Online Appendices

for

"Advertising, Consumer Awareness, and Choice: Evidence from the U.S. Banking Industry"

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Elisabeth Honka[*]   Ali Hortaçsu[†]   Maria Ana Vitorino[‡]

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[*]University of California Los Angeles, elisabeth.honka@anderson.ucla.edu.
[†]University of Chicago and NBER, hortacsu@uchicago.edu.
[‡]University of Minnesota, vitorino@umn.edu.

A Additional Tables

Table A.1: Demographics for Initial and Final Samples

This table compares the demographics of the respondents in the final sample with the demographics of all the survey respondents (with valid zip codes). The columns "All Respondents" and "Final Sample" report the percentage of respondents in each of the demographic groups for all of the survey respondents and for the respondents in the final sample, respectively.

| | Data set | |
	All Respondents $(n = 4,246)$ %	Final Sample $(n = 2,214)$ %
Gender		
Female	60.0	61.5
Male	40.0	38.5
Age		
19-29	17.0	17.9
30-44	30.4	31.8
45-59	34.0	32.7
60+	18.7	17.6
Household Income		
Under $49,999	36.5	36.4
$50,000-$99,999	38.0	37.5
$100,000 and over	25.5	26.1
Race		
White	81.3	78.5
Black	5.0	5.5
Asian	7.5	9.1
Hispanic	3.9	4.9
Other	2.3	2.1
Education		
High school or less	8.5	7.5
Some College	32.2	31.4
College graduate	29.4	31.1
Postgraduate	29.9	29.9
Marital Status		
Single/Divorced	33.4	33.1
Married/Partner	63.7	64.6
Widowed	2.9	2.3
Region		
New England	5.6	6.1
MidAtlantic	22.9	27.1
Midwest	10.5	6.8
North Central	10.9	8.6
Southeast	8.1	8.6
South Central	4.1	3.3
Texas	4.1	4.7
Florida	8.8	10.6
Southwest	6.3	6.0
Northwest	4.3	4.7
California	12.8	12.5
Other	1.6	0.9

Table A.2: DMA-level Advertising Expenditures and Placements by Bank

This table shows average advertising expenditures (dols000) and the average number of placements (also called "units") by bank. It includes the categories Spot TV, Newspapers, National Spot Radio, Internet Display, and Outdoor at the DMA-level. The averages are taken by dividing total advertising expenditures or total advertising placements at the DMA-level over the entire reference period by the number of DMAs in which each bank had some advertising activity.

Institution	Average per DMA		Number of DMAs
	Expenditure	Units	
Bank of America	162.7	901.2	206
BB&T	144.6	136.8	33
Capital One	293.7	654.9	150
Chase/WaMu	688.4	1107.8	152
Citibank	356.1	186.5	182
Citizens Bank	184.5	178.5	140
Comerica Bank	284.2	238.5	19
Fifth Third Bank	687.5	1378.7	35
HSBC	156.4	226.8	130
Keybank	336.6	1216.5	36
M&T	364.3	576.6	15
PNC/National City Bank	363.0	564.1	145
Regions Bank	167.4	254.7	67
Sovereign Bank	108.8	150.5	70
Suntrust Bank	269.7	437.9	106
TD Bank	717.3	705.3	51
U.S. Bank	84.2	141.0	152
Wells Fargo/Wachovia	230.1	638.4	197

Table A.3: Respondents with Bank Branches within 5 Miles of their Home (Shoppers only)

This table reports the percentage of shoppers in the final sample with bank branches within 5 miles of their home conditional on having considered or chosen each of the institutions listed.

