Location and Competition in Retail Banking

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Abstract

We investigate the impact of banking deregulation during the 1990s on consumer welfare. We estimate a spatial model of consumer demand for retail bank deposits that explicitly accounts for consumer disutility from distance traveled. This is important given the substantial changes in banks' branch networks observed in the data. Our model indicates that cross-price elasticities between banks whose branches are close to consumers ('close' banks) are larger than those between 'far' banks and more than double the cross-price elasticity of 'close' banks with respect to 'far' banks. We distinguish between thrifts and other banks and find that within-thrift competitive effects are stronger than within-bank effects or those between thrifts and banks. We use our estimates to predict the effect of changes in market structure on consumer welfare following the branching deregulation of the Riegle-Neal Act of 1994. Our results indicate that the median household gained around $60 per year from the changes. Approximately two thirds of the gains come from within-market changes in market structure. The gains were greater in markets with high initial numbers of banks than elsewhere.

1 Introduction

The period since the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 has seen substantial growth and consolidation of the U.S. banking industry. This Act removed regulatory barriers to nationwide branching and bank mergers and led to thousands of mergers and acquisitions and to a substantial increase in the number of bank branches throughout the U.S. We examine the

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effect of this market restructuring on consumer welfare. The scale of the reorganization of this industry, together with the extent of the industry's impact on consumers, makes the question important. The answer is theoretically ambiguous: while the increase in branch density is likely to have increased consumer surplus, previous papers such as Prager and Hannan (1998) find evidence that bank mergers can lead to an increase in market power and a reduction in deposit interest rates which would offset this effect.

We utilize a cross-sectional dataset that lists the characteristics of all banks in California, Washington and Oregon in 2000. We add new information on the location of every bank branch that we construct by geocoding the street addresses contained in the publicly-available dataset. We use the data to estimate a model of consumer demand for retail banks in which consumers choose a single bank for depository services. We modify the models used previously in the literature on banking choice in several ways. Most importantly, given the substantial change in banks' branch networks after deregulation, we explicitly account for consumer disutility from traveling to a bank by including in the demand model the distance from each consumer's home to the closest and second-closest branches of each bank. Much of the previous literature instead includes the number of branches per thousand population in the market. Both methods take account of the likely increase in consumer welfare as the number of branches increases. However, our approach is also able to account for the fact that, if new branches cluster in particular neighborhoods, the welfare increase may be smaller than it would be if branches were equally spaced throughout the market. We also allow each consumer to choose no depository institution[1]. Approximately 8 percent of U.S. households choose this outside option, and this proportion is much higher within certain demographic cagetories. By taking into account the fact that some consumers choose an option with zero deposit interest rates, we are likely to reduce the estimated elasticity with respect to interest rates and therefore increase the dollar value of the estimated welfare effects of market restructuring compared to the previous literature. We then use our estimates together with analogous data for the year 1994 to calculate the change in consumer surplus over this time period.

Our results contribute to a small previous literature that considers the extent of competition between different types of depository institutions. This has important implications for the definition

[1] Adams, Brevoort and Kiser (2007) also include this option in their demand analysis, although they incorporate it together with credit unions and brokerage firms.

of the geographic market and therefore for antitrust authorities' predictions of the pricing and welfare effects of bank mergers. We distinguish between three bank-market types: thrifts (including savings banks and savings and loans) in all markets, single-market banks (banks located in markets from which they receive over 90 percent of their total deposits) and multi-market banks (other banks plus non-home areas of single-market banks). We investigate competitive effects by comparing cross-price elasticities within and across bank-market types and comparing elasticities across rural and non-rural markets. We also distinguish between 'close' and 'far' banks (where a 'close' bank's nearest branch is within one mile of the consumer's home and a 'far' bank's nearest branch is outside that radius), and we provide new evidence on cross-price elasticities between pairs of banks based on these measures of distance to the consumer.

The results of our demand model are intuitive and are largely consistent with the previous literature. For example we find that consumers significantly prefer banks that are active in a large number of markets and those that have been active for a long time. They have a positive utility from high deposit interest rates and a negative utility from travel. We find that consumers significantly prefer banks for which the majority of branches are in the consumer's home market but do not have a significant preference for thrifts. We also investigate competitive effects between 'close' and 'far' banks and between banks and thrifts. The estimated own-price and cross-price elasticities with respect to the deposit interest rate indicate that close banks' interest rates have a substantial effect on demand for other close banks. Elasticities between other pairs of banks are smaller; the competitive effect of far banks' interest rates on close banks is particularly small. We also find that thrifts have more price-sensitive demand than other banks, while the cross-price elasticities imply that within-thrift competitive effects are the strongest. Consistent with the greater number of competitors in non-rural markets, estimated own-price elasticities are larger in non-rural markets while cross-price elasticities are larger in rural markets. As expected, our elasticities are smaller than those in the previous papers in this literature. Our mean own-price elasticity for all types of banks is 1.19.

Our welfare estimates indicate that the median household gained around $60 per year in utility from the changes in the depository banking market. Approximately two-thirds of these gains can be attributed to within-market changes in market structure that brought banks closer to consumers. The remainder are divided fairly equally between the effects of changes in branch locations outside

the market and the effects of changes in deposit interest rates (which on average increased slightly in the markets we consider). It is clear from these results that modeling the local, spatial nature of the bank choice problem is essential if we are to fully understand the effect of the market changes on consumers. We also estimate a positive correlation between median welfare gains per consumer and the number of banks present in the market in 1994 and find that much of the correlation stems from larger within-market branching changes in these larger or more competitive markets.

Several papers in the previous literature are relevant to our work. We adapt the demand model of Ishii (2007) which allows for heterogeneity in both consumer and firm observable characteristics and incorporates the distance between the consumer and the first and second closest branches of each bank, but add to it the possibility that the consumer chooses not to join a depository institution. This step involves adding a second set of moment conditions to those used in Ishii (2007) which we discuss below.

We contribute to the literature on spatial competition which analyzes the impact of dispersed buyers and sellers on demand, prices and product characteristics. Previous papers analyze a range of different retail and service industries. For example Davis (2008) considers the impact of geographic dispersion of consumers within each market on competition between movie theaters. Mazzeo (2004) models product differentiation and market entry decisions by motels operating along US interstate highways. Locational choices are modeled by defining markets as clusters of motels located next to individual interstate highway exits, implying an assumption that competition between motels at a particular exit is more important than that between motels at different exits. Seim (2006) estimates a model of location choices in the video retail industry. Her results imply significant returns to product differentiation in terms of geographic location. We provide evidence on the importance of spatial competition in retail banking.

