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 interest rates are the primary ways in which interest rate changes affect the deposit market. We rationalize the use of these margins and not interest rates in a simple model with active and sleepy depositors. 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 offer interest 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 (Drechsler et al., 2017).

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 (but not all banks) offer cash bonuses for opening new accounts, and the size of these bonuses varies 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 this form of price competition in the market for checking and savings accounts.

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 trillions of total deposit 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. With this new data, we document new facts on banks pricing, advertising and targeting in the deposit market.

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]

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

[1] Another way for banks to compete is by opening branches in new areas (Begenau and Stafford, 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.

bonuses only to select prospects. We find that a 100-basis-points increase in the federal fund rate is associated to a 11% increase in mail volumes. 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 increase in the federal fund rate is associated to a $16 ($14) increase in bonuses for checking (savings) accounts.

Finally, 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.

Informed by these new facts, we develop a model to explain the use of these margins. Specifically, our goal is to develop a model that explains 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 hope to re-evaluate the degree of competition in the banking market and reassess the mechanisms of monetary pass-through.

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 often designed to break-even in the event that the customer stays only for the minimum duration required to receive the bonus. We interpret these findings as evidence of adverse selection, and therefore model two types of depositors, "sticky" and "awake". 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 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. 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. This 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 (above 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 2% of the deposit size), because these depositors are far more likely than the typical depositor to switch accounts again.

Put another way, adverse selection explain 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%.

Our analytical model has several shortcomings that arise from the simplifying assumptions we use to characterize the solution. To address these shortcomings and verify that the conclusions of our calibration are robust, we construct a quantitative version of our model (THIS IS TBD). 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.

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 literature has studied the role of banks market power for 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 and risk, which vary 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 micro data 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 model 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), and the impact of

digital banking (Koont, 2023; Jiang, Yu, and Zhang, 2024).

The majority of these papers have focused on exogenous horizontal differentiation across banks as the source of market power and endogenous deposit rates as the key competition variable.[3] Our new facts and modelling 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 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, a special case with an analytic solution, and an illustrative calibration. Section 5 confirms the conclusions of our illustrative calibration without the special-case assumptions required for our analytic results. 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.

[3] Koont (2023) also endogenize technology adoption and Jiang, Yu, and Zhang (2024) also endogenize branch choice.

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 Section REF, 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 acquisition of new customers consistent with checking being an entry product for potentially future cross-selling. Indeed according to the Survey of Con-

Table 1: SUMMARY STATISTICS

	Observations	Mean	Std. Dev.	Minimum	P5	Median	P95	Maximum
Panel A: Full sample								
Mail volumes (.000)	3,966	1,303.21	2,845.99	38.50	70.54	354.84	5,806.14	44,707.12
Mail dollar (.000)	3,966	485.87	941.64	18.48	36.72	161.25	2,147.49	12,875.65
Acquisition (%)	3,966	85.43	35.29	0.00	0.00	100.00	100.00	100.00
Retention (%)	3,966	14.40	35.11	0.00	0.00	0.00	100.00	100.00
Federal Fund Rate (%)	3,966	1.64	1.56	0.05	0.08	1.21	5.08	5.33
Panel B: Checking								
Acquisition (%)	2,838	90.03	29.97	0.00	0.00	100.00	100.00	100.00
Retention (%)	2,838	9.73	29.64	0.00	0.00	0.00	100.00	100.00
Incentive ($)	2,838	280.14	82.54	0.00	150.00	300.00	400.00	600.00
Minimum deposit ($)	2,838	951.09	1,442.02	0.00	0.00	500.00	4,000.00	9,000.00
Minimum balance days	1,196	90.06	11.33	30.00	90.00	90.00	90.00	207.00
Panel C: Saving								
Acquisition (%)	2,353	85.00	35.72	0.00	0.00	100.00	100.00	100.00
Retention (%)	2,353	15.00	35.72	0.00	0.00	0.00	100.00	100.00
Incentive ($)	2,353	214.78	108.04	0.00	100.00	200.00	400.00	2,500.00
Minimum balance ($)	2,353	15,949.85	10,403.27	5,000.00	5,000.00	15,000.00	25,000.00	250,000.00
Incentive - 15K min balance ($)	2,353	226.07	108.91	0.00	100.00	200.00	500.00	600.00
Minimum balance days	1,958	84.02	23.46	10.00	60.00	90.00	90.00	365.00

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. Direct deposit is a dummy if the offer required a direct deposit. Incentive is the value in dollars of the sign-up bonus. Saving implied rate is the incentive divided by the minimum balance.

sumer Finances in 2023 almost 95% of respondents have a checking account, while about 55% have a saving account.

Almost 90% of checking offers also require a direct deposit, which might increase future switching costs. The average incentive is approximately $280, which is very similar to the median incentive of $300. The median minimum deposit for checking account is $25, 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 two bps and the median rate is one bps, 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 $190, which is very similar to the median incentive of $200. The average minimum balance for checking account is $15,500, 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 average implied saving rate is 3%, while the median is 1.3%. Given a requirement to hold the minimum balance for at least 90 days, we can 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 account is higher than on checking, as expected. However, the median rate is relatively low at 4 bps, while the average is about 35 bps. 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. Most notably, using our monthly panel of campaigns over time, we estimate the following baseline regression:

$$y_{ilt}^k = \alpha^k FFR_t + \lambda^k X_{lt} + \gamma_l^k + \epsilon_{ilt}^k, \tag{1}$$

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_{ilt}^k 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 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]

In Appendix A 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

[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 time deposits (Drechsler et al., 2017).