Institution	Considered	Chosen
Bank of America	84.44	84.75
BB&T	83.72	83.56
Capital One	67.36	63.89
Chase/WaMu	86.76	89.83
Citibank	67.36	75.82
Citizens Bank	58.97	59.77
Comerica Bank	87.80	89.47
Fifth Third Bank	78.62	85.29
HSBC	41.03	45.00
Keybank	85.25	91.23
M&T	83.53	82.22
PNC/National City Bank	84.96	88.51
Regions Bank	86.92	89.06
Sovereign Bank	78.95	80.95
Suntrust Bank	86.11	88.12
TD Bank	89.36	92.77
U.S. Bank	81.16	87.72
Wells Fargo/Wachovia	88.32	91.67
Average	81.12	83.66

B Further Details on Survey Sample and Sampling Weights

In this Appendix, we provide further details regarding the sample of respondents that constitutes our main data and on the sampling weights used to ensure that our model results are representative of U.S. consumers' banking behavior.

In the main text, we make the distinction between two types of survey respondents: shoppers and non-shoppers. Shoppers are consumers who shopped and opened one or more new accounts and non-shoppers are consumers who neither shopped nor opened new accounts during the reference period."[1] Shoppers include three different types of consumers. Namely, they include consumers that a) moved to a new primary bank, b) opened (an) additional account(s) with their primary bank, or c) opened (an) additional account(s) with another bank but kept their primary bank.

The survey conducted by the marketing research company which provided us with the data focuses mostly on shoppers. We correct for the over-sampling of shoppers by using weights in the model estimations so that the results are representative and accurately reflect the search and switching behavior of the overall U.S. population of retail banking consumers.

We calculate these sampling weights using information from another survey conducted by the same marketing research company, which they shared with us. This "screener" survey does not contain the same level of detail as the data described in Section 3 (Consumer-Level Data subsection) but has a much larger scale (around $100,000$ respondents) and a sampling design that ensures U.S. population representativeness.

Comparing the proportions of each of the groups of respondents in the main survey and in the screener survey, we find that non-shoppers are under-represented (12% in our survey vs. 73% in screener survey), shoppers that moved to a new primary bank are over-represented (59% in our survey vs. 8.4% in screener survey), shoppers that opened (an) account(s) with another bank but kept their primary bank are over-represented (30% in our survey vs. 14% in screener survey). The sampling weights are thus calculated as ratios of the proportions of each of the groups of respondents in the main survey and in the screener survey. Note that shoppers that opened an additional account with their primary bank are not in our survey data (they were "terminated"). Fortunately, these only correspond to 5% of the U.S. population (based on the screener survey).

To further validate our sampling weights we compare them to the only other sources that we were able to locate that mention statistics on bank search and switching behavior. Specifically, a study conducted by TD Bank in 2013 says that "12% of the study respondents switched primary bank during the last two years."[2] Further, a NY Times article published in 2010 mentions that "Roughly 10 to 15 percent of households move their checking account from one bank to another each year, a figure that hasn't changed substantially in recent years, according to several industry

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[1]Note that we use the term "shop" interchangeably with "search" throughout the paper. Thus shoppers are consumers who searched, i.e. actively investigated at least one bank, and opened one or more new accounts and non-shoppers are consumers who did search, i.e. did not actively investigate any bank, and did not open any new bank accounts.

[2]https://mediaroom.tdbank.com/download/Infograph-Checking+Experience.pdf,http://thefinancialbrand.com/33346/bank-checking-account-customers-research/

consultants and market researchers."[3]

According to the screener survey, 8.4% of the population (or 31.3% of shoppers) switched primary bank in the last 12 months. This number (and thus our sampling weights) is consistent with the statistics given by the secondary data sources mentioned above.

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[3]http://www.nytimes.com/2010/03/25/your-money/brokerage-and-bank-accounts/25BANK.html?_r=3

C Estimation of Consideration Set and Conditional Purchase Probabilities

We use simulated maximum likelihood (SMLE) to estimate the model. The probability that a consumer picks consideration S_i conditional on his awareness set is given by

$$P_{iS_i|A_i,\epsilon} = \Pr\left(\min_{j\in S_i}\left(E\left[u_{ijm}\right]\right) \geq \max_{j'\notin S_i}\left(E\left[u_{ij'm}\right]\right) \quad \cap \quad \Gamma_{ik} \geq \Gamma_{ik'} \qquad \forall k \neq k'\right) \tag{C.1}$$

and a consumer's purchase probability conditional on his consideration set is given by

$$P_{ij|S_i,\epsilon} = \left(u_{ijm} \geq u_{ij'm} \quad \forall j \neq j', \quad j,j' \in S_i\right). \tag{C.2}$$

