ and

$$b^*(f_t) = b^+(\sum_{X\in\{A,S\}} \frac{\mu_X\psi_X}{\psi^*} V_X^B(f_t)) \geq b_{\min}.$$

Proof. TBD. Outline: Prove (b, V) are Lipschitz, invoke general version of Kakutani fixed point theorem. ■

Pasting the constructed marginal value functions together over the three regions gives the conjectured marginal value functions. By Lemma 3, at each point the conjectured policy is optimal.[ELABORATE ON THIS]

Verification follows from the observation that under all possible policies, Q_{Xjt} is bounded [ELABORATE ON THIS].