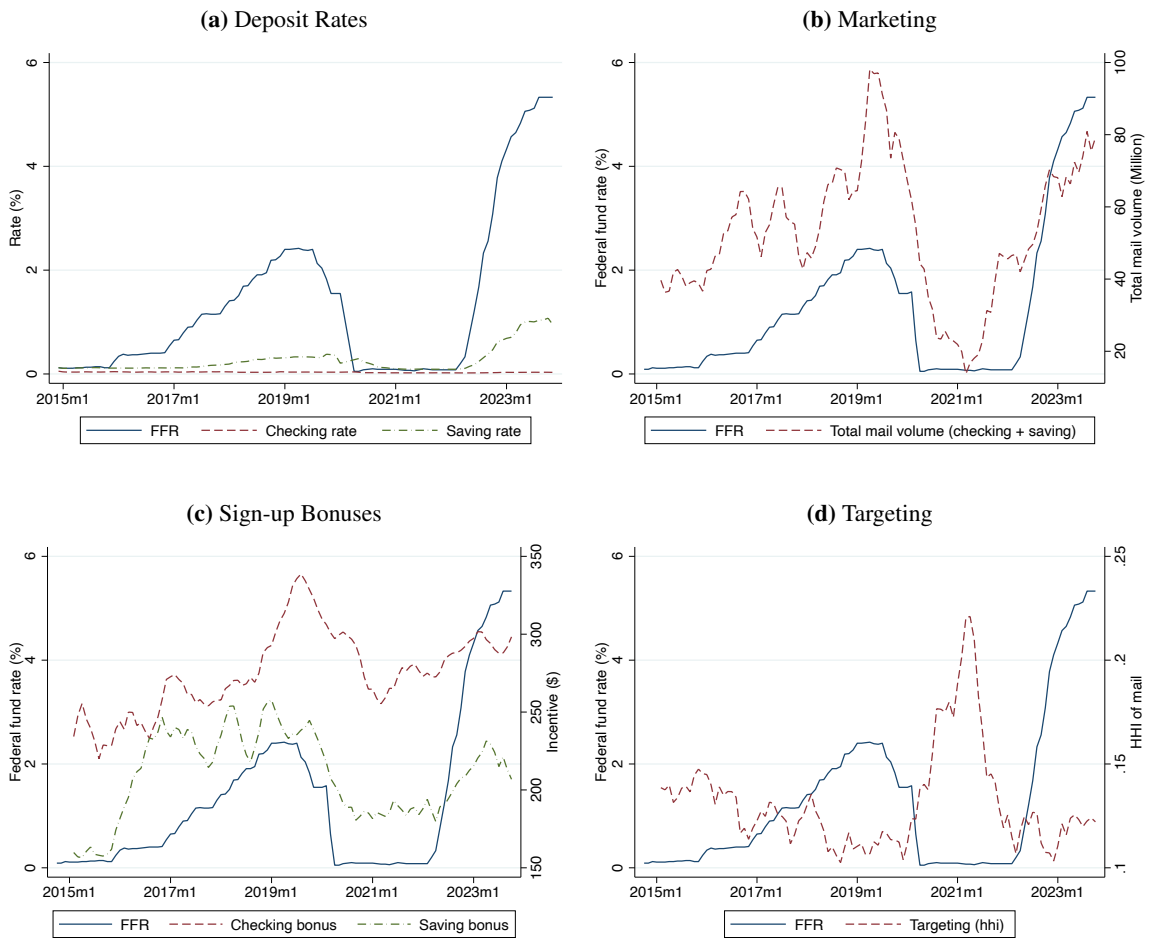


Figure 2: Pass-through on Checking and Savings Products - Rates, Mails, Bonuses and Targeting

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 HHI .

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.*

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) using the checking (Panel A) and saving (Panel B) rates as dependent variables. High-rate banks are Capital One, Discover and Citizens Bank. Robust standard errors in parenthesis. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

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 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 A 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 A 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 A 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 A 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 A. 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.

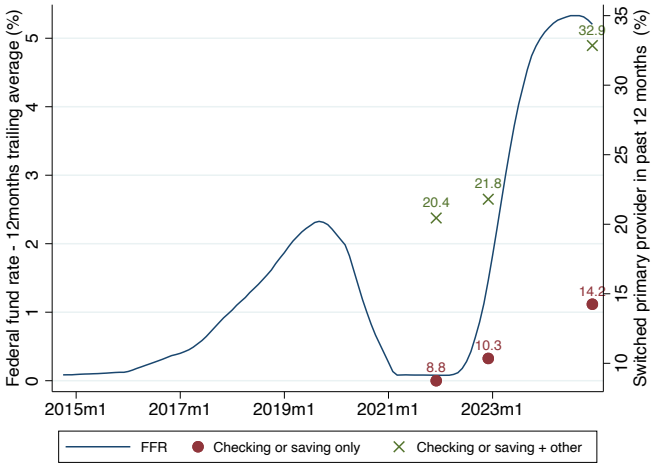
In Appendix A we show that the point estimate for the HHI is remarkably stable. The point estimate for the number of states drops when excluding the Chase, but remains large and statistically significant, and increases when focusing on the largest campaign within each bank-time pair. Finally, we find 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

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 XXX. The Table shows the results of equation (1) using the checking (Panel A) and saving (Panel B) rates as dependent variables. High-rate banks are Capital One, Discover and Citizens Bank. Robust standard errors in parenthesis. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

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.

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 switch-*

[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.

ing 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 purpose of this model is to consider two competing explanations for our facts:

1. Banks could have a large amount of market power. This could explain both the low levels of bonuses and the imperfect passthrough from interest rate changes to bonuses.

2. Bonus offers could be subject to adverse selection, in that households who respond to the bonus offer are far less sticky than the average household. This could also explain why bonuses are low and have imperfect passthrough.

We will begin by developing a model that incorporates both of these possibilities. The model developed in this section will illustrate how both market power and adverse selection can generate low bonuses and imperfect pass-through. We will then explore, through the lens of the model, how to discriminate between these two mechanisms. In particular, under certain assumptions, we will be able to analytically characterize this equilibrium in our model. This will allow us to calibrate the model, and differentiate between market power and adverse selection. We will show, in an illustrative calibration, that adverse selection explains most of the difference between the value of a representative depositor and the bonus paid by the bank to new depositors.

4.1 The Single-Market Model

We start by describing a model of competition within a single product/market. There are a continuum $j \in [0, 1]$ of banks and a continuum of depositors $i \in [0, 1]$. 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.