A number of previous papers consider the impact of the market changes following the Riegle-Neal Act. Dick (2008) is most closely related to our analysis. The author uses logit and nested logit models of consumer demand to investigate the change in consumer welfare resulting from market structure changes during the 1990s. This interesting paper has the advantage of incorporating data on bank fees, which we do not observe, in the utility equation and (since the author does not geocode branch addresses) of utilizing data on all US markets. However it does not focus on consumer responses to bank branching. Average bank branch density is included in the utility

equation in place of our explicit measures of branch distances. In addition consumers are not permitted to choose no depository institution in this analysis. The results imply positive average welfare effects of changes in the industry that are slightly smaller than our estimates. Other papers on the effects of the deregulation include Jayaratne and Strahan (1996) who find evidence that the relaxation of the bank branching regulations was associated with increases in real per-capita growth in income and output. Dick (2006) links the deregulation to increases in service quality, costs and fees. Amel and Liang (1992) associate it with significant bank entry. There is also a small literature considering the effects of bank mergers, largely focusing on those taking place before the Riegle-Neal Act. Prager and Hannan (1998) consider the period 1991-1994 and find that deposit interest rates in merging banks and their immediate rivals declined by more than did those offered by banks not directly affected by mergers; they interpret these results as evidence that mergers led to an increase in market power. Berger et al (1998) estimate that bank mergers led to a decline in small business lending by the merging institutions but that this was offset by the reactions of other banks. Focarelli and Penetta (2003) find that Italian bank mergers initially caused consumer welfare to decline but over time the merging firms achieved efficiencies that led to long run welfare increases.

The literature considering the extent of competition between banks and thrifts includes Cohen (2004) which extends earlier models of equilibrium entry using specification tests to compare models that assume substitutability versus market independence. He rejects the hypothesis that banks and thrifts operate in independent product markets. Cohen and Mazzeo (2007) further explore competition between bank types using a model of equilibrium market structure based on a cross-section of data. Adams, Brevoort, and Kiser (2007) estimate a non-nested, discrete choice random utility model of consumer choice of depository institutions distinguishing between multimarket banks, single market banks and thrifts. They include the choice of no account as part of the outside option (although they incorporate it together with credit unions and brokerage firms) but use branch density rather than the distance to the closest branch. They investigate the variation in elasticities across bank types but do not explore the change in consumer surplus over time that is the focus of this paper.

This paper continues as follows. In Section 2 we outline the important institutional features of the industry and of the deregulation. Section 3 describes the data and summary statistics; Section

4 provides an overview of our methodology and our demand estimates. Section 5 contains our counterfactual analyses and Section 6 concludes.

2 Industry Background

Regulatory restrictions affecting banks' ability to diversify geographically have decreased dramatically since the 1970s. At that time many individual states required banks to have a single branch and interstate banking was prohibited. Some of these regulatory restrictions were removed in the period up to 1994. For example, in 1975 states began introducing laws allowing out-of-state bank holding companies to acquire in-state banks. From the mid 1970s onwards most states deregulated their restrictions on intra-state branching. The Riegle-Neal Interstate Banking and Branching Efficiency Act was passed in 1994, permitting nationwide (inter-state) branching as of June 1997, with states permitted to "opt in" earlier than this deadline[2]. The number of commercial banks decreased dramatically, largely as a result of mergers and acquisitions: in California, Washington and Oregon (the states covered in our analysis) there were 512 banks in 1994 and 437 in 2000. At the same time the total number of branches rose from 7943 to 8342 in these three states.

Our analysis distinguishes between three types of banks: single-market commercial banks, multi-market commercial banks and thrift institutions. These are often treated differently in the Federal Reserve Board's bank merger review process[3], largely because thrifts have historically had a somewhat different customer base, focusing on residential real estate lending while commercial banks were more actively involved in small business lending. However, the empirical evidence on the extent of competition between them is limited. There have been some compositional changes in the industry over time. The number of thrifts fell from 95 to 55 in our sample from 1994 to 2000 (with the number of branches also falling from 2225 to 1908), while the number of commercial banks fell from 417 to 382 and their branch numbers rose from 5718 to 6434. These aggregate changes, however, are not necessarily informative about the way in which commercial banks and thrifts compete; there may have been differential changes in the sizes of individual banks or branch

[2]The Riegle-Neal Act probably affected branching in local markets for two reasons. First, since it permitted interstate acquisitions as well as branching, it may have led to greater concentration and therefore more branches for a given bank. Second, this may have prompted non-merging banks to also increase their numbers of branches within the local market.

[3]See Adams et al (2007) for details.

networks. We consider these issues in more detail below.

3 The Dataset

The dataset used in our demand analysis is a cross-section of banking institutions for the year 2000. It was compiled from several different sources. Deposit data for each bank comes from the Summary of Deposits for 2000. This provides deposits by branch and the addresses of the branches for each commercial bank and thrift. By geocoding the branches (assigning a latitude and longitude to each) we can calculate the total deposits that each bank has in each local market.[4] We define dummy variables for multimarket banks, single market banks and thrifts. We define a bank-market as "single-market" if over 90% of its deposits were received from branches in that market and "multi-market" otherwise.[5]

We use additional bank-level data from the Call Reports and Thrift Financial Reports for June 2000. These are statements of condition that financial institutions file with the Federal Deposit Insurance Corporation (FDIC) and the Office of Thrift Supervision (OTS) respectively. We estimate the bank-level deposit interest rate as the ratio of interest expense on deposits to deposits. This is calculated as a six month rate. We also use the bank's total number of branches and employees to calculate the number of employees per branch. Finally, we use several variables from these data sources to calculate instruments that we describe below.[6]

We include credit unions as a single additional option in every market where at least one credit union is active. We aggregate all credit unions in the market into a single choice because each householder is likely to have access to only one or two credit union options (such as their employer's credit union). The Financial Performance Reports of the National Credit Union Association provide credit union deposit data. We calculate a weighted average credit union deposit rate for each market by multiplying the rate on each type of deposits by the amount of that type of deposits, then summing across deposit types and across credit unions within a market and dividing by total deposits in the market. Our distance measures come from the average distance between each census

[4] We use the Maptitude software package for all geocoding of street addresses.

[5] This means that a bank can be designated "single-market" in one market and "multi-market" in another. It is consistent with Cohen and Mazzeo (2007) except that their cutoff level is 80% rather than 90%.

[6] The interest rates use expenses from January through June 2000. The other variables are calculated as of the end of June 2000.

tract and all credit unions in the market.[7] We also calculate a weighted average across same-market credit unions of the number of employees, the number of employees per branch (assuming that each credit union has a single branch in the market)[8] and the instruments described below. We assume that each credit union is active in only a single market and that the age of these credit unions is the mean of bank age for all banks in the market.

The third dataset is the 2001 Survey of Consumer Finance. This is a triennial survey of the balance sheet, pension, income and other demographic information of U.S. families and their use of financial institutions. The unit of analysis is the Primary Economic Unit (PEU), defined as an economically dominant individual or couple in a houshold plus all others in the household who are financially dependent on them. We use these data to calculate the proportion of PEUs who choose not to open any kind of deposit account for each demographic group that we consider. We also regress the size of the PEU's deposit account on demographic characteristics (age and income). The results of these analyses are used in the demand model as described below.

Finally we use data from the 2000 Census. This provides us with census tract-level information on median income levels conditional on the age groups of householders,[9] total population and the latitudes and longitudes of the area centroids. We combine this information with the geocoded locations of the bank branches in order to calculate distances from each block group to each branch location.

