U.S. Savings Banks' Demutualization and Depositor Welfare

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Historically, U.S. savings banks were owned by their customers, in particular by their depositors. In recent decades, however, many savings banks have demutualized, by converting from customer ownership to investor ownership. This paper provides an assessment of the effect on depositor welfare of such events. We first estimate a random coeffcients logit model of bank deposit account choice, using data on commercial and savings banks from 1994 to 2005. Having recovered depositors' preferences for bank attributes, we then measure the effect on depositor welfare of a simulated demutualization of all customer-owned savings banks. We find that, on average, depositors' welfare would increase. In particular, if demutualized savings banks offered a deposit rate in line with other investor-owned savings banks, each depositor would gain \$1.14 annually, for a total of \$22 million for each state and year. Our findings cast doubt on whether U.S. customer-owned savings banks are well serving their customers' interests, and offers a new explanation for observed U.S. savings bank demutualizations.

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1 Introduction

Many banking systems around the world are populated by banks owned by their customers, and banks owned by investors. In the U.S., customer-owned banks include mutual saving banks and credit unions, while investor-owned banks include commercial banks and stock savings banks. Historically, U.S. savings banks were all customer-owned. They became established in the nineteenth century as a means of providing banking services to households and small firms, which were unprofitable for commercial banks to serve. Indeed, customer ownership is associated to the joint maximization of profits and consumer surplus (Hansmann (1996), Fonteyne (2007), Ayadi, Llewellyn, Schmidt, Arbak, and De Groen (2010)). Since the 1980s, however, many savings banks have "demutualized", by converting from customer ownership to investor ownership (Chaddad and Cook (2004)). This is why, now, savings banks can be either *mutual*, or *stock*. The question we raise is what is the effect on depositor welfare of such demutualizations. A priori, with the demutualization, banks do not maximize anymore a combination of profit and consumer surplus. Therefore, such events may imply a welfare loss for depositors.

In this paper, we provide an answer to that question by measuring the effect on depositor welfare of a simulated demutualization of the entire mutual savings banking sector. We structure an empirical model of bank deposit account choice, in which each depositor derives utility from a bank account depending on the deposit rate offered, on other bank characteristics, and his own "taste" for these attributes. Importantly, we allow for the attribute of "being a savings bank" (whether stock or mutual) and "being a mutual bank" to have a role in depositors' valuation, and in depositors' sensitivity to the deposit rate offered. Every depositor chooses the bank that provides him or her the greatest utility. Aggregating all depositors that choose a precise bank defines the supply to that bank, and the market share it has. We collect data on U.S. commercial and savings banks from 1994 to 2005. We refer to the state as the geographic market in which depositors take their decision, and define a market to be a state in a particular year. Overall, we consider 564 markets, with a total of 50,332 bank account alternatives available to depositors. We then estimate the model using the full random coefficient logit model technique. Having obtained the estimates of depositors' tastes, we carry out our policy experiment with all mutual savings banks being assumed to demutualize. Specifically, we consider two scenarios: one, in which demutualized banks have only lost their attribute of "being mutual" and offer their pre-demutualization deposit rates; another, in which demutualized banks have lost their attribute of "being mutual", and offer a deposit rate in line with other non-mutual savings banks.

As in any estimation of a supply equation we need to deal with the classic simultaneity problem that makes the price – in our case the deposit rate – endogenous. Our approach is to use as instrument for the deposit rate a shifter of banks' deposit demand. We construct this shifter from the regulatory changes that came with the Riegle-Neal Act 1994. The Riegle-Neal Act relaxed branching restrictions that once impeded commercial banks to branch out of their home state. The relaxation of the branching restrictions was a reduction of the barriers to entry in a market, and increased competition between banks (Rice and Strahan (2010)). Importantly, while opening the way to inter-state branching, the Riegle-Neal Act gave states considerable leeway on how to implement it. To our purposes, the relaxation of the branching restictions is a shifter of deposit demand. Similarly to Rice and Strahan (2010), we exploit the staggered nature of the lifting of restrictions, and we construct a state-year specific "openness index" describing how many pro-competitive provisions of the Riegle-Neal Act each state had passed at a given time. Consistent with the view that the lifting of restrictions increased competition between banks, we find a positive and statistically significant relation between the openness index and the deposit rate paid by banks.

Using this exogenous shifter for the deposit rate, we implement the methodology described by Berry et al. (1995), and Nevo (2000, 2001) to recover the taste parameters. As expected, we find that depositors prefer higher deposit rates. However, relative to commercial banks, depositors' valuation of the deposit rate is lower on average if the offering bank is savings (both stock and mutual), though to a lesser degree if the savings bank is mutual. Additionally, we find that there exists a large heterogeneity in depositors' valuation of the deposit rate, and of the deposit rate when the bank is stock or mutual savings. Another important finding is that the attribute of being a savings bank, especially if combined with mutual ownership, leads, on average, to a lower utility for the depositors.

We interpret these results as suggesting that choosing the bank where to have an account goes beyond the choice of where to deposit a given amount of money. Having an account at a bank gives the depositor access to a range of services offered by the bank, such as a loan or investing in the financial market. The number of such additional services appears limited in savings bank, which still focus on residential mortgages almost exclusively. This is the possible reason why depositors react less to a deposit rate increase if it comes from a savings bank, and why "being a savings bank" leads to a lower utility. Interestingly, our findings indicate that "being mutual" leads to a higher depositor utility relative to stock savings only for high level of the deposit rate. Because they are customer-owned, so in principle consumer surplus maximizers, mutual savings banks should offer higher deposit rates, relative to stock competitors. Our findings may then be interpreted as indicating that depositors prefer mutual savings to stock savings banks only if their current objective is still to mazimize customer surplus, and pay high deposit rates.

We use the estimated depositors' tastes for bank attributes in a policy experiment to measure the welfare change that depositors would incur if all mutual savings banks demutualized. Our approach is to estimate the expected compensating variation that would make depositors indifferent between a choice set in which mutual savings banks operate, and one in which they have demutualized. We find that every depositor would gain, on average, more than one dollar ($1.14) per year if demutualized banks offered the deposit rate of other stock savings banks. This amount reduces to 36 cents if demutualized banks instead maintained the deposit rate they offered when they were mutual. The estimates increase their magnitudes when we focus on the markets that display the largest presence of mutual savings banks. In those markets, every depositor would gain an average of 2 dollars per year if, following demutualization, mutuals offered the deposit rate of other stock savings. Finally, we also compute the total, market-wide, welfare effect of such simulated mass demutualization. Focusing on the entire sample, we find that a full demutualization would increase total welfare by, on average, $6 million per state-year if former mutuals still offered their pre-demutualization deposit rate, or almost $22 million if those banks offered the deposit rate offered by other stock savings banks.

Overall, our conclusion is that depositors, on average, would benefit from a demutualization of mutual savings banks. As highlighted above, mutual banks should, all other things being equal, offer higher deposit rates than stock savings banks. Hence the attribute of "being mutual" is valued by depositors only if these banks pursue the objective of customer surplus maximization, and pay their deposits more. In practice, mutual and stock savings banks pay similar deposit rates, and sometimes stock savings banks even offer higher rates. So, on the one hand mutual savings banks do not pay deposits "enough" to be considered customer surplus maximizers. On the other hand, if demutualized savings banks paid the same as other stock savings banks, they would offer higher rates than if they were mutuals. This is why a complete demutualization would be expected to increase depositors' welfare.

The existing literature on U.S. savings banks' demutualization has mostly focused on these events from the perspective of the banks involved. Hadaway and Hadaway (1981), Masulis (1987), and Chaddad and Cook (2004) suggest that the main reason savings institutions decide to demutualize is to have access to capital. Additionally, Kroszner and Strahan (1996) find that regulation incentivized mutual savings banks to convert to stock form in the 1980s. Given better access to capital, newly demutualized savings banks can better pursue opportunities of growth, and are found to have greater performance (Cole and Mehran (1998)). However, such higher performance comes from higher risk taking (Cordell, Mac Donald, and Wohar (1993), and Esty (1997)), so potentially impairing the positive effect at the aggregate level. As argued by Chaddad and Cook (2004), however, "the literature is silent about distributional effects related to demutualizations, particularly the effects on depositors". Ours is the first paper, to our knowledge, to address depositor welfare considerations of demutualizations.

This paper also adds to the growing literature that applies discrete choice models to banking. To this respect, the closest references are Dick (2002, 2008) and Ho and Ishii (2011), who both measure the effect on depositors' welfare of the U.S. deregulation changes in the 1990s. While Dick (2002, 2008) estimates multinomial and nested logit models focusing on commercial banks only, Ho and Ishii (2011) include in their analysis also savings banks and credit unions. However, they do not distiguish between stock and mutual savings banks. Also, Adams et al. (2007) estimate a generalized extreme value model of deposit supply choice in both commercial and savings banks in the U.S.. They assess the degree of market segmentation for these two institutional subgroups, and find that there is limited substitution across commercial and savings institutions. Other applications of discrete choice models to non-U.S. banking environments include Molnar et al. (2006), Nakane et al. (2006), Perez Montes (2014), and Crawford, Pavanini and Schivardi (2015). Overall, all these analyses do not measure consumers' taste for banks' ownership type. Our paper is the first in measuring this.