Time is discrete. 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 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.

Offering a bonus to α_{jt} depositors incurs a cost $\chi_j \alpha_{jt}$.[7] In our analytic results, we assume that all banks have the same cost, $\chi_j = \chi$. In our quantitative analysis, we assume χ_j is logistic distributed with mean χ and standard deviation κ. Our analytic results can be thought of as describing the $\kappa = 0$ limit, although we will not provide this formally. Note that α_{jt} can be interpreted as the probability of sending a bonus to all depositors in the market under a mixed strategy, in which case χ_j can be interpreted a fixed cost. Alternatively, it can be interpreted as the share of depositors receiving a bonus offer, in which case the cost is a variable cost linear in this share.

In each instant, a fraction ψ_A and ψ_S 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 uniformly from the set of banks (excluding the depositors' current bank). If the depositor received a bonus offer from bank j' (probability $\alpha_{j't}$), they will take the bonus $b_{j't}$ into account. If they did not receive a bonus offer (probability $1 - \alpha_{j't}$), they will choose between the two banks as-if they received a bonus offer of zero from bank j'.

Whether a particular borrower awakens or not and if so which bank they consider is independent across time, borrowers, and banks. The active borrowers are always awake, while the sleepy depositors are not, $\psi_A = 1 > \psi_S$. A borrower who switches from bank j to bank j' at time t has to pay a switching cost δ (expressed as a fraction of liquid wealth). This cost is paid, and any bonus is received, at time $t + 1$. When awake, depositors will enjoy a utility (in monetary units) of $\sigma \epsilon_{ijt}$ per unit wealth if they choose bank j, and $\sigma \epsilon_{ij't}$ if they choose bank j'. The random utilities ϵ_{ijt} and $\epsilon_{ij't}$ are also I.I.D. across agents, banks, and time, and gives rise to randomness in their choices.

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.[8] 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.

[7] We assume that χ_j is constant over time, meaning that banks' decisions about whether to offer bonuses are persistent. Nothing in our results would change if we instead assumed χ_{jt} varied over time, provided the population density remained constant.

[8] 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 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 that follow a finite state Markov process with values $f_t \in F \subset \mathbb{R}^K$, and is strictly positive, $r_t = r(f_t) > 0$. 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.

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.[9]

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

4.2 The Depositor's Problem

Depositors have a rate of time preference r_t, 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.

The depositor's Bellman equation can be written as

$$\begin{aligned} V^X(f_t, Q_t, j) &= (1 - \psi_X) e^{-r(f_t)} \mathbb{E}^{\mathbb{P}}[V^X(f_{t+1}, Q_{t+1}, j) | f_t, Q_t] \\ &\quad + \psi_X e^{-r(f_t)} \int_0^1 (\alpha_{j't} \bar{V}^X(f_t, Q_t, j, j', b_{j't}) + (1 - \alpha_{j't}) \bar{V}^X(f_t, Q_t, j, j', 0)) dj', \\ \bar{V}^X(f_t, Q_t, j, j', b) &= \int \max_{j'' \in \{j, j'\}} \{\mathbf{1}\{j'' \neq j\}(b - \delta)w + \sigma w \epsilon_{i,j'',t} \\ &\quad + \mathbb{E}^{\mathbb{P}}[V^X(f_{t+1}, Q_{t+1}, j'') | f_t, Q_t]\} dg(\epsilon_{ijt}, \epsilon_{i,j',t}). \end{aligned}$$

$V^X(\cdot)$ is the depositor's value function as the beginning of the period. If the borrower does not awaken this period, they receive their continuation value. If the borrower awakens and considers bank j', they will consider the bank's bonus offer if one has been sent (probability $\alpha_{j't}$). Either way, they will take into account both the switching cost δ and their idiosyncratic non-pecuniary taste shocks for the two

[9] 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.

banks when deciding whether or not to switch.

We assume that non-pecuniary taste shocks have a type-1 extreme value distribution with mean zero and standard deviation one ($dg(\cdot)$ in the above), which leads to the usual logit demand, with σ as parameter that governs the elasticity. The bonus, switching cost, and utility are received/paid in the period after the switch.

Let $D(b)$ denote the probability of switching to a bank that offers a bonus of b. Observe that $V^X(f_t, Q_t, j) = V^X(f_t, Q_t)$ for all j, which is to say that all banks are identical once the initial bonus has been paid. This leads to

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

If a bank chooses to offer bonuses to a fraction α of depositors, the average switching probability will be

$$D(\alpha, b) = \alpha D(b) + (1-\alpha)D(0).$$

Note also that sleepy and active households make the same choices conditional on being awake; they differ only in the their probability of being awake.

4.3 A Bank's Problem

Now consider the HJB equation of the bank. The density of type X at bank j evolves as

$$Q_{Xj,t+1} - Q_{Xjt} = \psi_X D(\alpha, b)\mu_X - \psi_X D(\alpha^*(f_t, Q_t), b^*(f_t, Q_t))Q_{Xjt},$$

where b is the bonus set by bank j, α is offer volume for bank j, and $\alpha^*(f_t, Q_t)$ and $b^*(f_t, Q_t)$ are the offer volume and bonuses set by other banks in equilibrium. 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 entire 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 full Bellman equation for the bank is

$$V^B(f_t, Q_{Ajt}, Q_{Sjt}, Q_t) = \sup_{\alpha\in[0,1], b\geq 0} (1 - e^{-r(f_t)})w(Q_{Ajt} + Q_{Sjt}) - \alpha\chi_j$$
$$- e^{-r(f_t)}\alpha \sum_{X\in\{A,S\}} \psi_X \mu_X D(b) w b$$
$$+ e^{-r(f_t)}\mathbb{E}_t^{\mathbb{Q}}[V^B(f_{t+1}, Q_{Aj,t+1}, Q_{Sj,t+1}, Q_{t+1})].$$

The constant χ_j captures the cost of making bonus offers. Bonuses are paid only to depositors who have received bonus offers, and not to all new depositors.[10]