3.1 Market Definition and Summary Statistics

We define a market to be a metropolitan statistical area (MSA) or, in rural areas that are not part of MSAs, to be a county. The product market is defined as deposits at depository institutions. Deposits include checking, savings, and time deposits[10], and depository institutions include com-

[7] We use an average, rather than the minimum value, because consumers are not in general free to choose their closest credit union. We then obtain a weighted average distance for a given market to use as an instrument by taking a weighted average over census tracts, weighting by the number of households in each tract.

[8] The number of credit union branches is not available for years after 1991. Ishii (2007) uses hand-collected data on credit union branch locations in Massachusetts and finds that out of 275 credit unions in MA in 2002, only 16 had more than one branch. In addition, only eight were active in more than one market.

[9] A household includes all people who occupy a housing unit. One person in each household is designated as the "householder". This is the person in the household in whose name the home is owned, being bought, or rented. If there is no such person, any adult household member 15 years old or over could be designated as the householder. We assume that the householder in the Census is the same as the head of the PEU in the Survey of Consumer Finances.

[10] We cannot analyze these three types of deposits separately because their dollar amounts are not separately reported at the branch level in the Summary of Deposits data.

mercial banks, thrifts, and credit unions but exclude other financial institutions such as mortgage or finance companies. We exclude small business activity because it represents a small proportion of the total activity of depository institutions. The Federal Reserve Flow of Funds tables indicate that the personal sector represented approximately 82% of total (personal and nonfinancial business) checkable deposits, savings and time deposits in 2007. We also choose not to consider loans in this analysis. While we recognize that consumers may consider their needs for loans as well as deposits when choosing a bank, we note that loans are increasingly obtained from non-depository institutions. Amel and Starr-McCluer (2001) state that in 1998 only 42 percent of consumer loans were taken from depository institutions. We therefore follow the previous literature and maintain the tractability of the analysis by limiting our attention to the market for deposits.

To make the geographic analysis more tractable, we restrict our attention to banks in the Pacific Division of the continental U.S. (those in California, Washington and Oregon). Essentially no interstate branching was permitted by any of these three states before the Riegle-Neal Act[11]. Each state permitted intra-state branching from 1985 onwards; most of the changes in market structure we observe between 1994 and 2000 are therefore likely to be due to the inter-state branching deregulation of the Riegle-Neal Act or to be much longer-run responses to the overall deregulation taking place during the 1970s and 1980s. We drop observations for U.S. branches of foreign institutions, branches which have zero deposits or zero premises expenses (and therefore missing instruments), and bank-markets with a within-market share of less than 0.1 percent. We also drop the very few branches for which the Summary of Deposits data does not match with Call Report data. This leaves us with 437 banks, 8342 branches and 115 markets in 2000. Summary statistics are provided in Tables 1 and 2. On average there are 13 banks per market. The average four-firm concentration ratio is 30 percent, and the average Herfindahl index is 2342. On average banks have 6 branches per market, the average deposit interest rate is 3.4 percent, and the average bank age is about 38 years.

[11] In Oregon, national reciprocal branching was permitted from November 1993.

4 A Model of Demand

4.1 Demand Methodology

The model assumes that each consumer either chooses a single bank or thrift or a single credit union for depository services or chooses to use no depository services from any provider. Some modification of the usual discrete-choice demand models (such as that set out in Berry, Levinsohn and Pakes (1995) (BLP)) is needed for an application to retail banking because the quantity variable in this industry is a bank's amount of total deposits rather than its number of customers. Defining market shares based on the number of customers would ignore cross-bank variation in average deposit size, thereby mis-measuring bank market shares and potentially generating biased demand estimates. We follow Ishii (2007), which addresses this issue in detail, by assuming that individual consumers are endowed with a level of deposits and that each consumer places her deposits in the institution of her choice.[12] We extend Ishii's work by including the option "no institution" in the choice set. Deposit market shares are determined by aggregating over the expected deposits of individual consumers.

Omitting market subscripts for convenience, we define consumer i's utility from bank j to be:

$$\begin{aligned} U_{i0} &= \pi D_i + \xi_0 + \varepsilon_{i0} \\ U_{ij} &= \lambda dep_i r_j^{dep} + d_{ij}'\beta + x_j'\gamma + a'\rho + \phi_{1i} SM_j + \phi_{2i} Thrift_j + \xi_j + \varepsilon_{ij} \end{aligned} \tag{1}$$

Choice $j = 0$ is the choice of no bank account at all, choice $j = 1$ is the choice of any credit union and choices $j = 2, ..., J$ are the choices of an inside bank (a commercial bank or thrift). D_i is a vector of demographic characteristics, dep_i is individual i's deposits, r_j^{dep} is bank j's deposit interest rate, d_{ij} is a vector of individual-specific branch distance variables for bank j (the distances from the consumer's census tract to the nearest and second-nearest branches of the bank), x_j is a vector of bank-specific characteristics (employees per branch, bank age and the number of markets in which the bank has a presence - both included as controls for bank size and perceived safety to consumers - and a dummy variable for banks with a single branch in the market), a is a set

[12] The assumption that deposits are not a choice variable is standard in the banking literature. While clearly a simplification, it is fairly reasonable since individual deposits are largely driven by transaction needs and by income. We assume below that the level of individual deposits depends on demographic characteristics.

of market dummy variables, (SM_j, $Thrift_j$) are dummy variables for single-market banks and for thrifts, ξ_j is a bank unobservable and ε_{ij} is an individual- and bank-specific unobservable. As usual in this literature we assume that ε_{ij} is i.i.d. with an extreme value distribution. Some markets have no credit unions: these have one less good in the choice set. The variable ξ_0 is not identified, so we normalize it to 0. Our baseline analysis defines the vector of demographic characteristics as follows: $D_i = \{income_i, age18-34_i, age35-64_i\}$, where $income_i$ is household income, $age18-34_i$ is a dummy variable for householders between the ages of 18 and 34, and $age35-64_i$ is a dummy variable for householders between the ages of 35 and 64.

The probabilities of consumer i choosing options 0 or $j = 1, ..., J$ are then:

$$\begin{aligned} P_{i0} &= \frac{\exp(\pi D_i)}{\exp(\pi D_i) + \sum_{k=1}^{J} \exp(\lambda dep_i r_k^{dep} + ... + \xi_k)} \\ P_{ij} &= \frac{\exp(\lambda dep_i r_j^{dep} + ... + \xi_j)}{\exp(\pi D_i) + \sum_{k=1}^{J} \exp(\lambda dep_i r_k^{dep} + ... + \xi_k)}. \end{aligned} \tag{2}$$

Following Ishii (2007) and letting h denote observable household characteristics, market shares measured in terms of dollars of deposits are:

$$\begin{aligned} s_0 &= \frac{\int_{h,dep} P_0(h) \times 0 \; g(h, dep) \; dh \; ddep}{\sum_{k=1}^{J} \int_{h,dep} P_k(h) \; dep \; g(h, dep) \; dh \; ddep} = 0 \\ s_j &= \frac{\int_{h,dep} P_j(h) \; dep \; g(h, dep) \; dh \; ddep}{\sum_{k=1}^{J} \int_{h,dep} P_k(h) \; dep \; g(h, dep) \; dh \; ddep}. \end{aligned} \tag{3}$$

We simulate market shares by taking $s = 200$ draws of households from each market using the Census data. Each draw is associated with distance variables, age category dummies and an average income value. Then, the simulated market shares are:

$$s_j = \frac{\sum_{i=1}^{s} P_{ij} dep_i}{\sum_{k=1}^{J} \sum_{i=1}^{s} P_{ik} dep_i}, \text{ for } j = 1, ..., J. \tag{4}$$

As noted above, household deposits dep_i are not directly observed. Instead, we predict the deposits of each household draw using the results of a regression of the log of deposits (conditional on having a deposit account) on householder age and the log of income using data from the Survey of Consumer Finances. The independent variables are dummies for age range 35-64 and over 65,

total family income and income squared, and interactions between the two age categories and both income and squared income.[13] The results are set out in Table 3 and Figure 1. They are intuitive. Older people have substantially higher deposits than other age groups at almost all income levels. Deposits are increasing in income for each age group.