This paper is organized as follows. In Section 2 we describe the types of banking institutions that operate in the U.S.. In Section 3 we set out our deposit supply specification and estimation approach, while in Section 4 we describe the empirical details. Section 5 presents the results of the deposit supply estimation, and Section 6 describes our policy experiment, and the related results. Finally, Section 7 concludes.

2 Types of Banking Institutions in the U.S.[1]

The US banking system is characterized by a variety of bank types. As illustrated in Figure 1, U.S. banks can be distinguished by whether they are commercial banks or thrifts. Thrifts can be further characterized by their type of charter, being either savings banks, savings and loans (S&Ls), or credit unions, and by whether they are owned by their customers, or investors.

Commercial banks first emerged in 1781. They were exclusively investor-owned, returning profits to stock-holders, and arose to serve the banking needs of commercial customers, rather than offering depository or mortgage lending services to smaller customers such as households. Mutual savings banks were created to fill this gap, with the Philadelphia Saving Fund Society, and the Boston-based Provident Institution for Savings, commencing operations in 1816. Such banks were intended to encourage savings among the working and lower classes. They became prominent in the Mid-Atlantic and industrial North-East states, which had a large number of wage-earners. Initially, mutual savings banks were required by law to invest in safe assets such as government bonds, but were soon permitted to also invest in other assets such as real estate mortgages.[2] Savings and loans emerged soon after mutual savings banks, with the Oxford Provident Building Association commencing operations in 1831. Whereas the main objective of mutual savings banks was to encourage savings, and only later added mortgage lending, S&Ls were specifically created to facilitate home ownership by individuals. By pooling members' savings, S&Ls could satisfy the mortgage needs of the growing working class.[3]

[1]This section is based on chapters 4 and 6 of Federal Deposit Insurance Corporation (1997), chapter 1 of Williams (2006), Wilcox (2006), Barth et al. (2009), and web chapter 25 of Mishkin and Eakins (2012). Regulatory information was also obtained from legal and accounting publications on the website of the U.S. Department of the Treasury's Office of the Comptroller of the Currency, www.occ.gov.

[2]These constituted an increasing proportion of their assets, particularly with the housing boom following the end of World War II.

[3]Credit Unions emerged much later, in 1909. They were created to meet demand for loans initially not met by either commercial banks, mutual savings banks, or S&Ls. Nowadays these include loans for automobiles and home improvement. Following the original German model, credit unions enabled a group with little capital but

At their inception, mutual savings banks and S&Ls were customer-owned, and, in particular, were owned by their depositors.[4] Customer-ownership implies that it is in the bank's purpose to maximize consumer welfare jointly with the bank profit. Indeed, this ownership structure allowed mutual savings banks and S&Ls to fulfil their objective of providing banking services to customers who would have not been served by commercial banks. To see why the ownership structure modifies banks' behavior, we present in the Appendix a stylized model of banking under investor- and customer-ownership. We consider an economy populated of perfectly differentiated banks. Banks can be of two types: investor-owned and customer-owned. Both types of bank have zero capital, and lend every dollar they raise in deposits. They face a deposit supply, which is upward sloping in the deposit rate, and a loan demand, which is downward sloping in the loan rate. The key difference between bank types is that customer-owned banks maximize the surplus of both loan takers and depositors together with their profits, while investor-owned banks only maximize their profits. Banks engage in Bertrand-Nash competition in the deposit rate, and so each of them sets its deposit rate taking the others' move as given. At equilibrium, relative to investor-owned banks, customer-owned banks offer a greater deposit rate, charge a lower loan rate, and serve more customers. These results confirm that customer-ownership allowed mutual savings banks and S&Ls to fulfil their objective of serving a greater portion of potential consumers. They also suggest that customer-owned banks should be associated to higher deposit rates and lower loan rates.

In the the rest of the paper, we refer to savings banks and S&Ls as generically "savings banks". Following the passage of enabling legislation in 1948, savings banks were allowed to "demutualize", which means converting from mutual ownership to investor ownership. We refer to the resulting investor-owned savings banks as "stock savings banks", while to the original customer-owned savings banks as "mutual savings banks". Conversions often followed episodes of bank instability, enabling access to new capital, and facilitating bank mergers and takeovers. Such conversions were often necessary because mutual savings banks cannot issue new shares to investors, and have retained earnings as their only source of capital.[5]

a common bond to raise a loan which they were collectively liable to repay.

[4]However, mutual savings banks originally differed from S&Ls on the ground of corporate governance. While members of S&Ls enjoyed voting rights over bank governors, "members" in mutual savings banks did not. In fact, following an original Scottish model, governors of mutual savings banks were often philanthropists and acted in a form of trustee capacity on behalf of the members.

[5]Bank reforms in the 1980s eased this constraint, by allowing the creation of bank holding companies. Bank holding companies facilitate access to external capital while ensuring continued majority depositor ownership.

It is important to stress that savings bank have been regulated differently to commercial banks in many respects. Regulators have influenced the riskiness of savings bank investments by means of lending limits, which typically have not been imposed on commercial banks. Current regulation establishes that commercial and small business loans cannot make up more than 20% of a savings banks' assets, and consumer loans and corporate debt cannot make up more than 35%. Residential real estate loans can be up to 400% of capital. Figures 2 and 3 plot, respectively, the evolution of residential property loans and personal loans to total assets ratios between 1994 and 2005. Savings banks, especially those with customer ownership, focus on mortgage lending almost exclusively. Conversely, regulation is the same with respect to capital requirements, and since 1951 with respect to income taxes.[6]

Historically, commercial banks have dominated savings banks in terms of both number and total assets.[7] As Figure 4 shows, in our sample period, commercial banks are still more numerous than both stock and mutual savings banks. However, the number of banks has markedly reduced in the years in all bank types. To this respect, many mutual savings banks have converted to investor ownership. In fact, as it appears in Figure 5, between 1994 and 1999, the number of demutualizations is around 80 per year, which corresponds to 8% of the total. Between 1999 and 2005 the number of conversions is closer to 20 every year.

To sum up, the U.S. banking system is populated by investor-owned and customer-owned banks. Investor-owned banks include commercial and stock savings banks. Customer-owned banks include mutual savings banks and credit unions. Originally, all savings banks were customer-owned, and had the objective of providing banking services to customers who would not be served by commercial banks. They attained such objective by maximizing their profit jointly with customer surplus. However, since 1948, savings banks were allowed to demutualize, thus originating the difference between stock and mutual savings banks. Between 1994 and 2005, which is the focus of our analysis, many banks demutualized. The question we raise is then whether or not depositors benefit from such demutualizations. To this purpose, we present in the following an empirical model of bank account choice. This allows us to understand whether depositors value the fact that a bank is customer-owned. Then, after estimating the model with U.S. data from 1994 to 2005, we assess what would be the effect on depositors of a policy

[6] Unlike Credit Unions, which continue to be tax-exempt.

[7] See Table 1 of Barth et al. (2009) for long-term historical figures for each bank type.

by which all mutual savings banks demutualize.

3 Empirical Model and Estimation

We structure an empirical model of bank account choice, and we study the extent to which depositors' choices depend on the deposit rate, on other bank characteristics (e.g. size of the branch network), and on the bank type (i.e. commercial, stock savings, or mutual savings). Our methodology specifically allows for heterogenous "taste parameters" for bank characteristics across depositors.

3.1 Specification

We introduce a discrete choice model of deposit supply. Traditional references for the methodology are Berry (1994), Berry et al. (1995) (hereafter BLP), and Nevo (2000, 2001). We assume that depositor i has already chosen a dollar quantity to deposit (I_i), but he still has to choose in which bank j to deposit it. Each bank j offers only one type of deposit.[8] Depositor i has exogenous income y_i and can choose among J alternatives. We assume that, conditional on choosing to make a deposit at bank j in market t, he derives the indirect utility u_{ijt}:

$$u_{ijt} = \alpha_i \left(y_i + r_{jt}^D I_i\right) + \alpha_i^{SAV} \left(r_{jt}^D I_i \times SAV_{jt}\right) + \alpha_i^{MUT} \left(r_{jt}^D I_i \times MUT_{jt}\right) + x_{jt}\beta_i + \xi_{jt} + \varepsilon_{ijt} \tag{1}$$

where r_{jt}^D denotes the deposit rate offered by bank j, SAV_{jt} denotes whether j is a savings bank (irrespective of mutual or stock ownership), and MUT_{jt} denotes whether j has mutual ownership. x_{jt} is a vector of bank characteristics, other than deposit rate, that are observed by the econometrician (including SAV_{jt}, MUT_{jt}, and time and geographic market fixed effects), while ξ_{jt} represents bank characteristics unobserved by the econometrician. Finally, ε_{ijt} is an iid Type 1 Extreme Value error term that captures consumer heterogeneity not explained by the customer-specific taste parameters α_i and β_i. Note that α_i is the marginal utility of income, which is assumed constant across the choice situations and the deposit rates being considered.