Let $V_X^B(f_t, Q_t) = \frac{\partial}{\partial Q_{Xjt}} V^B(f_t, Q_{Ajt}, Q_{Sjt}, Q_t)$ be the marginal value of a borrower of type X, noting that this marginal value does not depend on the bank's current population. By the envelope theorem, this marginal value satisfies

$$V_X^B(f_t, Q_t) = (1 - e^{-r(f_t)})w + e^{-r(f_t)}(1 - \psi_X D(\alpha^*(f_t, Q_t), b^*(f_t, Q_t)))\mathbb{E}_t^{\mathbb{Q}}[V_X^B(f_{t+1}, Q_{t+1})],$$

which can be integrated as

$$V_X^B(f_t, Q_t) = w\mathbb{E}_t^{\mathbb{Q}}[\sum_{j=0}^{\infty} \frac{(e^{r(f_{t+j})} - 1)\Pi_{k=0}^{j-1}(1 - \psi_X D(\alpha^*(f_{t+k}, Q_{t+k}), b^*(f_{t+k}, Q_{t+k}))}{\exp(\sum_{k=0}^{j} r(f_{t+k}))}]. \quad (3)$$

The intuition behind the marginal values $V_X^B(\cdot)$ is straightforward. Attracting a depositor allows the bank to earn the interest spread ($w(e^{r(f_t)} - 1)$). This benefit is discounted with the effective discount factor $e^{-r(f_t)}(1 - \psi_X D(\alpha^*(f_t, Q_t), b^*(f_t, Q_t))$, 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 ($V_A^B(\cdot) < V_S^B(\cdot)$).

Let $\psi^* = \sum_{X\in\{A,S\}} \psi_X \mu_X$. The weighted-average value of a marginal depositor (scaled by the size of the deposit) can be defined as

$$MV(f_t, Q_t) = \frac{\sum_{X\in\{A,S\}} \psi_X \mu_X \mathbb{E}_t^{\mathbb{Q}}[V_X^B(f_{t+1}, Q_{t+1})]}{w\psi^*}.$$

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

[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.

marginal depositors is how the model captures adverse selection.

The best-strictly-positive-bonus, $b^+(f_t, Q_t)$, can be derived from the first-order condition[11] as

$$b^+(\cdot) = \underbrace{MV(\cdot)}_{\text{Marginal Value}} - \underbrace{\frac{D(b^+(\cdot))}{wD'(b^+(\cdot))}}_{\text{Optimal Markdown = Inverse Elasticity}}, \tag{4}$$

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) less the optimal markdown ($\frac{D(\cdot)}{D'(\cdot)} = \sigma w(1 - D(\cdot))^{-1}$), which is the inverse of the demand elasticity.

Now the first-order condition for the offer volume α, assuming that the optimal bonus is $b^+(\cdot)$. For a bank with $\chi_j = \chi$, it will be optimal to increase (resp. decrease) α if $h(f_t, Q_t)$ is greater than (resp. less than) zero, where

$$h(f_t, Q_t) = \underbrace{(MV(\cdot) - b^+(\cdot))\frac{D(b^+(\cdot)) - D(0)}{D(0)}}_{\text{Profits from Marginal New Depositors}} - \underbrace{b^+(\cdot)}_{\text{Cost of Bonuses to Inframarginal New Depositors}} - \underbrace{\frac{\chi}{w\psi^* D(0)}}_{\text{Fixed Cost per Inframarginal New Depositor}}. \tag{5}$$

The function $h(\cdot)$ is the profit from sending bonus offers to the population per inframarginal new depositor (defined as the quantity of new depositors that bank would attract even with a zero bonus). When considering whether to offer bonuses, 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 ($MV(\cdot) - b^+(\cdot)$), scaled by ratio of marginal to inframarginal new depositors ($D(b^+(\cdot))/D(0) - 1$). This ratio can also be viewed as an elasticity. If the elasticities in equations (4) and (5) 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.

There are two costs of offering bonuses. There is the direct cost, which is paid in proportion to the depositor population, even though only awake depositors might respond to bonus offers. There is also a cost associated with paying bonuses to inframarginal depositors, who would have come to the bank even in the absence of a bonus offer.

[11] In the main text, we set aside details (concavity, positivity) that are discussed in the proof.

In our quantitative model, the fraction banks with $\alpha_{jt} = 1$ is the fraction for which $w\psi^* D(0)h(f_t, Q_t) > \chi_j - \chi$, implying that

$$\alpha^*(f_t, Q_t) = \frac{1}{1 + e^{-\kappa^{-1} w\psi^* D(0)h(f_t, Q_t)}}.$$

In our analytic model, in which $\chi_j = \chi$, $\alpha^*(\cdot) = 1$ if $h(f_t, Q_t) > 0$, $\alpha^*(\cdot) = 0$ if $h(f_t, Q_t) < 0$, and $\alpha^*(\cdot)$ can take on any value in $[0, 1]$ if $h(f_t, Q_t) = 0$. This can be viewed as a limiting case of the quantitative model in which $\kappa \to 0$.

4.4 Equilibrium and Comparative Statics

We next provide results on the existence of equilibrium for our analytic model. 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 $\alpha^* : \mathbb{R}^K \to [0, 1]$ and $b^* : \mathbb{R}^K \to \mathbb{R}_+$ such that, if all other banks are assumed to play the strategy (α^*, b^*), each bank's has a best response of (α^*, b^*). Starting from the first-order conditions above, we demonstrate that an equilibrium exists.