We use the BLP contraction mapping to isolate the bank unobservable, ξ_j, based on the market shares above.[14] This leads to the first set of moments for use in estimation:

$$E(\xi_j(\theta)|Z_j) = 0, \tag{5}$$

where θ denotes the vector of parameters to be estimated.

We require a set of instruments, Z, that are uncorrelated with ξ. We include the vector of firm characteristics, x, and averaged versions of the household-specific branch distance variables, d_{ij}, where we weight by census tract population. We also use instruments based on competitors' characteristics. As discussed in BLP, in an oligopoly we expect competitors' characteristics to be correlated with the firm's own prices but not with its own ξ_j. We include the average of competitors' employees per branch, the average of competitors' numbers of domestic offices, the number of banks in the market, and the number of competitor branches in the market. Cost-shifters provide another source of demand-side instruments. We include expenses on premises and equipment, other expenses, a credit risk cost variable (provisions for loan and lease losses), and the wage. The first three of these variables are normalized by assets and the wage is calculated based on the bank's labor expenses and the number of employees.

We generate additional moments by fitting the model's predictions for the probability of choosing the outside option (no deposit account) within different demographic groups to data from the Survey of Consumer Finance. Our methodology is similar to that in Davis (2007). We begin by using the Survey data to calculate the proportion of householders in each of three age groups (18-34, 35-64 and over 65) and (separately) each of four income groups (defined by the four quartiles of the income distribution) who report having no deposit account in the Survey. The results are in

[13] Every SCF since the 1989 survey constitutes multiple complete datasets. We perform separate analyses on each of the five datasets (implicates) and combine the results following the methodology set out in Montalto and Sung (1996) and using the Stata code provided in the Survey of Consumer Finances codebook, available at www.federalreserve.gov/Pubs/oss/oss2/2001/codebk2001.txt.

[14] As in Ishii (2007), it can be shown that the BLP contraction mapping is valid given our market share equation.

Table 4. The proportions vary substantially across income quartiles (from 0.7 percent in the highest quartile to 26.8 percent in the lowest quartile), but the proportions vary less across age groups. In the final estimation we distinguish between all four income categories and between householders under and over the age of 35. These age statistics are more distinct from each other and are also given in Table 4.

The next step is to calculate the model's predictions for these proportions. We use the same 200 draws of households from the Census data that were used in equation (4). For each set of demographic characteristics, we identify the set of households, D_g, amongst our household draws with those characteristics, and we denote the number of those households as $\#\ D_g$. For example, assume that D_1 is the set of households that have $18 <= age <= 34$. D_2 contains households that have $35 <= age$, D_3 contains households in the first income quartile, and so on through all four income categories. We use our model to simulate the probability of choosing the outside good as follows:

$$Pr(no\ account|D_g) = \frac{1}{\#D_g} \sum_{i \in D_g} P_{i0} \tag{6}$$

where P_{i0} is predicted by the model and varies across individuals in D_g because, for example, the distance and income variables differ for each individual in a particular age category. Then the moments based on the probability of choosing the outside option have the following form:

$$E(e^g(\theta)) = 0, \tag{7}$$

where

$$e^g(\theta) = \left(\frac{1}{\#D_g} \sum_{i \in D_g} P_{i0} \right) - Pr(no\ account|D_g)^{observed}. \tag{8}$$

Our instrument here is simply a vector of ones.

In summary, then, our demand analysis utilizes two sets of moments to estimate the parameters:

$$\begin{aligned} E(\xi_j(\theta)|Z_j) &= 0 \\ E(e^g(\theta)) &= 0. \end{aligned} \tag{9}$$

4.2 Demand Results

4.2.1 Coefficient Estimates

Our results are reported in Table 5. Column 1 contains the results of the main specification. Here $\theta_1 = (\gamma, \phi_1, \phi_2)$ and $\theta_2 = (\lambda, \beta)$ from equation (1). Bank age provides a measure of experience, and the estimates indicate that consumers significantly prefer banks that have been active for a long time. They also significantly prefer institutions that are active in a large number of markets, and they have a significant disutility from banks with a single branch in the market. The coefficient on single-market banks (those that receive over 90% of their total deposits from this market) is positive and significant. There is no significant difference between preferences for thrifts and multi-market banks (the excluded category). The coefficients in θ_2 indicate that consumers have a significant preference for high deposit interest rates and that they dislike travel. High-income households are significantly less likely to choose the outside option of no depository institution than the rest of the population. In addition, householders in the two lower age group categories are significantly more likely to choose the outside option of no depository institution than the excluded category of householders over age 65. These effects are consistent with our findings in Table 4, which reports that householders over age 65 have the lowest probability of having no deposit account and that the probability of having no deposit account decreases as household income rises.

Column 2 of Table 5 reports the results of an alternative specification which adds random coefficients to the bank type dummies, $SM\ bank_j$, $MM\ bank_j$, and $Thrift_j$, following a methodology similar to that in BLP. This allows for heterogeneity in preferences over bank types, however the additional coefficients are close to zero and insignificant. In untabulated results, we also include interactions between $income_i$ and $age18-34_i$ and between $income_i$ and $age35-64_i$ in the expression for U_{i0}. This has little effect on the coefficients in θ_1 and θ_2 or their standard errors, but results in large standard errors for all the coefficients in U_{i0}. We therefore take the specification in Column 1 as our baseline and use it in the counterfactual that follows.

As a robustness test we added controls for the retail density of the branches chosen by each bank. This was motivated by the observation that banks frequently choose to cluster their branches in retail areas, even when this means locating alongside or very close to competitors' branches and leaving other areas of the market underserved. The reason is likely to be twofold. First, consumers

wish to be able to visit their bank when shopping, and second, retail centers are often close to train stations and other public transport and therefore provide convenient access for customers[15]. The only available information on retail density was zipcode-level data from the Census. We first included average retail density in the vector of bank characteristics, x_j. Average retail density is defined as the number of retail establishments per square mile on average across the zip codes of the bank's branches. Perhaps not surprisingly, given the lack of geographically-detailed data, the coefficient on this variable was not significant. We then included the retail density of the zip code in which the nearest branch of bank j to consumer i was located and estimated its coefficient as part of θ_2. Again the coefficient was close to zero and insignificant. We therefore omit retail density variables from our main specification.