Since we do not observe individual deposits in our data, we normalize each depositor's deposit size to one, and correspondingly normalize depositor income by dividing it by deposit size. We further assume that such normalized income, denoted $\tilde{y}$, is constant across depositors,

[8] This is because the data we use to estimate the model do not report the number of demand, savings or time deposit accounts a bank has in a market. Moreover, the data do not include the interest rates paid on each of these account types.

which is equivalent to assuming that depositors hold the same fixed ratio of income as deposits. Normalizing income does not modify the substance of the problem, since income y_i enters linearly across any given depositor's choice alternatives. We can then re-write (1) as:

$$u_{ijt} = \alpha_i \left(\tilde{y} + r_{jt}^D\right) + \alpha_i^{SAV} \left(r_{jt}^D \times SAV_{jt}\right) + \alpha_i^{MUT} \left(r_{jt}^D \times MUT_{jt}\right) + x_{jt}\beta_i + \xi_{jt} + \varepsilon_{ijt} \tag{2}$$

In addition to choosing at which bank j to make a deposit (i.e. choosing an "inside good"), we allow for depositor i to choose an alternative such as a credit union or a mutual fund (i.e. to choose an "outside good"). Thus changing deposit rates will not only affect depositors' choices regarding which bank to accept, but also whether they accept any bank at all. Since only relative utilities affect consumers' discrete choices, we are unable to identify taste coefficients for one good, so as usual we normalize the utility of the outside good to zero (i.e. $u_{i0t} \equiv 0$).

Our specification allows for heterogeneity in depositor tastes.[9] This is achieved by introducing interactions between bank characteristics and depositor i specific random variables.[10] The introduction of customer-specific heterogeneity in the taste parameters β_i and α_i was a key innovation in BLP. We follow their approach and decompose these parameters as:

$$\begin{bmatrix} \alpha_i \\ \beta_i \end{bmatrix} = \begin{bmatrix} \alpha \\ \beta \end{bmatrix} + \Sigma v_i \qquad v_i \sim P_v^* (v) \tag{3}$$

with v_i being a $(K+3) \times 1$ vector of random variables, distributed as $N(0, I_{K+3})$ with K being the number of observed non-price bank characteristics, and Σ being a vector of scale parameters.[11]

[9] As highlighted in the literature, this allows for more reasonable substitution patterns (i.e. cross elasticities) between products that those obtainable with a multinomial logit specification. In a multinomial logit specification depositor tastes are homogeneous, so $\alpha_i = \alpha$ and $\beta_i = \beta$ for all depositors i. As discussed in Berry (1994), one important limitation of that specification is that price elasticities depend just on prices and market shares, leading to implausible substitution patterns. The multinomial logit model's limitations are partially addressed using the nested logit variant in which products believed to be correlated in terms of consumer preferences are grouped into nests, with parameters estimated for each nest. Adams et al. (2007) fit a more general, generalized extreme value specification using U.S. banking data, finding that their specification rejected both the multinomial and nested logit approaches.

[10] Dick (2002, 2008), Adams et al. (2007) and Nakane et al. (2006) interact market-level demographics with bank characteristics. However, their approaches did not incorporate variation in the distribution of demographics in each market, as does the random coefficient logit approach. Ho and Ishii (2011) introduce variation from the distribution of demographics, but were unable to produce significant coefficients on the relevant interactions.

[11] Note that we have $K+3$ elements in v_i because we include the deposit rate interacted with two dummy variables as additional price-related characteristics.

Using (3), we can re-express (2) as:

$$\begin{aligned} u_{ijt} &= \underbrace{\alpha\left(\tilde{y}+r_{jt}^{D}\right)+\alpha^{SAV}\left(r_{jt}^{D}\times SAV_{jt}\right)+\alpha^{MUT}\left(r_{jt}^{D}\times MUT_{jt}\right)+x_{jt}\beta+\xi_{jt}}_{\delta_{jt}\left(x_{jt},r_{jt}^{D},\xi_{jt};\theta\right)} \\ &+ \underbrace{\sum_{k=1}^{K}\nu_{ik}\sigma_{k}}_{\mu_{ijt}\left(x_{jt},r_{jt}^{D},v_{i};\Sigma\right)} + \varepsilon_{ijt} \end{aligned} \tag{4}$$

where α, α^{SAV}, α^{MUT} and β represent mean taste parameters common to all depositors. This classifies the parameters depending on whether they enter linearly ($\theta = \left(\alpha, \alpha^{SAV}, \alpha^{MUT}, \beta\right)$) or non-linearly ($\Sigma$) in the objective function used for estimation purposes described below. Here δ_{jt} represents the mean utility enjoyed by all depositors in bank j and market t, depending on just θ. Conversely, $\mu_{ijt}+\varepsilon_{ijt}$ represents depositor-specific zero-mean deviations from δ_{jt} due to making a deposit at bank j in market t, with μ_{ijt} depending on Σ and capturing the model's random coefficients.

We complete the specification by defining the set of depositors that choose bank j in market t. Specifically, it comprises all depositors for whom making a deposit at bank j provides greater utility than making that deposit at some other bank (or choosing the outside good) in market t, i.e.:

$$A_{jt} = \left\{\left(v_i, \varepsilon_{i0t}, \ldots, \varepsilon_{iJt}\right) \mid u_{ijt} \geq u_{ilt},\ \forall l \neq j\right\}$$

With this definition of A_{jt}, the market share of bank (i.e. deposit product) j in market t is:

$$s_{jt} = \int_{A_{jt}} \mathrm{d}P^{*}\left(v,\varepsilon\right) = \int_{A_{jt}} \mathrm{d}P_{v}^{*}\left(v\right)\mathrm{d}P_{\varepsilon}^{*}\left(\varepsilon\right) \tag{5}$$

under the assumption that v and ε are independently distributed. So if the total size of market t is M_t, then bank j's deposit supply in market t is:

$$q_{jt}^{D} = M_t s_{jt}$$

while depositors' supply to the outside good in that market is $q_{0t} = M_t\left(1-\sum_{j=1}^{J_t} s_{jt}\right)$.

3.2 Estimation

Estimation of the full random coefficients deposit supply specification proceeds as follows. First, we sample $ns = 100$ independent standard normal vectors for ν_i for each market. As in Train (2009), we use Halton sampling to improve efficiency. Next, we use logit estimates and random draws as initial estimates of, respectively, δ_{jt} and Σ. Given those initial values, we compute the predicted market shares using the empirical counterpart of (5). Given only Σ, we compute the value of δ_{jt} that minimizes the distance between observed and predicted market shares of each bank j in market t, using the contraction mapping proposed by BLP. Based on this estimate of δ_{jt} for each market t, we then obtain an estimate of the unobserved bank characteristics term ξ_{jt}. This can be thought of as a structural error term suitable for GMM estimation purposes. However, ξ_{jt} is likely to be correlated with the deposit rate. We expect, in fact, that a bank offering better bank facilities to its customers is able to secure deposits by offering a lower deposit rate. To resolve this endogeneity problem it is necessary to introduce suitable instruments for the deposit rate (discussed further in Section 4.5). Defining a set of such instruments as Z, and given our current estimate of θ and Σ, the next step in the estimation is to compute an updated estimate of θ and Σ using the following GMM problem:

$$\left(\hat{\theta}, \hat{\Sigma}\right) = arg \min_{\theta, \Sigma} \xi\left(\theta, \Sigma\right)' Z \Phi^{-1} Z' \xi\left(\theta, \Sigma\right) \tag{6}$$

where Φ is a consistent estimate of $\mathbb{E}\left(Z'\xi\xi'Z\right)$.

The above steps are repeated until the resulting objective function value, or estimate of θ and Σ, converges to within a pre-specified tolerance level. Additionally, the entire algorithm is repeated for multiple sets of starting values for Σ. Indeed, since Σ enters the vector $\xi\left(\theta, \Sigma\right)$ non-linearly, the above GMM estimate must be obtained using numerical procedures. It is well-documented that the choices of optimization method, convergence tolerance levels and sets of starting values, are all critical to obtaining reliable estimates (Knittel and Metaxoglou (2014)). We implemented the algorithm with convergence tolerances of 10^{-16}, and 50 different sets of starting values for Σ.

As in Nevo (2001), the asymptotic covariance matrix for the parameter estimates is a variation on that implemented by BLP based on the then working paper version of Berry et al. (2004). Specifically, we use:

$$\left(\Gamma' W \Gamma\right)^{-1} \Gamma' W \Phi W \Gamma \left(\Gamma' W \Gamma\right)^{-1}$$

where Φ is as in (6), $W = (Z'Z)^{-1}$, and Γ is the limit of the derivative of the GMM moment condition $\xi(\theta)$ with respect to θ as the number of banks J increases. As discussed in Berry et al. (2004), for consistent and asymptotic normal parameter estimates in random coefficients logit models, it is necessary for ns to be large relative to J, which is why we opted for $ns = 100$ and used Halton sampling to improve sampling efficiency.