Both probabilities do not have a closed-form solution and are non-smooth. Because common optimization routines require smoothness, the non-smooth probabilities would either require using non-gradient based optimization methods or taking a very large number of draws (simple frequency simulator, McFadden 1989). Instead, we choose to smooth the probabilities using a scaled multivariate logistic CDF (Gumbel 1961):

$$F\left(w_1,\ldots,w_T; s_1,\ldots,s_T\right) = \frac{1}{1 + \sum_{t=1}^{T}\exp\left(-s_t w_t\right)} \qquad \forall\, t = 1,\ldots,T \tag{C.3}$$

in which $s_1,\ldots,s_T$ are scaling parameters. McFadden (1989) suggests this kernel-smoothed frequency simulator which satisfies the summing-up condition, i.e. that probabilities sum up to 1, and is asymptotically unbiased.

We now describe the step-by-step implementation of the kernel-smoothed frequency simulator.

1. Take $q = 1,\ldots,Q$ draws from ϵ_{ij} (for each consumer/ bank combination)

2. For each ϵ_{ij} draw, calculate w_{qt} for the

   (a) Conditional consideration set probabilities:

       i. Consumers who searched at least once

   $$w_{1|A_i,\epsilon}^{q} = \min_{j\in S_i}\left(E\left[u_{ijm}\right]\right) - \max_{j'\notin S_i}\left(E\left[u_{ij'm}\right]\right)$$
   $$w_{2|A_i,\epsilon}^{q} = \Gamma_{ik} - \max\left(\Gamma_{ik'}\right)$$

       i. Consumers who did not search

   $$w_{1|A_i,\epsilon}^{q} = -\max\left(\Gamma_{ik'}\right)$$

   (b) Conditional purchase probabilities:

   $$w_{1|S_i,\epsilon}^{q} = u_{ijm} - u_{ij'm} \qquad \forall j \neq j',\ \forall j,j' \in S_i$$

3. Calculate the smoothed conditional consideration set and conditional purchase probabilities using the scaled logistic CDF (Gumbel 1961)

   (a) Conditional consideration set probabilities:

i. Consumers who searched at least once

$$P^q_{iS_i|A_i,\epsilon} = \frac{1}{1+\exp\left(-s_1 w^q_{1|A_i,\epsilon}\right)+\exp\left(-s_2 w^q_{2|A_i,\epsilon}\right)}$$

i. Consumers who did not search

$$P^q_{iS_i|A_i,\epsilon} = \frac{1}{1+\exp\left(-s_1 w^q_{1|A_i,\epsilon}\right)}$$

(b) Conditional purchase probabilities:

$$P^q_{ij|S_i,\epsilon} = \frac{1}{1+\exp\left(-s_1 w^q_{1|S_i,\epsilon}\right)}$$

4. Calculate the joint consideration and purchase probabilities conditional on awareness by multiplying the conditional consideration set and conditional purchase probabilities (see equation 12) and averaging them across all Q draws, i.e.

$$P_{ij} = \frac{1}{Q} \sum_{q=1}^{Q} P^q_{iS_i|A_i,\epsilon} P^q_{ij|S_i,\epsilon}$$

In the estimation, we use a scaling factor of $s_1 = s_2 = 4$ and take $Q = 50$ draws from the error distribution.

D   Pre and Post Control Function Model Results

In this appendix, we provide a comparison of the estimates pre and post control function (CF) for the main models in the paper.