4.2.2 Elasticities

The elasticities with respect to deposit interest rates that are implied by our baseline estimates are set out in Tables 6 and 7. Table 6 summarizes own-interest rate elasticities while Table 7 summarizes cross-interest rate elasticities. The mean own-price elasticity across all types of institutions is 1.19. Thrifts are estimated to have more interest rate-sensitive demand than banks, and single market institutions face slightly more elastic demand than multi-market institutions. Splitting the sample into rural and non-rural markets (where non-rural markets are defined as MSA markets), average elasticities are estimated to be higher in non-rural markets. This is consistent with the larger number of competitors in non-rural markets leading to more price-sensitive demand.

Panel A of Table 7 shows that the average cross-interest rate elasticity across all pairs of competing firms is -0.048, but that the average pair-wise cross-interest rate elasticity has a higher magnitude in rural than non-rural markets. This is again consistent with the larger choice set in non-rural markets. In a market with many competitors, when one bank lowers its deposit interest rate, deposits flow away from that bank but are spread across its many competitors, each of whom tends to enjoy only a small increase in market share. A similar effect is also documented in Adams et al. (2007). Panel B examines cross-interest rate elasticities within and between banks and thrifts. The estimates with the largest magnitude are the within-thrift cross-price elasticities. For example,

[15] Banks may also choose to locate close to small businesses, since these are also important customers. This is outside the scope of this analysis.

in the full sample as well as in both the rural and non-rural subsamples, an increase in thrift interest rates leads to a larger decrease in competing thrift market shares on average than competing bank market shares. This difference may be due to the historically different customer base of thrifts compared to banks: thrifts tended to focus on residential real estate lending and may therefore have customers with different elasticities from banks. The effect of a change in bank interest rates is estimated to be very similar for both competing banks and thrifts. Panel C examines cross-interest rate elasticities within and between single-market and multi-market institutions. In rural markets, a change in one bank's interest rate has a stronger within-type than cross-type effect on market shares on average, but the pairwise cross-price elasticities for single-market and multi-market institutions don't show a strong pattern in Panel C. Overall, the estimates in Panels A through C of Table 7 illustrate the strong within-type competition amongst thrifts and the effect that cross-price elasticities have a greater magnitude in rural than non-rural markets.

Finally, Panel D of Table 7 explores the different cross-interest rate elasticities for banks with different minimum distances from the consumer. We define 'close' banks to be those whose closest branch is within one mile of the consumer and 'far' banks to have no branches within that radius.[16] We compute cross-interest rate elasticities between pairs of banks at the household level and take averages over bank pairs within a market for each household and then over households. As indicated in Table 7, the average cross-interest rate elasticity between close banks is high at -0.089. Far banks have less of an impact on their competitors than close banks, and the estimate with the smallest magnitude is between far banks and close banks: not surprisingly, when a far bank increases its interest rate it is much more likely to attract customers from other far banks than from close banks.

As expected, our own-price elasticities are smaller than those in the most closely-related previous paper, Ishii (2007), which does not include the option of choosing no depository institution. The mean own-price elasticity for all types of banks in Ishii (2007) is 4.20. Including the outside option is expected to lower estimated price sensitivities, since it accounts for the fact that some consumers essentially choose an option with a zero deposit interest rate. Dick (2008) estimates median elasticities, and the median elasticity from the nested logit model is closer to ours at 1.77. Adams et al (2007) estimate median elasticities of 3.69 in MSAs and 2.44 in rural areas, that are again higher than our estimates. Similar to our results, they find that banks face less elastic demand

[16] The results are similar if we lengthen the distance threshhold to two miles or shorten it to one-half mile.

than do thrifts, and that single-market thrifts (banks) face more elastic demand than multi-market thrifts (banks).

5 Consumer Surplus Effects

Our final step is to use the demand estimates to predict the effects of the changes in market structure during the 1990s on consumer welfare. We supplement our dataset with data from the Summary of Deposits and the Call Reports and Thrift Financial Reports for California, Washington and Oregon for 1994. As noted in Section 2 there was a reduction in the number of banks and an increase in the number of branches in these states between 1994 and 2000. Table 8 sets out these changes together with data on the changes in other bank characteristics. The average distance from the consumer's home to the bank's closest branch fell slightly during the time period we consider[17] but average branch density, measured as branches per thousand households in the market, increased much more (by 14 percent compared to a decrease in average distance of less than 2 percent). This is evidence of increased branch clustering: some branches were probably opened in retail or other centers, close to existing branches. Changes in clustering can be expected to have welfare implications, and our distance measures are able to identify these changes in a way that simple measures like average branch density cannot.

Other bank characteristics also changed over the time period we consider. In particular the average number of markets where each bank was active increased from 2.8 to 3.5 between 1994 and 2000. Deposit interest rates increased on average, from 2.8 percent to 3.4 percent. The number of employees per branch fell slightly and the percentage of banks that were thrifts fell during our time period. We take account of all these changes in market structure and bank characteristics in our welfare calculations.

Our methodology follows that discussed by Nevo (2001) and based on McFadden (1981). Consumer i's expected gain from a change in bank characteristics, is

$$\Delta_i = U_i^t - U_i^{t-1} \tag{10}$$

[17] This average is taken across banks and across our random draws of households.

where U_i^t and U_i^{t-1} are defined by

$$U_i^t = E_\varepsilon \max_{j=0...J}(U_{ij}^t). \tag{11}$$

A dollar-valued measure of welfare is obtained using the method suggested by Hicks (1939) to create the equivalent variation (EV), defined as the change in consumer wealth that would be equivalent to the change in consumer welfare due to the change in market structure. McFadden (1981) shows that:

$$EV_{it} = \frac{1}{\lambda_t} U_i^t - \frac{1}{\lambda_{t-1}} U_i^{t-1} \tag{12}$$

where λ_t is the coefficient on $dep_i r_j^{dep,t}$ in equation (1). This implies that:

$$EV_m = M \frac{1}{s} \sum_i \left(\frac{1}{\lambda_t} \ln \sum_{j=0}^{J} \exp(V_{ij}^t) - \frac{1}{\lambda_{t-1}} \ln \sum_{j=0}^{J} \exp(V_{ij}^{t-1}) \right) \tag{13}$$

where m indexes markets, $V_{ij}^t = U_{ij}^t - \varepsilon_{ij}$ and $V_{i0}^t = U_{i0}^t - \varepsilon_{ij}$, M is the number of households in the market and s is the number of draws from each market.

We utilize Summary of Deposits data on the location of all banks' branches in the Pacific Region in 1994 as well as 2000. We take bank characteristics in each year from the Call Reports. All the bank characteristics that are inputs to the demand model are allowed to vary over time but we hold the draws of consumer characteristics, and credit union characteristics, fixed at their 2000 levels. We re-estimate the demand model using the 1994 data and use the estimated coefficients to determine 1994 consumer surplus. This is an important step in the analysis since without it each bank's unobserved quality $\xi_{j,t}$ would be implicitly assumed to be fixed at the level estimated for 2000. In reality characteristics such as the size of the bank's overall branch network are likely to have changed substantially over the period considered. The 1994 demand estimates are not reported here due to space constraints. They are similar to the estimates for 2000 (for example the distance coefficients are -4.06 and -8.12 in 1994 compared to -4.02 and -7.00 in 2000) and are available from the authors on request.