Without random coefficients (i.e. if $\alpha_i = \alpha$ and $\beta_i = \beta$ for all i) our model reduces to a multinomial logit model. As shown by Berry (1994), the BLP contraction mapping to recover δ_{jt} is no longer required in that case, and δ_{jt} can instead be computed by a simple inversion. θ can be recovered using standard regression techniques, after appropriately instrumenting for deposit rates to allow for the endogeneity between deposit rate and unobserved bank characteristics ξ_{jt} identified above.

4 Empirical Details

4.1 Bank Data

We obtain data on U.S. commercial and savings banks from the Federal Deposit Insurance Corporation (FDIC), which is the U.S. agency responsible for providing deposit insurance to account holders. Unfortunately, the data do not contain information on credit unions, which are instead included in the "outside good". The two datasets employed in our study are the Statistics on Depository Institutions (SDI), and the Summary of Deposits (SOD). The SDI records quarterly information on the institutional characteristics, balance sheet and income statement of each FDIC-insured institution. By contrast, the SOD provides, for each FDIC-insured institution, information on each branch location, and the amount of deposits there raised.

4.2 Geographic Market Definition

The relevant geographic market for deposits is taken to be the state, for two reasons. First, selecting a finer geographical market would have increased enormously the computational burden when implementing the random coefficient logit estimation. Second, we do not observe branch-specific interest rates, so such analysis would lack a fundamental component.

To see this better, it should be stressed that while the SOD allows us to precisely determine where each bank obtains its deposits, it does not record branch-specific interest payments, and hence we are unable to establish whether a given bank pays different interest rates across different branches. The deposit interest rates are derived from the SDI, which reports interest payments on a branch-consolidated basis. The interest rate we obtain is therefore bank-year specific. Also, these constraints imply that even if we used a finer geographical market definition we would still have to use bank-year rates.

Taking the state as the relevant geographical market differs from earlier studies such as Dick (2002, 2008). In her analysis, Dick uses Metropolitan Statistical Areas for urban markets and counties for rural ones. This conforms with evidence that the market for financial services is local (Amel and Starr-McCluer (2002) and Kiser (2002)). However, Dick shares our limitations and is unable to define bank-market specific interest rates and product characteristics. It is therefore not clear whether the benefits in setting smaller geographical markets remain when no variation can be captured in the interest rates and product characteristics.

In support of our approach, the assumption behind the selection of the state as the relevant geographic market is that deposit interest rates are set uniformly across branches by bank headquarters. This conforms with the evidence presented by Radecki (1998), who finds that banks typically set uniform rates at the state level. He also suggests that future analysis regarding variables like retail loan and interest rates should look at the overall scope of each bank. Indeed, as we detail in the following, the U.S. banking industry underwent a significant deregulation process after the passing of the Riegle-Neal Act in 1994. The most direct effect was the possibility for commercial banks to operate outside of their home state, meaning that in our sample period some banks started to operate in more than one state. We assume that the new branches located outside of the home state borders offer the same rates as in the home state, and that these are set at the headquarters level.

4.3 Market Size and Outside Good

Depositors select their bank as a discrete choice, but supply deposits as a continuous variable. Because our interest is understanding the choice of bank, rather than the choice of quantity deposited, we obtain the number of accounts a bank serves in a given market. We proxy the total size of the market, and, we finally compute the market shares.

The SOD records for each bank branch the quantity of deposits obtained but not the number of accounts served. That information is available only on a branch-consolidated basis throught the SDI. This is problematic when a bank operates in more than one state in a given year. In this case, in fact, we do not know from which state the accounts are obtained. We need a rule to assign the total number of accounts served to each of the states in which the bank operates. We choose to assign a bank's number of accounts to a given market proportionally to the number of branches that the bank has there. For example, if a bank has three branches, two in state A and one in state B, we assign two thirds of the bank's accounts to state A, and the rest to state B.[12] Information on branch location is available through the SOD as of every June 30. Despite the SDI displays quarterly figures, we are therefore constrained to use annual observations.

Once having recovered the number of accounts every bank has in each market, we need to proxy the market size. We first investigate which economic agents are typical depositors. Based on data from the U.S. Federal Reserve's Flow of Funds, we find that in 1994 51% of checkable deposits was held by households and 25% by non-financial businesses. In the same year, almost 100% of savings and time deposits was held by households. By contrast, in 2005, one third of outstanding checkable deposits and currency was held by households, and another third by non-financial businesses. Yet, 75% of total savings and time deposits was held by households. These figures suggest that households and firms are, in volume terms, the principal suppliers of all forms of deposits.

Knowing how many households and firms reside in a market is essential for proxying the size of the market. The total population of any given state and year is retrievable from the Bureau of Economic Analysis. At the same time, as argued by Adams et al. (2007), the number of businesses in a market is very correlated to the market population. This means that the number of people in a market is already a sufficient statistics to proxy for the size of the market. We need, however, to scale the population size to account for the total bank account choices.

We first measure how many bank accounts a typical household maintains. Exploiting data from the Survey of Consumer Finances, we find that in both 1995 and 2004, the median number of accounts per household was 2, and the mean was 3. When this figure is adjusted for the number of people that compose the household, it appears that the median number of accounts

[12] This is very similar to the strategy adopted by Adams et al. (2007). In their case, however, they assign a bank's accounts proportionally to the dollar quantity of deposits obtained in each market.

per person was 1, and the mean was 1.5. If, on top of those, we consider the deposit accounts held by businesses, it is likely that for every household, the number of deposit accounts held is three. So, to proxy for the size of the market we scale population by a factor of three. This scaling factor, and the overall methodology is in accordance with Adams et al. (2007).[13]

We observe that the number of banks competing is very heterogeneous across markets, and sometimes very large (up to more than 1,000). A very large number of banks in the same market is problematic because it leads to a considerable computational burden when implementing the full random coefficients logit model. To reduce this burden, we first compute market shares by dividing the number of bank accounts a bank serves in a market by the size of that market. Then, we eliminate from the sample all banks having a cumulative deposits share of 10% or less in any given market.

As final step, we compute the market share of the "outside good". This is equal to one minus the sum of the market shares of the "inside goods", i.e. the bank deposit accounts of those banks that we retain. The outside good includes any product that provides liquidity to its holder. In fact, while the types of deposit accounts can be relatively heterogeneous,[14] they share the common trait of satisfying a liquidity need.

4.4 Deposit Rate and Other Observed Bank Characteristics

We construct bank-specific deposit rates and other explanatory variables based on the SDI. The proxying of the deposit rate r_{jt}^{D} exploits the quarterly structure of the SDI. We first obtain quarterly interest rates dividing the domestic deposit interest payments realized during a quarter by the amount of domestic deposits outstanding at the end of the previous quarter. Then, we obtain the yearly interest rate, promised at a given point in time, compounding the gross quarterly interest rates realized in the subsequent four quarters and subtracting one. So, for example, the deposit rate promised by a bank in June 30, 1994, is taken to be the product of the gross quarterly interest rates realized during the third and fourth quarters of 1994, and

[13] We find that in Delaware, New Hampshire, South Dakota, and Utah, the previously computed number of accounts exceeds the retrieved market size. This same problem is also experienced by Dick (2002, 2008), and Adams et al. (2007). One reason for Delaware having relatively large number of bank accounts may be that it is a an important commercial center and therefore hosts a lot of non-resident deposits. However, we have no explanation for the relatively high number of accounts in New Hampshire, South Dakota, and Utah. In any case, since the number of these markets is negligible compared to the rest, we omit them from our analysis.

[14] For example, some deposit accounts allow withdrawals and/or have check writing/transfer privileges. They are, therefore, alternative to cash. Other deposit accounts are, instead, alternative to Treasury Bills or mutual funds, as they are a store of value and earn interest.

first and second quarters of 1995, minus one.

For bank characteristics, we control for branch staffing, for the scope of the branch network, and for the strength of the customer relationships the bank may have built. All these characteristics are expected to have a positive effect on depositors' choice of bank. Therefore, we include in x_{jt} the log of the number of employees per branch ($Empl\,per\,branch_{jt}$), the log of the number of branches ($Number\,of\,branches_{jt}$), the log of the branch density ($Branch\,density_{jt}$), and a dummy variable capturing whether the bank's headquarters are located out of the state being considered ($Out\,of\,State\,bank_{jt}$). To be precise, $Empl\,per\,branch_{jt}$ is obtained by first dividing the total number of employees by the total number of branches and taking the log, while $Branch\,density_{jt}$ is computed dividing the number of branches a bank has in a state by the land area of that state in square miles and then taking the log.[15]

We isolate the bank type in the following way. We define the dummy SAV_{jt} that equals one when the bank's charter is of a savings institution. We then differentiate stock from mutual savings institutions defining the dummy MUT_{jt}, which equals one if the bank is customer-owned.