Table D.1: Results from Awareness Stage

| | (A) Pre-CF | | | (A) Post-CF | | | |
| | Advertising | Local Bank Presence | | Advertising | Local Bank Presence | | Advertising |
		1 Branch	>1 Branch		1 Branch	>1 Branch	Residual
Bank of America	0.060	0.191	0.519	0.029	0.250	0.616	0.126
	(0.129)	(0.988)	(0.544)	(0.153)	(0.943)	(0.559)	(0.205)
BB&T	1.500	3.007**	3.150**	4.945**	2.628**	2.691**	-4.829**
	(1.208)	(0.493)	(0.518)	(1.896)	(0.508)	(0.579)	(2.127)
Citibank	0.353**	1.236**	1.607**	0.539**	1.057	1.315**	-0.752**
	(0.079)	(0.620)	(0.397)	(0.149)	(0.647)	(0.402)	(0.277)
Citizens Bank	1.610**	0.831	1.563**	2.287**	0.330	0.967*	-1.605**
	(0.448)	(0.543)	(0.423)	(0.486)	(0.736)	(0.554)	(0.673)
Comerica	1.753*	2.152**	3.502**	6.199**	1.093	2.369**	-7.136**
	(0.922)	(0.631)	(0.597)	(1.688)	(0.876)	(0.807)	(2.216)
Fifth Third	1.174	2.151*	2.850**	1.514*	1.919*	2.075**	-0.985**
	(1.280)	(1.273)	(0.731)	(0.864)	(0.992)	(0.639)	(0.451)
HSBC	0.705**	0.552	0.662	0.864**	0.358	0.331	-0.584**
	(0.133)	(0.601)	(0.434)	(0.163)	(0.572)	(0.464)	(0.218)
Chase/WaMu	0.019	1.237**	0.950**	0.052	1.193**	0.888**	-0.060
	(0.072)	(0.596)	(0.362)	(0.083)	(0.607)	(0.384)	(0.104)
Keybank	0.445	1.922**	3.881**	0.682*	1.388**	3.546**	-0.601**
	(0.565)	(0.612)	(0.680)	(0.402)	(0.664)	(0.632)	(0.266)
M&T	0.712	2.382**	3.899**	2.938**	1.847**	2.608**	-3.202**
	(1.238)	(0.798)	(0.630)	(1.296)	(0.805)	(0.792)	(0.767)
PNC/N. City Bank	0.252**	0.941**	1.863**	0.247**	0.942**	1.870**	0.015
	(0.055)	(0.463)	(0.303)	(0.083)	(0.462)	(0.308)	(0.201)
Regions	2.764**	2.823**	3.054**	2.677**	2.797**	2.964**	-1.006
	(0.590)	(0.641)	(0.545)	(0.641)	(0.653)	(0.584)	(2.128)
Sovereign	0.192	4.238**	4.060**	1.066**	3.701**	3.371**	-1.728*
	(0.201)	(1.069)	(0.543)	(0.478)	(1.416)	(0.649)	(0.983)
SunTrust	1.234**	2.659	3.052**	1.258**	2.610	3.006**	-0.118
	(0.386)	(3.104)	(0.550)	(0.609)	(2.891)	(0.610)	(1.196)
TD	0.602**	3.354**	2.155**	0.863**	3.183**	1.402**	-0.466**
	(0.170)	(0.812)	(0.678)	(0.168)	(0.831)	(0.662)	(0.132)
US Bank	1.698**	3.107**	2.917**	1.976**	2.994**	2.766**	-0.489
	(0.785)	(0.762)	(0.438)	(0.828)	(0.799)	(0.507)	(0.923)
Wells Fargo/Wachovia	0.005	2.376**	0.119	-0.034	2.440**	0.212	0.147
	(0.085)	(0.506)	(0.431)	(0.111)	(0.540)	(0.502)	(0.280)
Capital One	0.046**	4.911**	2.638**	0.056**	4.834**	2.503**	-0.050
	(0.020)	(0.727)	(0.641)	(0.025)	(0.750)	(0.706)	(0.065)