Our results are set out in Table 9. The cross-market median of the within-market median change in consumer surplus per household was a gain of $60.87 per year from 1994-2000. The cross-market median of the within-market mean change in consumer surplus per household is somewhat lower at

$43.32. Summing over households in each market, the median per-market change was an increase of $0.88 million. Table 10 and Figure 2 decompose the overall welfare effects into the effects of changes in four sets of variables. These are variables capturing within-market locations (the distance variables and dummies for banks with a single branch in the market); those capturing branch locations in other markets (the number of markets where the bank is active and the Single-Market dummy variable); the deposit interest rate; and other variables in the demand system (employees per branch and the dummy variable for thrifts). We allow each set of variables to adjust in turn, holding subsequent sets of variables fixed at their 1994 levels, to build up to the total welfare change. Approximately two-thirds of the median change can be attributed to changes in within-market locations, underlining the importance of the spatial model to capture consumer welfare in this application. The remainder is divided fairly equally between changes in other-market locations and interest rates[18].

The magnitudes of our welfare estimates are fairly substantial. Dick (2008) estimates that a consumer in the median market experiences a gain in welfare of $8-18 per year from market changes between 1993 and 1999. The average number of consumers per household can be estimated at around 2.8 based on 2000 Census data on population per household in the Pacific Division. Thus, our estimate of $60 per household per year translates to approximately $21 per consumer per year, somewhat above the upper end of Dick's range of estimates. Her analysis covers all markets in the U.S. and is therefore not directly comparable to ours. This fact together with the differences between our methodologies that are noted above account for our slightly different results[19].

Finally we investigate whether market characteristics are correlated with changes in consumer surplus. Figures 3A and 3B show scatter plots of the median welfare change per household against mean market income (in $000) and the number of banks in the market in 1994 respectively. The plots are at the market level; each circle represents a market. We exclude a single market that

[18] The last increment is small and negative because employees per branch fell slightly and very few banks changed status from thrift to bank or vice versa. The effect of thrift exit and bank entry, which caused the overall decline in percent thrifts noted in Table 8, is captured in the first increment of Table 10.

[19] Dick includes bank fees as well as interest rates in the utility equation and notes that bank fees increased during the period. However, this is unlikely to be the cause of the difference in results because bank fees are absorbed in the estimated unobserved bank quality variable $\xi_{j,t}$ in our analysis and permitted to change flexibly between 1994 and 2000. The differences are more likely to be explained by the difference in geographic sample between the two papers or by our explicit modeling of the distance to the consumer's closest branches and the option to choose no deposit account.

is an outlier in both plots[20]. Both plots have positive slopes with correlations of 0.36 and 0.43 respectively. Both correlations are statistically significant: when we regress the median welfare change on either variable together with a constant term the relevant coefficients are positive and significant at the 5% level. However, these two market characteristics are quite highly correlated with each other (the correlation is 0.70). When the median welfare change is regressed on both variables together with a constant term, both coefficient estimates are positive but only that on the number of banks present in 1994 is significant at the 5% level suggesting that the level of local competition, rather than the attractiveness of the local population, may have generated the correlation with welfare changes. Finally we repeat the correlations at every stage of the waterfall chart in Figure 2. At the first stage, when the welfare change accounts only for the within-market branching changes, the correlation between the median utility gain and the number of banks is already high at 0.33. It increases to 0.41 at the second stage (which also accounts for branching effects in other markets) and to 0.43 after also accounting for changes in interest rates. We conclude that banks focused their merger and branching strategies in markets that were more competitive in terms of the number of active banks in 1994 and that this led to larger welfare gains in these areas than elsewhere.

6 Conclusion

We have estimated consumer demand for bank deposit services using a model that explicitly accounts for the spatial nature of the retail banking industry by geocoding bank branch locations and including in the demand model distances from the consumer's home to her closest and second-closest branches of each bank. This allows us to account for spatial effects such as branch clustering in a precise way and is important given our focus on a time period when banks' branch networks changed substantially. Our distance measures are of course imperfect: for example we do not observe each consumer's work location and therefore cannot control for distances measured from work as well as from home. However, our measures are a clear improvement on the branch density

[20] The outlier market is Deschutes County, OR. It is also excluded from the regressions and correlations discussed in the remainder of the paragraph. If this outlier is included the correlation between the median welfare change and mean market income falls to 0.27; that between the median welfare change and the 1994 number of banks per market falls to 0.28. Neither coefficient is significant when both variables are included, together with a constant term, as explanatory variables in an OLS regression. The waterfall analysis is essentially unchanged.

variables used in much of the previous literature.

Our demand results are intuitive, confirming that consumers have significant preferences over a variety of characteristics including a positive utility from high deposit interest rates and a negative utility from travel. Elasticity calculations show that competitive effects are strongest between pairs of close banks while far banks have only a weak effect on close banks. Thrifts have larger own-price elasticities than banks and within-thrift competitive effects are stronger than within-bank competitive effects or those between thrifts and banks.

We estimate a substantial gain in consumer surplus from changes in bank characteristics and market structure from 1994, when barriers to nationwide branching were removed through passage of the Riegle-Neal Act, until 2000. Of course we cannot infer that the deregulation was the sole cause of the predicted welfare changes during this period, since other events such as financial innovation and a period of growth might have led to consumer surplus increases even absent the Riegle-Neal Act. We take steps to understand the determinants of the welfare gain by decomposing it into the effects of changes in different observed variables. We find that the gain was generated largely by an increase in the geographic footprint of banks, particularly within-market, underlining the importance of the spatial model for our application. The gains were greater in markets with high initial numbers of banks than elsewhere. The results illustrate that all of the various changes, rather than just price effects, should be taken into account in analyses of the effects of mergers and other policy questions.