In Table 1, we report summary statistics for market shares, deposit rates and bank characteristics at the bank-market level. We differentiate by bank type and also report the starting and ending years in our sample separately. We observe that stock savings banks tend to have larger market shares than commercial banks and mutual savings banks. We also note that market shares increase over time for all ownership types. This indicates that the industry experienced a process of consolidation, as already remarked in Figure 2. As for deposit rates, their inter-temporal comparison is meaningless since they tend to be influenced by the outstanding monetary policy stance. However, cross-sectional differences reveal that savings banks, both mutual and stock, pay in general higher rates. In terms of branch staffing we do not observe marked differences both cross-sectionally and inter-temporally. On the contrary, stock savings are found to have on average a more extensive branch network than both commercial and mutual savings banks. It should be noted, however, that mutuals have more dense branch networks than commercials. Still, in the three cases, the size of the branching network has increased over time. Finally, the presence of commercial out-of-state banks was modest in 1994, but increased dramatically by 2005. The increase is shared by both mutual and stock savings banks. In our

[15]Data on states' land area come from the 2000 U.S. Census.

sample, stock savings are the most present out of their home state; at the opposite we find that mutual savings banks mainly operate in the state where they are headquartered.

To conclude, from Table 1 we see that our sample comprises 50,332 bank-year observations. Of these, 3,063 observations are for mutual savings, 5,146 are for stock savings, and the rest are commercials.

4.5 Instruments

As discussed in section 3, we expect deposit rates r^D_{jt} to be correlated with the unobservable bank characteristics ξ_{jt}. The reason is that banks are likely to set their prices based on those attributes. Suppose that a bank is geographically "well-located". This characteristic is unobservable to the econometrician. However, because of this characteristic, the bank is able to pay less for its deposits than its competitors. The observed deposit rate is then correlated with the unobservable component, and neglecting it would result in biased estimates.

The correlation between r^D_{jt} and ξ_{jt} arises from the classic simultaneity problem in the analysis of demand and supply (BLP). In these contexts, when one estimates the supply equation, it is customary to use demand shifters as instruments for prices. We follow the same approach here. Since our interest is in estimating deposit supply, we use bank demand shifters as instruments for the deposit rates. We derive these shifters from the staggered relaxation of commercial bank branching restrictions. This had the effect of promoting entry of out-of-state commercial banks and therefore increased the demand for deposits.

Until at least the 1980's, regulation on commercial banks' geographic expansion was strict and directed at both *intra*-state and *inter*-state *banking* and *branching* operations (Johnson and Rice (2008) and Kane (1996)).[16] The situation changed with the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994. First, the Act removed the last vestiges of state restrictions on inter-state bank acquisitions left from the deregulation of the 1980's. Second, the Act permitted the consolidation of existing out-of-state subsidiaries, which would have become branches of the lead bank (of an existing multi-bank holding company), and *de novo* branching. The date of effectiveness for inter-state branching provisions was set to June 1, 1997. States could "opt in early" or "opt out" by passing state laws any time between September 1994

[16]Intra-state operations are those taking place within the bank's home state borders, while inter-state ones those across. With banking it requires the establishment or acquisition of a separate charter. With branching, the establishment or acquisition of a branch office which is not separately chartered or capitalized.

and June, 1 1997 (trigger date). By opting out, states would have not allowed cross-border branching at all. Instead, by opting in early, states had the possibility to put limitations and restrictions. Therefore, while opening the way to inter-state branching, the Act gave states considerable leeway on how to implement it.

States could set stricter provisions on four subjects. They could set a minimum age requirement for the institution object of the consolidation, not to exceed 5 years. Equally, they could decrease the statewide deposit cap, set in the Act to 30%. Finally, on the *de novo* branching and on the acquisition of individual branches provisions, states needed, if willing, to explicitly opt in. Overall, states could choose to grant cross-border activities only if the home state of the bank willing to do them was also setting similar provisions (reciprocity clause). Clearly, setting stricter provisions relative to the ones contained in the original Act would have erected anti-competitive barriers and restricted entry. As reported by Johnson and Rice (2008) and Rice and Strahan (2010), between 1994 and 2005, states gradually moved towards a relaxation of the constraints. However, changes were not uniform, and, at the same point in time, some states were more deregulated than others.

We construct a state-year specific "openness index" based on how many provisions each state set in line with the Act in the period 1994 – 2005. The index ($Index$) ranges from 0 to 5, with 0 denoting the least open environment, and 5 the most open one. The index is reported in Table 2, together with the dates at which states changed their legislation. We then use the constructed openness index as an instrument for the deposit rate r_{jt}^D. By allowing entry of out-of-state banks, the relaxation of branching restrictions created an increase in bank demand (i.e. competition) for deposits. This is likely to have brought an increase in deposit rates, and a compression of mark-ups. We expect therefore that deposit rates are positively associated with the index. To be noted is that when we assess the effect of $Index_{jt}$ we will control for state and time effects which are included in x_{jt}. Indentification will then come from the fact that the relaxation of the restrictions did not happen at the same time in the different states.

In our setting, deposit rate r_{jt}^D is interacted with the SAV_{jt} and MUT_{jt} dummies. The endogenous variables are therefore three: r_{jt}^D, $r_{jt}^D \times SAV_{jt}$, and $r_{jt}^D \times MUT_{jt}$. To have an appropriate set of instruments, we follow Wooldridge (2010), and we first regress r_{jt}^D over $Index_{jt}$ and x_{jt}. We predict the fitted values $\hat{r}_{jt}^D$ and interact them with the SAV_{jt} and MUT_{jt}

dummies. Our set of instruments is then composed by $\{Index_{jt},\ \hat{r}^D_{jt} \times SAV_{jt},\ \hat{r}^D_{jt} \times MUT_{jt}\}$.

5 Results

For reference purposes, we first present the results derived from the multinomial logit specification, in Table 3. We then present the results of our full, random coefficient logit model, in Table 4.

5.1 Multinomial Logit Model

As discussed in Section 3, when no random coefficients are considered, the BLP contraction mapping is not required to recover mean utility δ_{jt}. In that case, adapting the derivation of Berry (1994), the equation to be brought to the data is:

$$\ln(s_{jt}) - \ln(s_{0t}) = \alpha r^D_{jt} + \alpha^{SAV}\left(r^D_{jt} \times SAV_{jt}\right) + \alpha^{MUT}\left(r^D_{jt} \times MUT_{jt}\right) + x_{jt}\beta + \xi_{jt} \tag{7}$$

for which $\theta = \left(\alpha, \alpha^{SAV}, \alpha^{MUT}, \beta\right)$ can be readily estimated. We do so using 2SLS, first regressing r^D_{jt}, $r^D_{jt} \times SAV_{jt}$, and $r^D_{jt} \times MUT_{jt}$ against observed bank characteristics x_{jt} and $Index_{jt}$, $\hat{r}^D_{jt} \times SAV_{jt}$, and $\hat{r}^D_{jt} \times MUT_{jt}$. Then we estimate (7) using the predicted variables from the first stage.

The first column in Table 3 presents results of the regression of the deposit rate r^D_{jt} on the explanatory variables x_{jt} and the openness index $Index_{jt}$. We refer to this regression as the "preliminary regression". The preliminary regression is important for checking the strength of our instrument in influencing r^D_{jt}, and is used in the constuction of $\hat{r}^D_{jt} \times SAV_{jt}$, and $\hat{r}^D_{jt} \times MUT_{jt}$. We find that the effect of $Index_{jt}$ on r^D_{jt} is positive and statistically significant at 5%. The sign of the effect is in line with our expectations: a higher $Index_{jt}$ means a higher level of competition, and this forces banks to increase the interest rate offered on their deposit accounts.

The second column in Table 3 presents the estimates of (7) using OLS. In case the deposit rate r^D_{jt} is correlated with the error term ξ_{jt}, parameter estimates are biased and inconsistent. We expect the deposit rate to be endogenous in (7), so the OLS estimates are likely not to be reliable. Indeed, we find that the deposit rate coefficient α is not statistically significant, claiming that depositors do not choose a bank account based on the deposit rate offered. The picture changes when we instrument r^D_{jt}, $r^D_{jt} \times SAV_{jt}$, and $r^D_{jt} \times MUT_{jt}$ by $Index_{jt}$, $\hat{r}^D_{jt} \times SAV_{jt}$, $\hat{r}^D_{jt} \times MUT_{jt}$. The results, which appear in the third column of Table 3 suggest, instead, that depositors react positively to the interest rate offered, and the effect is statistically significant.