Proposition 1 *There exists a symmetric Markov equilibrium (α^*, b^*) in which the marginal values $V_X^B(f)$ satisfy (3), $b^*(f) = \max(b^+(f), b_{min})$, and $\alpha^*(f) < 1$ only if $b^+(f) \leq b_{min}$, with $\alpha^*(f) = 0$ if $b^+(f) < b_{min}$, where $b^+(f)$ is the unique solution to*

$$\sum_{X \in \{A,S\}} \frac{\psi_X \mu_X}{\psi^*} V_X^B(f) = w(b^+(f) + \frac{\sigma}{1 - D(b^+(f))})$$

and $b_{min} > 0$ is the unique solution to

$$\sigma \frac{1 - D(0)}{1 - D(b_{min})} - D(0)b_{min} = \sigma + \frac{\chi}{w\psi^*}.$$

Proof. See the appendix, ... ■

In the equilibrium described by this proposition, there are three regions of the parameter space. There is a region in which banks send offers to all potential depositors, a region where the banks send no offers, and a region where the banks send offers to some but not all depositors. When other banks are more aggressive (higher b^*, higher α^*), the value of a new depositor ($V_X^B(\cdot)$) falls, because it becomes more likely that the depositor will leave for another bank soon after arriving. Conversely, if other banks are less aggressive, the value of a new depositor rises.

Suppose, as an example, that interest rates were constant. It is possible that a bank would want

to offer a bonus $b^+ > b_{min}$ if it knew other banks were not offering bonuses, but would prefer not to offer a bonus if it knew the other banks were offering bonuses. In this case, the equilibrium would necessarily feature an $\alpha^* \in (0,1)$.[12]

4.5 Analytic Results

Taking this point a step further, we will under additional assumptions construct an explicit equilibrium of this sort. This equilibrium features a region in which bonuses are constant and all of the bank's response to interest rates occurs through changes in the offer volume α, as well as a region in which bonuses are not offered and a region in which bonuses are offered to the entire market and co-move with interest rates. This equilibrium will, in a stylized manner, reproduce the qualitative features of our data on bonus offers, although it cannot speak to depositor heterogeneity or the targeting of offers.

To construct this equilibrium, we first define a constant, λ.[13]

Definition 1 *Define λ as the positive solution to the equation*

$$b_{min} + \frac{\sigma}{1 - D(b_{min})} = \sum_{X \in \{A,S\}} \frac{\mu_X \psi_X}{\psi^*} \frac{1}{1 + \lambda \psi_X}.$$

We make the following assumption about the interest rate process:

Assumption 2 *The stochastic process for the factors f_t and short rate function $r(f_t)$ has the following property:*

1. *If $r(f_t) > \lambda^{-1} D(0)$, then $r(f_{t+1}) \geq \lambda^{-1} D(0)$ almost surely, and*
2. *If $r(f_t) < \lambda^{-1} D(b_{min})$, then $r(f_{t+1}) \leq \lambda^{-1} D(b_{min})$ almost surely.*

This assumption says that if short-term rates are above $\lambda^{-1} D(0)$, they will not drop below this value without first passing through $\lambda^{-1} D(0)$, and likewise short rates will not rise above $\lambda^{-1} D(b_{min})$ without first passing through that value. This is the discrete time analog of the standard assumption of continuous sample paths (no jumps) in continuous time. It allows us to benefit from the tractability of continuous time models without the additional complexity of those models. We do not claim it is entirely realistic; one purpose of a quantitative exercise is to avoid imposing this assumption.

[12] Equivalently, if we interpret α as the probability of a positive bonus under a mixed strategy, there would be no pure-strategy equilibrium, only a mixed strategy equilibrium.

[13] Note that the equation that implicitly defines λ can be rewritten as a quadratic equation, and this quadratic equation has one positive and one negative solution.

The following proposition states that, under this assumption, inside the specified interval the bonus will always be equal to b_{min} and the offer volume will absorb all interest rate fluctuations.

Proposition 2 *Under Assumption 2, there is a symmetric Markov equilibrium in which:*

1. *When* $r(f_t) < \lambda^{-1}D(0)$, $\alpha^*(f_t) = 0$,
2. *When* $r(f_t) > \lambda^{-1}D(b_{min})$, $\alpha^*(f_t) = 1$ *and* $b^*(f_t) > b_{min}$, *and*
3. *When* $r(f_t) \in [\lambda^{-1}D(0), \lambda^{-1}D(b_{min})]$, $b^*(f_t) = b_{min}$ *and*

$$\alpha^*(f) = \frac{\lambda(e^{r(f)} - 1) - D(0)}{D(b_{min}) - D(0)}.$$

Proof. See the appendix, ... ■

In the interior region of this equilibrium (item 3 in Proposition 2), the marginal value of a depositor (of both types) is constant and satisfies $V_X^B(f) = \frac{w}{1+\lambda\psi_X}$. The rate at which depositors leave their current bank is linear in the arithmetic interest rate,

$$\psi_X D(a^*(f), b^*(f)) = \psi_X \lambda(e^{r(f)} - 1).$$

As interest rates rise, competition intensifies, with other banks offering bonuses to a larger fraction of the depositor population. This increase in competition cancels out the increase in depositor value that comes from interest rates, leaving the marginal value of a new depositor constant. Each bank is willing to raise its offer volume in response to rising interest rates (which is the best-response that supports the equilibrium).

Eventually, if interest rates rise beyond $\lambda^{-1}D(b_{min})$, the banks will send offers to all of the depositors in the market. At this point, bonuses will begin rising beyond $b_{\min}$, and the value of a marginal depositor will increase with interest rates in a way that depends on both current short rates and expectations of future rates.

Conversely, if interest rates fall below $\lambda^{-1}D(0)$, banks will cease sending bonus offers. At this point, the value of a depositor is equal to the value of the net interest margin that will be earned until either the depositor leaves or rates exit this region, plus a discounted terminal value, which is either zero (if the depositor has left) or $\frac{w}{1+\lambda\psi_X}$ (if rates have risen above $\lambda^{-1}D(0)$).[14]

[14]This last point illustrates the utility of Assumption 2: we do not need to consider the possibility that interest rates move in a single period from below $\lambda^{-1}D(0)$ to above $\lambda^{-1}D(b_{min})$.

This equilibrium captures several of the stylized facts documented in Section 3. Specifically, bonuses are roughly constant while offer volume strongly co-moves with short rates. That it is short rates and not long rates that matters is an endogenous outcome that emerges in equilibrium. If other banks held their bonuses and offer volumes constant, the value of a sticky depositor would depend on the net present value of future interest margins, and hence on long rates. In equilibrium, however, competitor banks increase their offer volumes in response to a rise in rates, which makes depositors less valuable to their current banks. This increase offsets the direct rise income and generates a stable value.