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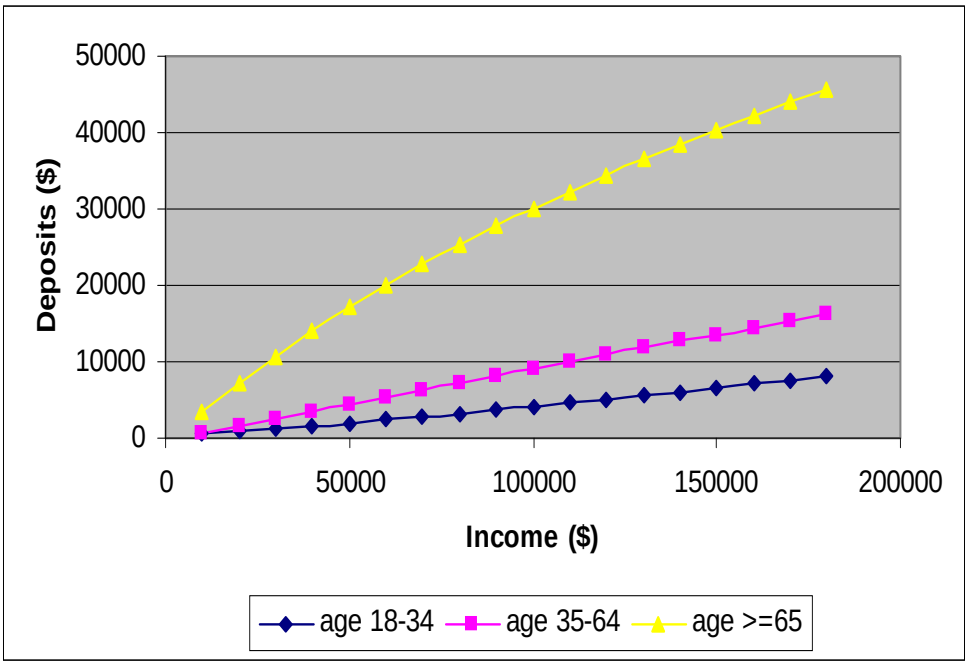
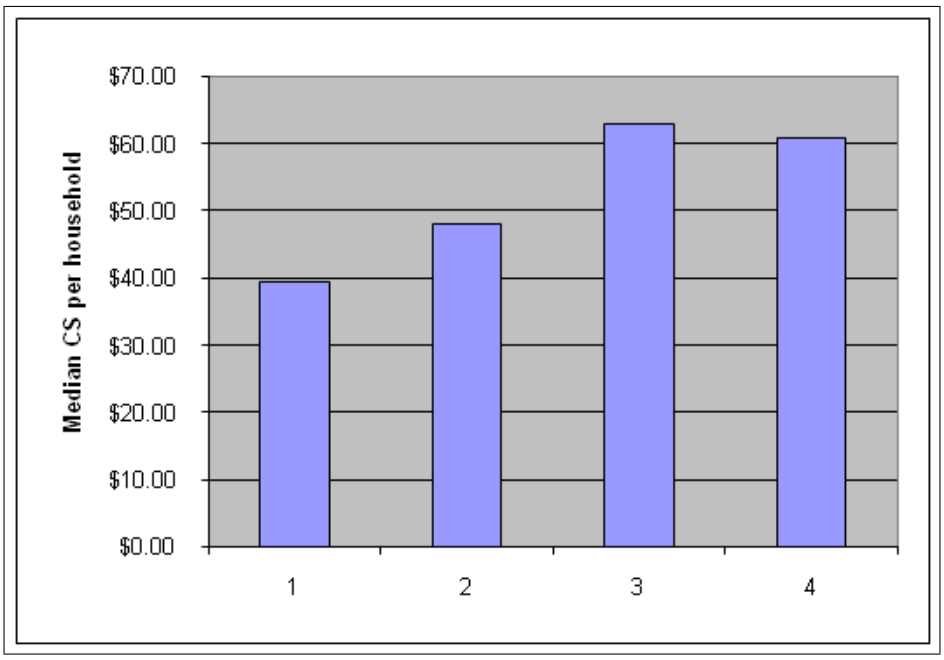
Figure 1: Relation of Householder Deposits to Demographics



Notes: Relationship between householder deposits and income for each of three age groups, estimated using log-log regression analysis of the 2001 Survey of Consumer Finances data. See Table 3 for regression results.

Figure 2: Determinants of Consumer Surplus Effects



Notes: Breakdown of determinants of consumer surplus effects. See Table 10 for data. Data represents median consumer surplus gain per household. Bar 1 relates to "Branch locations within market" which allows only the distance variables and fixed effect for banks with a single branch in the market to change from 1994-2000. Bar 2, "Branch locations within and outside market", also allows the "number of markets" variable and dummy for Single Market banks to change. Bar 3, "Branch locations and deposit interest rate", also allows the deposit interest rate to change. Finally the full effect in bar 4 also allows employees per branch and the dummy for thrifts to change over time. Banks active in 2000 but not 1994 have their 2000 values in all cases.

Figure 3: Relation between Market Variables and Welfare Change

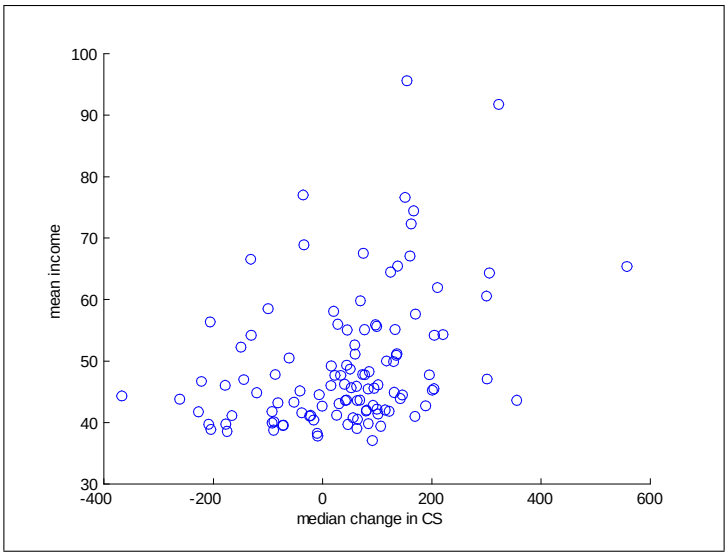


Figure 3A: Relationship between median change in consumer surplus per household, 1994-2000, and mean income in the market in $000. Each circle represents a market. One outlier, Deschutes County OR, has been removed.

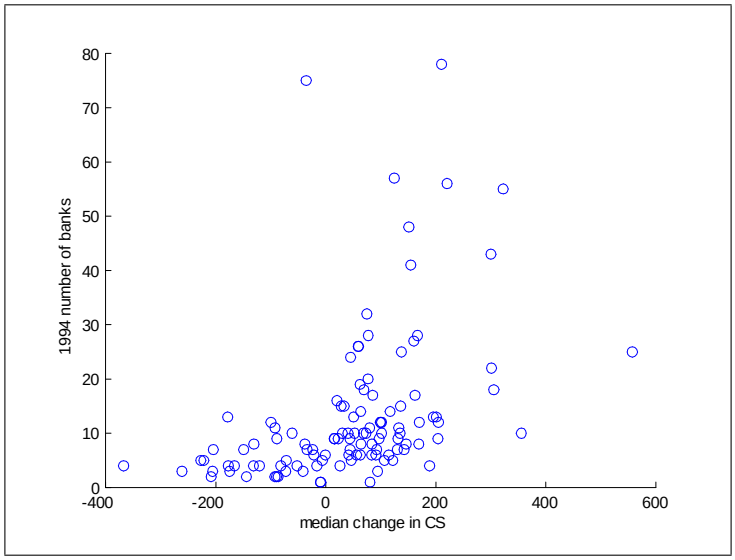


Figure 3B: Relationship between median change in consumer surplus per household, 1994-2000, and number of banks in the market in 1994. Each circle represents a market. One outlier, Deschutes County OR, has been removed.

Table 1: Market Summary Statistics

	Mean	Median	Std Error
Number banks	13.1	9	12.6
C(1)	8.1	1.0	19.6
C(4)	30.0	11.5	35.0
HHI	2342	1690	1807
Number markets	115		

Notes: HHI is the sum of the squared market shares multiplied by 10,000. C(1) is the one-firm concentration ratio, and C(4) is the four-firm concentration ratio.