The effect of the deposit rate on depositors' account choice is however different depending on the bank type. Relative to commercial banks, depositors respond less to the deposit rate if the bank is a stock or mutual savings bank. However, they do so to a lesser degree if the savings bank is mutual. Correspondingly, we also find that the coefficients of SAV_{jt} and MUT_{jt}, while not being statistically significant, indicate that being a savings bank, especially if customer-owned, brings less value to the depositor relative to being a commercial bank. Interpreting all these coefficients as factor loadings in depositors' utility function, we can say that: 1) the deposit rate has more value if the bank offering it is commercial; 2) the value of being a savings bank is negative for depositors; 3) depositors perceive a difference between stock and mutual savings bank, and the attribute of being mutual increases its value the higher is the deposit rate offered. Note that this latter point comes from the fact that the coefficient of MUT_{jt} is negative, while its interaction with r^D_{jt} is positive.

The number of employees per branch, the size of the branch network, and the branch density, all enter positively in the utility function. This confirms earlier findings of Dick (2002, 2008), and Adams et al. (2007), which suggest that depositors prefer well-staffed branches, and large branch networks. Our results also indicate that depositors' utility falls if a bank is headquartered in another state. Indeed, if a bank operates out-of-state, it has weaker relationships with local depositors, and this reduces its perceived value to the customers, all other things being equal.

5.2 Random Coefficient Logit Model

We present here our estimates of the full random coefficient logit model. We run our routine with 50 different sets of starting values for Σ, and in 49 cases we obtain convergence. In Table 4, we present the estimates that produced the lowest value of the objective function in (6). The first column reports $\hat{\theta}$, while the second column reports $\hat{\Sigma}$, together with the standard errors. As discussed in Section 3, estimates of θ measure the mean levels of tastes for deposit rate and other observed bank characteristics across consumers. Estimates of $\hat{\Sigma}$ give, instead, the heterogeneity of depositor preferences in these taste parameters.

We first note that the mean level of $\hat{\alpha}$ is larger than that indicated by the multinomial logit estimation. However, as in the multinomial logit case, we see that depositors value, on average, less the deposit rate if the offering bank is savings, but to a lesser degree if the offering savings bank is mutual. Also, we find that the estimates of the elements of Σ corresponding to the deposit rate are large in magnitude and statistically significant. This indicates that there exists a large heterogeneity in depositors' valuation of the deposit rate, and of the deposit rate when the bank is stock or mutual savings. Finally, similarly to the multinomial logit estimates, the attribute of being a savings bank, especially if with mutual ownership, is found to lead, on average, to a lower utility for the depositor.

Relative to the taste for the number of employees per branch and for the size of the branch network, the results are in line with the multinomial logit estimates. Depositors prefer, on average, well-staffed branches, and large branch networks. Also, valuations display minimal heterogeneity across depositors. As for branch density, we find, instead, that the taste is markedly heterogenous across consumers, while the mean valuation is not statistically different from zero. Finally, the attribute of being a bank headquartered in another state negatively affects depositors' utility, but this effect is not statistically significant.

Overall, these results confirm our multinomial logit model findings on the taste of depositors for the interest rate, and the savings bank and mutual ownership attributes. Our interpretation for the finding on the savings bank attribute is the following. Having an account at a bank not only gives the ability to store value and gain interest in a liquid asset, it also enables a depositor to have a relationship with a bank. This, in turn, gives access to a range of services. For example, asking for a mortgage or a personal loan, or investing in the financial market. The choice of where to have a bank account is therefore likely to be related to the scope of additional services offered by each bank. As discussed in Section 2, savings banks still focus on mortgage lending almost exclusively. This means that the range of operations a depositor may find there is quite limited. Therefore, if the average depositor is interested in having a relationship with a bank that offers other services than mortgage lending, he would derive a lower utility from having an account at a savings bank, relative to having it at a commercial bank. Additionally, it is also likely that this depositor is less responsive to changes in the deposit rate if the offering bank is a savings bank. This is the possible reason we observe that the valuation of the savings bank attribute is negative, and depositors' valuation of the deposit rate is lower if the offering bank is savings.

The most interesting finding in Table 4 relates, however, to the mutual ownership attribute. The first element is that depositors' average valuation of "being mutual" is negative. The second element is that depositors value more the deposit rate if the savings bank offering that rate has mutual ownership. The combination of these two elements implies that a mutual savings bank is preferred to a stock savings banks for high levels of the deposit rate, all other things being equal. The model of bank behavior under investor- and customer-ownership that we present in the appendix suggests that, relative to investor-owned institutions, customer-owned banks should offer greater deposit rates. This is because their objective is also to maximize depositor surplus. Therefore, the finding that depositors prefer mutual savings banks to stock savings banks for a high levels of the deposit rate can be interpreted as an indication that depositors value the mutual attribute only if that means that the bank is truly maximizing depositor surplus.

To conclude, our estimates suggest that depositors value stock and mutual savings differently. In particular, mutual savings banks are preferred to stock savings banks for high levels of the deposit rate offered. This implies that it is hard to predict a priori the change in depositors' welfare in case all mutual savings banks demutualized. The following Section provides measures to this respect.

6 Savings Banks' Demutualization and Depositor Welfare

In this Section we estimate the welfare change that depositors would experience under a policy experiment in which all mutual savings banks are assumed to demutualize.[17] To carry out this experiment, we define as situation "0" the status quo scenario, in which mutual savings banks operate. We define as situation "1" the counterfactual scenario, in which all mutuals are assumed to demutualize, and become stock savings banks. Accordingly, $r_{jt}^{D,0}$ and x_{jt}^{0} are bank j's deposit rate and other characteristics in situation "0", while $r_{jt}^{D,1}$ and x_{jt}^{1} are j's deposit rate and other characteristics in situation "1".

We measure the change in depositor welfare between situation "0" and situation "1" by the (expected) compensating variation. This is the money amount that should be taken from a depositor's total income after demutualization to equate his or her utilities in the status quo

[17]In this experiment we ignore all transaction and transitional costs, so our results should be interpreted in this light.

and counterfactual scenarios.

We proceed as follows. As in Section 3, we normalize financial variables by dividing them by deposit size. We further assume that the compensating variation is a constant and uniform ratio of deposit size for all customers. Adapting Bockstael and McConnell (2007, chapter 5), we can then implicitly define the normalized compensating variation $\widetilde{CV}$ of a change from $r_{jt}^{D,0}$ to $r_{jt}^{D,1}$ and from x_{jt}^{0} to x_{jt}^{1} by the following equation:

$$\max_{j \in J} \left[\alpha_i \left(\tilde{y} + r_{jt}^{D,0}\right) + A_{jt}^{0} + x_{jt}^{0}\beta_i + \xi_{jt}^{0} + \varepsilon_{ijt}\right] =$$

$$\max_{j \in J} \left[\alpha_i \left(\tilde{y} + r_{jt}^{D,1} - \widetilde{CV}\right) + A_{jt}^{1} + x_{jt}^{1}\beta_i + \xi_{jt}^{1} + \varepsilon_{ijt}\right]$$

where:

$$A_{jt}^{0} = \alpha_i^{SAV}\left(r_{jt}^{D,0} \times SAV_{jt}^{0}\right) + \alpha_i^{MUT}\left(r_{jt}^{D,0} \times MUT_{jt}^{0}\right)$$

$$A_{jt}^{1} = \alpha_i^{SAV}\left(r_{jt}^{D,1} \times SAV_{jt}^{1}\right) + \alpha_i^{MUT}\left(r_{jt}^{D,1} \times MUT_{jt}^{1}\right)$$

and $\widetilde{CV}$ is the normalized compensating variation. If $\widetilde{CV}$ is positive, depositor i experiences an increase in utility when all mutual savings banks are demutualized.

Since both $\tilde{y}$ and $\widetilde{CV}$ are constant across maximizations, we can simplify the previous equation to:

$$\max_{j \in J} \left[\alpha_i r_{jt}^{D,0} + A_{jt}^{0} + x_{jt}^{0}\beta_i + \xi_{jt}^{0} + \varepsilon_{ijt}\right] =$$

$$-\alpha_i\widetilde{CV} + \max_{j \in J} \left[\alpha_i r_{jt}^{D,1} + A_{jt}^{1} + x_{jt}^{1}\beta_i + \xi_{jt}^{1} + \varepsilon_{ijt}\right]$$

Solving for $\tilde{CV}$, we obtain:

$$\widetilde{CV} = \frac{1}{\alpha_i}\left(\max_{j \in J} \left[\alpha_i r_{jt}^{D,1} + A_{jt}^{1} + x_{jt}^{1}\beta_i + \xi_{jt}^{1} + \varepsilon_{ijt}\right] - \max_{j \in J} \left[\alpha_i r_{jt}^{D,0} + A_{jt}^{0} + x_{jt}^{0}\beta_i + \xi_{jt}^{0} + \varepsilon_{ijt}\right]\right)$$