4.5.1 Illustrative Calibration

We next discuss an illustrative calibration of the equilibrium described in Proposition 2. We will calibrate the model under the assumption that in 2024, interest rates were in the interior region describe in Proposition 2, with $\alpha^*(\cdot) \in (0,1)$ and $b = b_{min}$. This is consistent with our data, in particular our estimate of the number of competing bonus offers received by households (described in more detail below).

Table 3 lists the moments we use in this illustrative calibration, their associated data sources, and the interpretation of the moment in the context of the model.

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, consistent with our model. 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.

The average savings account bonus in our data is close to \$200. A common minimum balance required to earn the savings account bonus is \$15000, 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 2024 Mintel survey data, combined with the average interest rate for 2024 and our data on marketing competition, 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 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

Table 3: Illustrative Calibration: Moments

No.	Moment	Value source	Data interpretation	Model
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)	$e^{\bar{r}} - 1$
4	Competing offers at $r = \bar{r}$ (%)	25	Mintel Comperemedia	$\frac{\alpha(\bar{r})}{(1-\alpha(\bar{r}))^2}$
5	Quarterly departure rate at $r = \bar{r}$ (%)	9.5	Mintel Survey 2024	$\sum_X \psi_X \mu_X \lambda(e^{\bar{r}} - 1)$
6	Minimum quarterly departure rate (%)	5.5	Mintel Survey 2021	$\sum_X \psi_X \mu_X D(0)$
7	Half life of depositor (n, quarters)	64	SCF	$\frac{1}{2} = \mu_A(1 - \lambda(e^{\bar{r}} - 1))^n$ $+(1 - \mu_A)(1 - \psi_S \lambda(e^{\bar{r}} - 1))^n$

consistent with the level of interest rates observed in 2024.

To assess the degree of competition between banks during 2024, we use data on the number of bonus offers received by households in a quarter, conditional on receiving at least one bonus offer. During 2024, the average number of offers received, conditional on receiving one offer, was 1.25. If the probability of receiving an offer is independent across banks within the subpopulation of households that have a non-zero probability of receiving an offer, this value is the function of $\alpha(\bar{r})$ listed in Table 3. We use this calibration method to address the possibility that there are some households banks do not send offers to. That is, if we observe that a large bank sends offers to one-fourth of the households in our sample, this does not mean the bank has set $\alpha = \frac{1}{4}$. It could well be that they are sending offers to all households within some market (where a market is defined by observable characteristics) and no offers outside of this market, which would correspond to $\alpha = 1$ within the targeted market. To address this possibility, we calibrate α to match a measure of the degree of competition, as described above.

We calibrate the minimum quarterly departure rate to the one reported in the Mintel Survey from 2021, for the reason that interest rates and mail volume were very low during this time period. That is, we assume that 2021 corresponds to the $\alpha^*(\cdot) = 0$ environment.

Armed with these moments, we can calibrate the key parameters of the model. The following

Table 4: Illustrative Calibration: Parameters

No.	Parameter	Value	Selected Relevant Moments
1	μ_A	15.2%	5, 7
2	ψ_S	1.42%	5, 7
3	δ	\$45.0 / w	1, 6
4	σ	\$65.6 / w	1, 4
5	χ	\$80.6	1, 5

table lists each of our parameters (apart from w, which is directly measured in data), the calibrated value, and the moments that are relevant for the calibration of that parameter.

That the sleepy investors are indeed quite sleepy (ψ_S is small) is essentially guaranteed by the observation that the quarterly departure rate is 9.5% but the half-life is 64 quarters. These two moments imply that there is a large portion of the population that switches banks much less often than the average switching rate. By the same logic, there must be another portion of the population that is frequently switching banks, which is to say that $\mu_A > 0$.

The observation that the minimum departure rate is substantial leads to the conclusion that the fixed costs δ cannot be too large compared to the scale of the preference shocks σ. That the departure rate is substantially larger in 2024 (when bonuses are offered) than in 2021 (when they are not) leads to the conclusion that the bonus is significant relative to the preference shocks. Combining these, it is not surprising that $\delta < \sigma < b_{min}$.

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). We can also compute the interest rate interval in which rates must remain to justify the equilibrium, and the semi-elasticity of α (which we interpret as marketing volume) to the short rate. We report these derived quantities in Table 5.

We find that the value of a sleepy depositor is roughly 60% of the size the deposit. 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

Table 5: Illustrative Calibration: Derived Values

Name	Model Expression	Value
Value of Active Type	V_A^B	\$320
Value of Sleepy Type	V_S^B	\$9080
Value of Awake Depositor	$MV * w$	\$962
Value of Rep. Depositor	$\mu_A V_A^X + \mu_S V_S^X$	\$7746
Difference btw. Rep. and Awake	$MV * w - \mu_A V_A^X - \mu_S V_S^X$	\$6784
Markdown (\$)	$w(MV - b_{min})$	\$762
Demand Elasticity	$\sigma(1 - D(b_{min}))$	19.7
Log Volume Rate Sensitivity (interior region, annualized)	$\frac{\lambda e^{r(f)}}{4\lambda(e^{r(f)}-1)-4D(0)}$	47.7
Lower Interest Rate Threshold (annual, %)	$(1 + \frac{D(0)}{\lambda})^4 - 1$	2.95%
Upper Interest Rate Threshold (annual, %)	$(1 + \frac{D(b_{min})}{\lambda})^4 - 1$	8.21%

will leave eventually reduces the value of the bank's claim, but given that the half-life is greater than 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 equal to roughly 1.7 quarters worth of interest when the quarterly interest rate is 1.25%.[15] These 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 average awake depositor is worth \$962 to the bank, and hence the bank earns of a profit of \$762 after paying the \$200 bonus. Note, however, that this profit is small relative to the value of a representative depositor (\$7746). Market power accounts for about 10% of the difference between the value of a representative depositor and the bonus paid by

[15] Recall that in our equilibrium, this value is constant, meaning that an active depositor is worth e.g. roughly 4 quarters of interest at a 0.5% quarterly interest rate. This extension is a consequence of reduced competition at lower rates.