Table 2: Bank Summary Statistics

	Mean	Median	Std Error
Number branches	5.9	2	14.0
Interest rate (%)	3.4	3.3	0.9
Employees per branch	20.7	16.6	35.1
Bank age (years)	37.5	37	22.5
Single-branch dummy	0.32		
Thrift dummy	0.20		
Single-market dummy	0.24		
Number bank-markets	1501		

Notes: Statistics in this table are measured at the level of bank-market combinations.

Table 3: Regression of Log Deposits on Demographics

	Coefficient	Std Error
age 35-64	-16.33	2.92
age $\geq$ 65	-15.96	3.35
log(family income)	-0.728	0.484
log(family income)^2	0.080	0.023
age 35-64*(log income)	3.07	0.535
age $\geq$ 65*(log income)	3.47	0.602
age 35-64*(log income)^2	-0.138	0.025
age $\geq$ 65*(logincome)^2	-0.166	0.027
constant	6.09	2.58
R^2	0.46	

Notes: Data are from the 2001 Survey of Consumer Finance. N=20,503 households.

Table 4: Probability of No Deposit by Demographic Group

	Estimated probability
age 18-34	0.146
age $\geq$ 35	0.078
age 35-64	0.084
age $\geq$ 65	0.065
income quartile 1	0.268
income quartile 2	0.082
income quartile 3	0.029
income quartile 4	0.007

Notes: Data are from the 2001 Survey of Consumer Finance. N=20,503 households. Income quartile 1 is under $20,000; quartile 2 is $20,000-$39,000; quartile 3 is $39,000-$71,000 and quartile 4 is above $71,000.

Table 5: Demand Results

	(1)	(2)
θ_1 :		
Employees per branch	0.419 (0.269)	0.419 (0.272)
Bank age	0.838 (0.162)	0.840 (0.220)
Number of markets	0.954 (0.111)	0.953 (0.120)
One branch	-1.757 (0.170)	-1.759 (0.231)
Thrift	-0.136 (0.122)	-0.148 (1.0621)
Single market bank	0.529 (0.080)	0.526 (0.539)
θ_2 :		
Interest rate*deposits	3.235 (0.798)	3.226 (0.997)
Distance 1	-4.044 (2.109)	-4.002 (2.068)
Distance 2	-7.003 (0.722)	-6.998 (0.741)
SM bank*$N(0,1)$		0.134 (8.710)
MM bank*$N(0,1)$		-0.028 (8.065)
Thrift*$N(0,1)$		-0.255 (8.711)
U_{i0} :		
Income	-17.849 (4.322)	-17.569 (5.845)
Age $18-34$	3.343 (1.233)	3.035 (1.559)
Age $35-64$	5.393 (1.921)	5.062 (2.289)
Market fixed effects?	Yes	Yes

Notes: Coefficients from the demand estimation are presented with standard errors in parentheses. SM bank=1 if over 90 percent of a bank's deposits were received in that market. Distance 1 is the distance from the consumer's census tract to the bank's closest branch; Distance 2 is the distance to the second closest branch. U_{i0} is the utility from the outside option.

Table 6: Own-Interest-Rate Elasticities

	Full Sample		Rural		Non-Rural	
	Number of Observations	Mean	Number of Observations	Mean	Number of Observations	Mean
All institutions	1501	1.190	519	0.866	982	1.360
Banks	1208	1.077	426	0.807	782	1.224
Thrifts	293	1.653	93	1.139	200	1.893
Single market	356	1.280	84	0.868	272	1.408
Multi-market	1145	1.161	435	0.866	710	1.342

Notes: Average own-price elasticities across institutions in the sample, based on the estimation results shown in Table 5, Column 1. The full sample consists of institutions in all markets, the rural sample consists of institutions in non-MSA markets, and the non-rural sample consists of institutions in MSA markets.

Table 7: Cross-Interest-Rate Elasticities

Panel A

	All	All Rural	All Non-Rural
All	-0.048		
All Rural		-0.111	
All Non-Rural			-0.040

Panel B

	Full Sample		Rural		Non-Rural	
	Thrift	Bank	Thrift	Bank	Thrift	Bank
Thrift	-0.072	-0.045	-0.164	-0.109	-0.065	-0.037
Bank	-0.063	-0.043	-0.147	-0.102	-0.054	-0.035

Panel C

	Full Sample		Rural		Non-Rural	
	Single Market	Multi Market	Single Market	Multi Market	Single Market	Multi Market
Single Market	-0.031	-0.048	-0.145	-0.102	-0.028	-0.043
Multi Market	-0.045	-0.052	-0.139	-0.107	-0.036	-0.043

Panel D

	Close	Far
Close	-0.089	-0.033
Far	-0.082	-0.079

Notes: Mean elasticity of institution type listed in row heading with respect to interest change of institution type listed in column heading. Results are based on the estimation results shown in Table 5, Column 1. Rural and non-rural markets are defined as in Table 6. 'Close' banks have their closest branch within one mile of the consumer while 'far' banks have no branches within that radius.

Table 8: Changes in Bank Characteristics 1994-2000

	1994	2000	Percent Change
Number of banks	512	437	-14.6%
Number of branches	7934	8342	5.0%
Average bank characteristics:			
mean distance 1	10.65	10.48	-1.6%
branch density	0.041	0.047	13.6%
number of markets active	2.78	3.53	26.9%
deposit interest rate	0.028	0.034	22.2%
employees per branch	20.75	20.44	-1.5%
thrift	0.185	0.126	-31.9%

Notes: Number of banks and branches and average bank characteristics in CA, WA and OR in 1994 and 2000. "Mean distance 1" is the average distance to the bank's closest branch, where the average is taken across bank-market pairs and across household draws. Other averages are taken across banks. Branch density is number of branches per thousand households.

Table 9: Estimated Changes in Consumer Surplus

Consumer Surplus Changes, 1994-2000	Median per household	Mean per household	CS per market
Median across markets	\$60.87	\$43.32	\$0.88 million

Notes: Change in consumer surplus resulting from market structure changes between 1994 and 2000. Column labeled "median per household" calculates the median across households within each market. Column labeled "CS per market" calculates the total change in consumer surplus per market as $M * \frac{1}{s} * \sum_i \Delta CS_i$, where M is the number of households per market, s is the number of random draws of households and ΔCS_i is the household-level change. We then take the median of these numbers across market observations.

Table 10: Determinants of Consumer Surplus Effects

Consumer Surplus Changes 1994-2000	Branch locations within market	Branch locations within and outside market	Branch locations and deposit interest rate	Full effect: add employees per branch and thrifts
Median across markets				
Median CS per household	\$39.33	\$47.92	\$62.81	\$60.87
Mean CS per household	\$26.85	\$34.07	\$43.50	\$43.32
CS per market	\$0.47 million	\$0.61 million	\$0.88 million	\$0.88 million

Notes: Breakdown of determinants of consumer surplus effects. "Branch locations within market" allows only the distance variables and fixed effect for banks with a single branch in the market to change from 1994-2000. "Branch locations within and outside market" also allows the "number of markets" variable and dummy for Single Market banks to change. "Branch locations and deposit interest rate" also allows the deposit interest rate to change. Finally the full effect also allows employees per branch and the dummy for thrifts to change over time. Banks active in 2000 but not 1994 have their 2000 values in all cases.