Then, as in Nevo (2003), we compute its expected value as:

$$\mathbb{E}\left(\widetilde{CV}\right) = \int \frac{1}{\alpha_i}\left[V\left(r_{jt}^{D,1}, x_{jt}^{1}\right) - V\left(r_{jt}^{D,0}, x_{jt}^{0}\right)\right] dF\left(\alpha_i, \beta_i\right)$$

with

$$V\left(r_{jt}^{D,1}, x_{jt}^{1}\right) = ln\left(\sum_{j=1}^{J} exp\left(\alpha_i r_{jt}^{D,1} + \alpha_i^{SAV}\left(r_{jt}^{D,1} \times SAV_{jt}^{1}\right) + \alpha_i^{MUT}\left(r_{jt}^{D,1} \times MUT_{jt}^{1}\right) + x_{jt}^{1}\beta_i + \xi_{jt}^{1}\right)\right)$$

$$V\left(r_{jt}^{D,0}, x_{jt}^{0}\right) = ln\left(\sum_{j=1}^{J} exp\left(\alpha_i r_{jt}^{D,0} + \alpha_i^{SAV}\left(r_{jt}^{D,0} \times SAV_{jt}^{0}\right) + \alpha_i^{MUT}\left(r_{jt}^{D,0} \times MUT_{jt}^{0}\right) + x_{jt}^{0}\beta_i + \xi_{jt}^{0}\right)\right)$$

$$dF\left(\alpha_i, \beta_i\right) = dP_v^{*}\left(v\right)$$

The estimate of $E\left(\widetilde{CV}\right)$ depends crucially on how the deposit rates and bank attributes change from situation "0" to "1". We consider two cases. In the first case, demutualized banks offer the same deposit rate as when they were mutual. In this scenario, mutual savings banks only lose the attribute of "being mutual". In the second case, on top of losing the attribute of "being mutual", newly demutualized stock savings banks offer a different rate than before. We assume they offer the mean rate of other stock savings banks operating in their market.[18]

Since $E\left(\widetilde{CV}\right)$ represents the normalized expected compensating variation, we obtain a non-normalized expected compensated variation multiplying $E\left(\widetilde{CV}\right)$ by the average dollar quantity deposited in each market t. Table 5 presents the percentiles of the annual per-depositor non-normalized expected compensating variation for each market t in 2005 dollars. We first consider the estimates across all markets. If mutual savings banks demutualized and they offered the deposit rate offered by other stock savings banks, every depositor would gain, on average, more than one dollar ($1.14) per market (i.e. state-year). This amount reduces to 36 cents if demutualized banks kept offering the same deposit rate they offered when they were mutual. In both cases, however, the distribution across markets suggests that a demutualization of mutual savings banks would increase depositors' utility. Only in the lowest quartile (see the 10% and 25% columns of Table 5) do we find negative expected compensating variation. This suggests that the complete demutualization of all mutual savings banks would harm depositor welfare in a minority of cases.

[18] When no stock savings bank is operating in the same market (44 cases), we assume demutualized banks offer the mean deposit rate computed across all stock savings banks in the same year.

We then differentiate markets by year and importance of mutual savings banks. To assess the importance of mutual savings banks in each market, we compute the proportion of deposits managed by mutual savings banks. We then distinguish markets depending on which quartile they fall in the year-specific distribution. To have a sense of the relative importance of mutual savings banks, in 2005 mutual savings banks managed 6% of the total mass of deposits in states at the top quartile, while they managed 0% in states at the bottom quartile.

Table 5 reports both sets of comparison. Comparing the estimates of the markets in 1994 with those of the markets in 2005, we find that the benefits of the demutualization would be greater in 2005. Moreover, Table 5 makes clear that the effect of the demutualization would be very sizeable in markets with a relatively high presence of mutuals, while it would be marginal in states with a low presence of these institutions. In markets with relatively high presence, a depositor would gain an average of 2 dollars per market if, following demutualization, mutuals offered the deposit rate of other stock savings.

Following Nevo (2003), we can compute an aggregate welfare effect. This is achieved by multiplying the non-normalized expected compensated variation by the size of the relevant market – i.e. the total number of bank account choices M_t. Table 6 presents the estimates (in 2005 millions of dollars per market). Focusing on the entire sample, we find that the demutualization would increase total welfare by, on average, $6 million per market if former mutuals still offered their pre-demutualization deposit rate, or almost $22 million if they offered the mean rate offered by other stock savings banks. Differentiating by year and by presence of mutuals does not affect the order of magnitude. Still, the effects are more sizeable the higher is the presence of mutual savings banks.

Overall, Tables 5 and 6 suggest that a demutualization of the entire mutual banking sector would increase depositors' welfare (all other things being equal, and ignoring transaction and transitional costs). This is because the attribute of "being mutual" enters negatively in depositors' utility, and mutual savings banks' deposit rates are insufficient to restore utility levels relative to stock savings banks. In Section 5 we found that mutual savings banks are preferred to stock savings banks when they offer high deposit rates. We argued that those results suggest that depositors value the mutual attribute only if that means that the bank is truly maximizing depositor surplus. The results of Table 5 and 6 can then be interpreted as casting doubt on whether mutual savings banks in practice are genuinely maximizing customer surplus.

Another important implication emerges from Tables 5 and 6: depositors' welfare gain would be even larger if demutualized banks offered a deposit rate in line with other stock savings banks. Figure 6 plots the evolution of the deposit rates paid by commercial, stock savings, and mutual savings banks from 1994 to 2005. The rate offered by stock savings banks is very similar to the one offered by mutual savings banks, and is often higher. This means that if newly demutualized savings banks offered a deposit rate in line with other stock savings, and that rate did not fall as a consequence of the demutualization, it would often be larger than the one offered when they were mutual. Therefore, following the demutualization depositors would be offered a higher interest rate, which means that their welfare increases.

7 Conclusions

U.S. mutual savings banks arised in the nineteenth century as a means of promoting saving and home ownership among the working and lower classes. Originally, they were all customer-owned, but in the last decades many converted to investor-ownership. Since customer-ownership is typically associated with consumer surplus maximization, such events of "demutualization" raise the question what is their effect on depositors' welfare. This paper provides an answer using structural econometric techniques.

We first obtain data on commercial and savings banks from 1994 to 2005. We estimate a discrete choice model of bank account choice with random coefficients. Specifically, we allow for the attribute of "being savings" and "being mutual" to change depositors' valuation of a bank, and of the deposit rate offered by that bank. Our estimates indicate that depositors value mutual and stock savings banks differently. In particular, mutuals are preferred for high levels of the deposit rate offered. In principle, because they are customer-owned and maximize consumer surplus, mutual savings banks should offer higher deposit rates. In light of this, we interpret our findings as an indication that depositors prefer mutual savings banks to stock savings banks only if they are truly maximizing consumer surplus.

We then measure the welfare change that depositors would experience under a policy experiment in which all mutual savings banks are assumed to demutualize. We obtain that if demutualized banks offered a deposit rate in line with other stock savings banks, every depositor would gain, on average, more than one dollar ($1.14) every year. Aggregating this figure across all depositors in the same state and year, it makes an average welfare gain of $22 million for each state and year. Overall, these figures suggest that depositors would, on average, benefit from a demutualization of mutual savings banks.

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Figures

Figure 1: Classification of U.S. Bank Types

	Thrifts*			Commercial Banks*
	Savings Banks		Credit Unions	
Customer-owned	Mutual Savings Banks	Mutual Savings & Loans	Credit Unions	-
Investor-owned	Stock Savings Banks	Stock Savings & Loans	-	Commercial Banks

*Can be further distinguished by state or federal charter.

Figure 2: Residential property loans to total assets ratio by bank ownership type

This figure plots the quarterly evolution of the residential property loans to total assets ratio, differentiating by commercial, stock savings, and mutual savings banks. We first compute the ratio between the residential property loans amount and the bank's total assets. We average this ratio across banks of the same type, and compute 95% confidence intervals. The data are from the FDIC, Statistics on Depository Institutions.

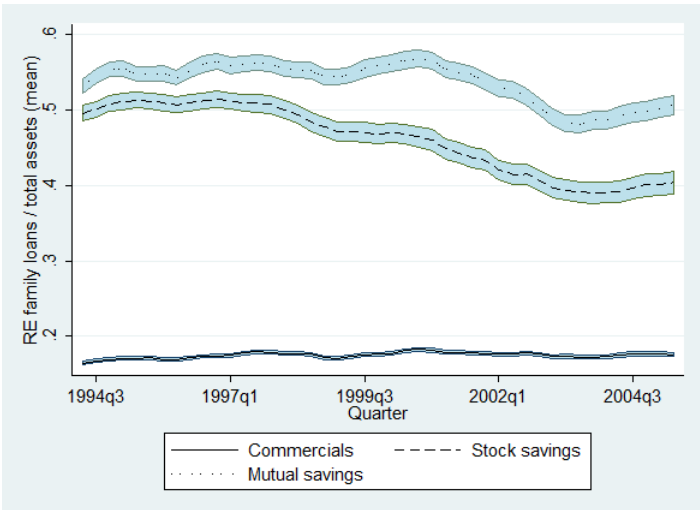


Figure 3: Personal loans to total assets ratio by bank ownership type

This figure plots the quarterly evolution of the personal loans to total assets ratio, differentiating by commercial, stock savings, and mutual savings banks. Personal loans are loans granted to individuals for household, family, and other personal expenditures. They include credit card loans and other secured and unsecured consumer loans. We first compute the ratio between the personal loans amount and the bank's total assets. We average this ratio across banks of the same type, and compute 95% confidence intervals. The data are from the FDIC, Statistics on Depository Institutions.