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 checking and savings accounts that are close substitutes to 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.

The thresholds for the interior region of interest rates in our calibration are 2.85% and 8.21% annualized. In our sample, interest rates lie inside this region or fall below 2.85%, but do not rise above 8.21%. Our model thus predicts that bonus offers should be constant over our sample, and that a regression of log offer volume on interest rates would lie in between 0 and 48, depending on the fraction of the sample for which rates were above 2.85%. The latter is broadly consistent with our regression estimates. The former is not, in the sense that our empirical evidence documents some sensitivity of bonus levels to interest rates, but can be viewed as a stylized approximation.

That the bonus does not change is a consequence of our assumption that all banks share a common χ parameter. This issue is addressed in our quantitative model by introducing bank-level heterogeneity in the χ parameter. This leads naturally to some of the increase in interest rates being absorbed by changes in offer volume and some of the interest rate increase being absorbed by changes in bonus levels, allowing the model to match the data.

4.6 Why Not Pay Interest?

Before turning to our quantitative model, 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 pay bonuses, and consider the problem of a single bank who can both pay bonuses and pay interest.

[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.

We will allow the bank to commit to paying interest for one period to its existing depositors. We will assume this interest rate is not available to new depositors, as a simplification. As discussed above, offering one period's worth of interest to new depositors is equivalent to a offering a bonus.[17]

We will conjecture and verify that paying interest will not be optimal. For this reason, depositors will anticipate that after one period (when the commitment expires), the bank will cease paying interest, and adjust their demands accordingly. In particular, depositors' continuation value will not depend on the identify of their bank ($\mathbb{E}_t[V^X(f_{t+1}, Q_{t+1}, j'')]$ is the same for all j'').

Under these assumptions, if the bank offers an interest rate of $d' \geq 0$ to its existing depositors, their departure rate is

$$D(\alpha^*(f), b^*(f), d') = \alpha^*(f)D(b^*(f) - d') + (1 - \alpha^*(f))D(-d'),$$

Intuitively, paying interest to the bank's current depositors discourages them from switching to another bank, in a manner that is equivalent to a situation in which there is no interest but the other bank's bonus offer is reduced.

The evolution of the population at the bank, given policies (α, b, d'), is

$$Q_{Xj,t+1} - Q_{Xjt} = \psi_X D(\alpha, b)\mu_X - \psi_X D(\alpha^*(f_t), b^*(f_t), d')Q_{Xjt}$$

The Bellman equation for the bank is now

$$\begin{aligned} V^B(D, f_t, Q_{Ajt}, Q_{Sjt}) = \sup_{\alpha\in[0,1], b\geq 0, d'\geq 0} & (1 - e^{-r(f_t)})w(Q_{Ajt} + Q_{Sjt}) - D - \alpha\chi_j \\ & - e^{-r(f_t)}\alpha \sum_{X\in\{A,S\}} \psi_X \mu_X D(b) wb \\ & + e^{-r(f_t)}\mathbb{E}_t^{\mathbb{Q}}[V^B(D(d', Q_{Ajt}, Q_{Sjt}, f_t), f_{t+1}, Q_{Aj,t+1}, Q_{Sj,t+1})]. \end{aligned}$$

where $D(d')$ is the total interest promised in the previous period to existing depositors,

$$D(d', Q_{Ajt}, Q_{Sjt}, f_t) = wd' \sum_{X\in A,S} Q_{Xjt}(1 - \psi_X D(\alpha^*(f_t), b^*(f_t), d')).$$

[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 $\alpha_{jt} < 1$.

The first-order condition for d' can be written as

$$\underbrace{\frac{\sum_{X\in\{A,S\}}\psi_X Q_{Xjt}\mathbb{E}_t^{\mathbb{Q}}[V_X^B(f_{t+1})]}{\sum_{X\in\{A,S\}}\psi_X Q_{Xjt}}}_{\text{Marginal Value of Retained Depositor}} - \underbrace{\frac{\sum_{X\in\{A,S\}}Q_{Xjt}(1-\psi_X D(\alpha^*(f_t),b^*(f_t),d'))}{-\frac{\partial}{\partial d'}D(\alpha^*(f_t),b^*(f_t),d')\sum_{X\in\{A,S\}}\psi_X Q_{Xjt}}}_{\text{Inverse of Retention Elasticity}} \leq d',$$

with equality if $d' > 0$.

For a bank with a representative population ($(Q_{Ajt}, Q_{Sjt}) \propto (\mu_A, \mu_S)$), this can be simplified as

$$MV(f_t) - \frac{1-\psi^* D(\alpha^*(f_t),b^*(f_t),d')}{-\psi^*\frac{\partial}{\partial d'}D(\alpha^*(f_t),b^*(f_t),d')} \leq d'.$$

This first-order condition can be compared with the first-order condition for the optimal bonus, (4). The difference is the distinction between the inverse elasticity of an awake depositor who received a bonus offer ($D(b)/D'(b)$) and the inverse retention elasticity. The key quantitative difference between these two elasticities is that the retained population $1-\psi^* D^*(\alpha^*(f_t),b^*(f_t),d')$ is generally much larger than the departing population $\psi^* D^*(\alpha^*(f_t),b^*(f_t),d')$.[18]

Put another way, 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, which is to say that bonuses are more efficient than interest payments. 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.

The following proposition provides sufficient conditions for $d' = 0$ to be the optimal policy for all possible interest rate paths in a symmetric equilibrium (which implies $(Q_{Ajt}, Q_{Sjt}) \propto (\mu_A, \mu_S)$).