* $p < 0.10$; ** $p < 0.05$

Table D.2: Results from Consideration and Choice Stages

	(CC-FI)		(CC-LI)	
	Pre-CF	Post-CF	Pre-CF	Post-CF
Brand				
Bank of America	-0.122	-0.123	-3.911**	-4.016**
	(0.134)	(0.170)	(0.115)	(0.083)
BB&T	-0.508**	-0.486*	-3.548**	-3.648**
	(0.243)	(0.251)	(0.216)	(0.161)
Citibank	0.054	0.086	-3.916**	-4.037**
	(0.231)	(0.271)	(0.194)	(0.105)
Citizens Bank	-0.045	-0.032	-3.603**	-3.681**
	(0.185)	(0.208)	(0.189)	(0.162)
Comerica	-1.012**	-1.003**	-4.398**	-4.505**
	(0.313)	(0.419)	(0.475)	(0.261)
Fifth Third	-0.278	-0.281	-3.921**	-4.051**
	(0.223)	(0.215)	(0.189)	(0.142)
HSBC	0.261	0.285	-3.160**	-3.285**
	(0.194)	(0.254)	(0.160)	(0.138)
Chase/WaMu			-3.741**	-3.829**
			(0.108)	(0.078)
Keybank	-0.520**	-0.527	-4.020**	-4.124**
	(0.219)	(0.343)	(0.186)	(0.161)
M&T	-0.435**	-0.410**	-3.347**	-3.437**
	(0.219)	(0.205)	(0.237)	(0.189)
PNC/N. City Bank	-0.650**	-0.642**	-3.925**	-4.043**
	(0.182)	(0.245)	(0.160)	(0.105)
Regions	-0.630**	-0.612**	-4.032**	-4.130**
	(0.235)	(0.249)	(0.226)	(0.149)
Sovereign	-0.306	-0.264	-3.753**	-3.841**
	(0.230)	(0.235)	(0.120)	(0.188)
SunTrust	0.121	0.128	-3.497**	-3.594**
	(0.185)	(0.160)	(0.159)	(0.112)
TD	-0.786**	-0.768**	-3.413**	-3.536**
	(0.248)	(0.266)	(0.209)	(0.143)
US Bank	0.126	0.152	-3.820**	-3.929**
	(0.161)	(0.164)	(0.161)	(0.115)
Wells Fargo/Wachovia	0.077	0.073	-4.000**	-4.088**
	(0.125)	(0.150)	(0.113)	(0.086)
Capital One	-0.094	-0.141	-4.111**	-4.390**
	(0.625)	(0.600)	(0.203)	(0.231)
Other parameters				
Primary Bank	3.024**	3.020**	0.385**	0.382**
	(0.059)	(0.061)	(0.072)	(0.030)
Interest Rates	-0.509	-0.575	1.127**	2.104**
	(0.525)	(0.526)	(0.414)	(0.553)
Advertising	0.023**	0.038**	0.012	0.015*
	(0.011)	(0.015)	(0.007)	(0.009)
Advertising Residual		-0.043		-0.015
		(0.039)		(0.022)
Bank Branches, N=1 (Y/N)	1.987**	1.972**	0.499**	0.504**
	(0.127)	(0.154)	(0.086)	(0.091)
Bank Branches, $3 \geq N \geq 2$ (Y/N)	1.964**	1.949**	0.652**	0.655**
	(0.130)	(0.175)	(0.132)	(0.081)
Bank Branches, $7 \geq N \geq 4$ (Y/N)	2.246**	2.225**	0.787**	0.796**
	(0.133)	(0.163)	(0.110)	(0.083)
Bank Branches, $N > 7$ (Y/N)	2.774**	2.747**	1.024**	1.034**
	(0.153)	(0.205)	(0.118)	(0.094)
Search Cost Constant			0.001**	0.001**
			(0.000)	(0.000)
LL	-2,215.620	-2,214.800	-3,093.360	-3,091.700

* $p < 0.10$; ** $p < 0.05$

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