Proposition 3 *If $\sigma \geq 1$ or if $\psi^* \leq \frac{4\sigma}{(1+\sigma)^2}$, it is never optimal to pay interest to existing depositors in the symmetric equilibrium described by Proposition 2.*

Proof. See the appendix, ... ■

The first condition ($\sigma \geq 1$) is a technical condition that is economically implausible. The second condition states that if the typical depositor is sufficiently sleepy relative to the retention elasticity of

[18] There is also the distinction that the bonus elasticity is conditional on receiving a bonus offer, whereas the retention elasticity is not.

awake depositors with respect to interest rates, it is not profitable to offer interest. In this case, most of the interest payments go to sleepy depositors, who would not leave the bank even if the bank paid them zero. Offering such payments to retain a small population of awake depositors is not worthwhile, even if those depositors are very valuable. The bound is a sufficient condition, and is derived under the assumption of almost infinite interest rates (and hence $MV(f) = 1$); it is likely that much weaker conditions are required under realistic interest rate processes. Nevertheless, the bound is sufficient for our purposes, as it is satisfied in our calibration.

Corollary 3 *In the calibration described in Table 3, it is not optimal for banks to offer interest to their existing depositors.*

Proof. The second condition of Proposition 3 is satisfied. ■

These results shows that banks with representative depositors populations should never pay interest. However, the story is different for a bank who population is active. The following result makes this point in a stylized way, demonstrating that a bank with entirely active depositors would always offer interest (provided interest rates are sufficiently high).

Proposition 4 *In any equilibrium, if* $1 - e^{-r(f_t)} \geq \frac{\sigma}{D(0)}$*, a bank with an entirely active depositor population* $Q_{Ajt} > Q_{Sjt} = 0$ *would set* $d' > 0$*.*

Proof. See the appendix, ... ■

In our calibration, this corresponds to a roughly 5% interest rate. It should be understood as a sufficient condition– the bank would likely offer positive interest on depositors at lower rates as well. The intuition behind this result is that even active depositors have some value, and if a bank's entire population is active, there is little "wasted" interest paid towards people who never would have left even with zero interest. This is particularly true when depositors are very elastic (σ is low relative to $D(\cdot)$).

We do not fully explore this kind of asymmetric equilibria in the present paper. However, we will 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, etc...). These differences might be explained by the newer entrants having a more active depositor base than their established competitors.

5 Quantitative Analysis

TBD.

6 Conclusion

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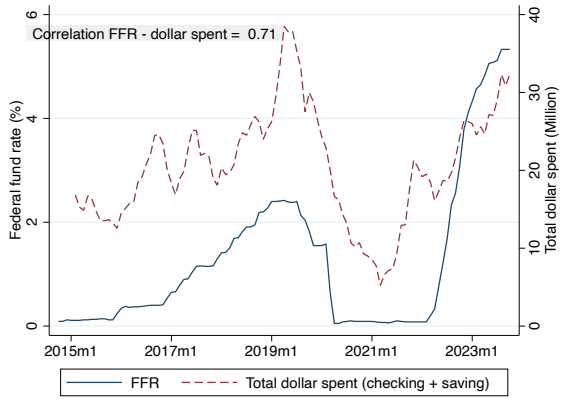
Online Appendix

In this online appendix we report additional figures and tables about results on the facts and structural model. Appendix **??** provides supplementary figures and tables for the data and setting. Appendix **??** provides supplementary figures and tables for the structural model.

A Additional Results on Facts

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

(a) Dollar spent on mail: Checking & Savings



(b) Direct mail volume: Mortages

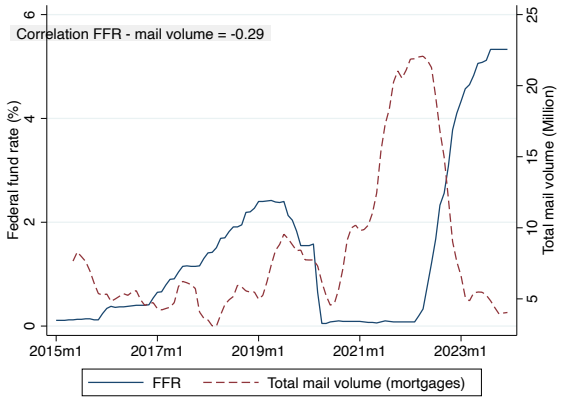
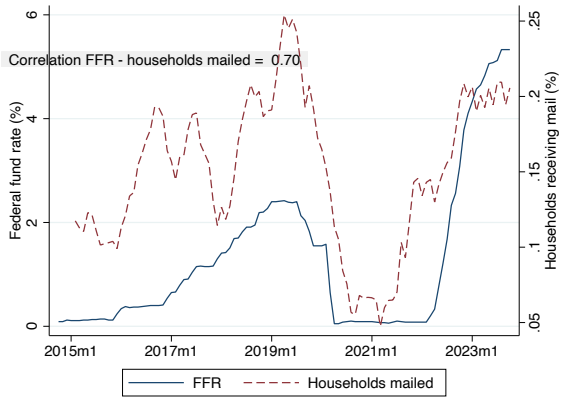


Figure A1: Pass-through on Checking and Savings Products - Marketing Extra

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.

(a) Fraction of household receiving mail



(b) Acquisition VS Retention

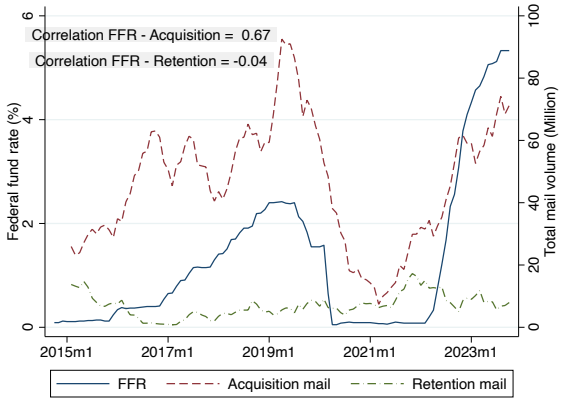


Figure A2: Pass-through on Checking and Savings Products - Targeting Extra

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: XXX. *, **, 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: XXX. *, **, 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: XXX. *, **, 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: XXX. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.