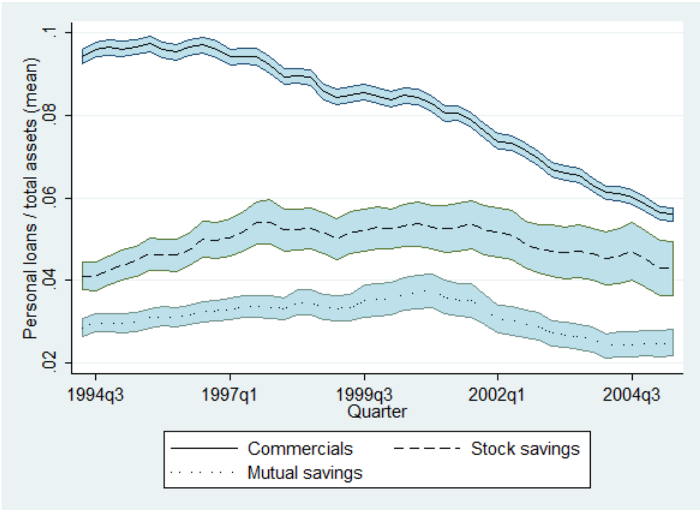


Figure 4: Number of banks in the U.S. by ownership type

This figure plots the quarterly evolution of the number of banks operating in the U.S. differentiating by commercial, stock savings, and mutual savings banks. The data are from the FDIC, Statistics on Depository Institutions.

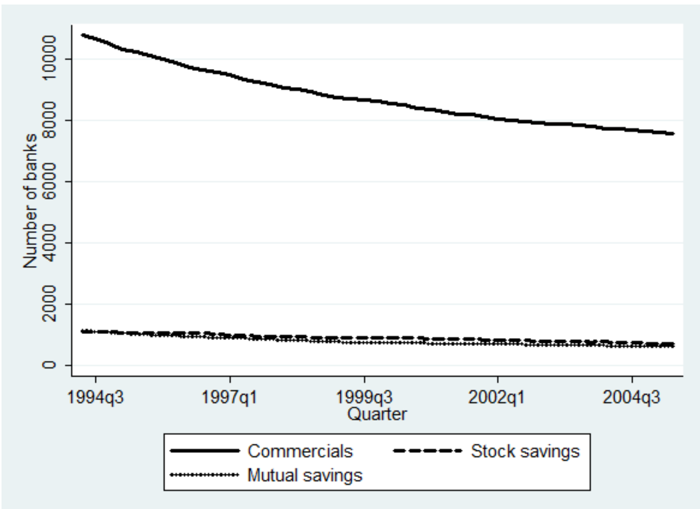


Figure 5: Number of demutualizations and % to total

This figure plots the quarterly evolution of the number of conversions of U.S. savings banks from customer- to investor-ownership. The data are from the FDIC, Statistics on Depository Institutions.

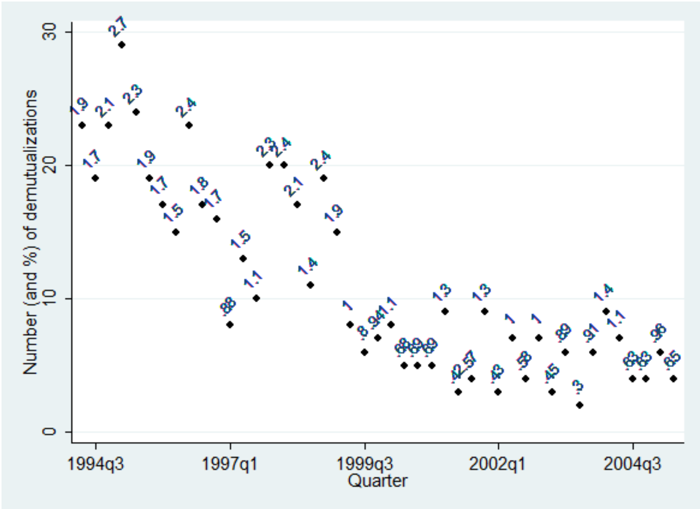
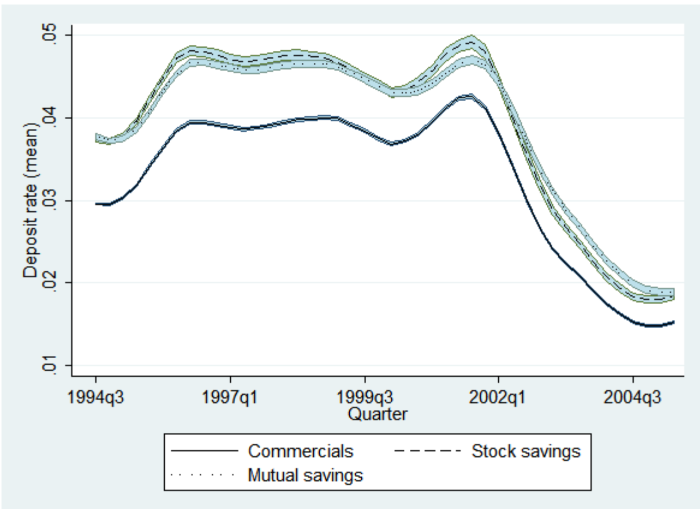


Figure 6: Deposit rate by bank ownership type

This figure plots the quarterly evolution of the deposit rate, differentiating by commercial, stock savings, and mutual savings banks. We first obtain quarterly interest rates dividing the domestic deposit interest payments realized during a quarter by the amount of domestic deposits outstanding at the end of the previous quarter. Then, we obtain the yearly interest rate, promised at a given point in time, compounding the gross quarterly interest rates realized in the subsequent four quarters and subtracting one. We average this rate across banks of the same type, and compute 95% confidence intervals. The data are from the FDIC, Statistics on Depository Institutions.



Tables

Table 1: Summary of Bank Market Shares, Deposit Rates and Other Characteristics by Ownership Type and Year

Type	Bank Characteristic	All years				1994				2005			
		N° Obs.	Mean	Median	S. D.	N° Obs.	Mean	Median	S. D.	N° Obs.	Mean	Median	S. D.
Commercial banks	s_{jt}	42,123	0.004	0.001	0.014	4,570	0.003	0.001	0.011	2,851	0.006	0.001	0.018
	r^D_{jt}	42,123	0.032	0.034	0.012	4,570	0.034	0.034	0.008	2,851	0.023	0.023	0.005
	$Empl\,per\,branch_{jt}$	42,123	2.780	2.741	0.463	4,570	2.870	2.833	0.501	2,851	2.723	2.694	0.428
	$Number\,of\,branches_{jt}$	42,123	1.782	1.386	1.493	4,570	1.321	1.099	1.103	2,851	2.350	1.792	1.836
	$Branch\,density_{jt}$	42,123	-9.406	-9.545	1.481	4,570	-9.747	-9.868	1.473	2,851	-9.002	-9.293	1.470
	$Out\,of\,State\,bank_{jt}$	42,123	0.054	0.000	0.226	4,570	0.001	0.000	0.033	2,851	0.121	0.000	0.326
Stock savings banks	s_{jt}	5,146	0.006	0.002	0.014	556	0.005	0.002	0.009	308	0.008	0.002	0.017
	r^D_{jt}	5,146	0.038	0.041	0.013	556	0.042	0.042	0.006	308	0.025	0.025	0.005
	$Empl\,per\,branch_{jt}$	5,146	2.801	2.773	0.504	556	2.801	2.797	0.453	308	2.865	2.798	0.480
	$Number\,of\,branches_{jt}$	5,146	2.613	2.398	1.471	556	2.482	2.303	1.322	308	2.991	2.639	1.725
	$Branch\,density_{jt}$	5,146	-8.344	-8.494	1.609	556	-8.426	-8.541	1.498	308	-8.063	-8.128	1.787
	$Out\,of\,State\,bank_{jt}$	5,146	0.141	0.000	0.348	556	0.110	0.000	0.313	308	0.195	0.000	0.397
Mutual savings banks	s_{jt}	3,063	0.003	0.001	0.005	410	0.002	0.001	0.004	165	0.003	0.001	0.006
	r^D_{jt}	3,063	0.038	0.041	0.011	410	0.041	0.041	0.005	165	0.025	0.025	0.005
	$Empl\,per\,branch_{jt}$	3,063	2.755	2.752	0.405	410	2.727	2.722	0.440	165	2.776	2.797	0.369
	$Number\,of\,branches_{jt}$	3,063	1.653	1.609	0.834	410	1.522	1.609	0.823	165	1.880	1.792	0.924
	$Branch\,density_{jt}$	3,063	-8.630	-8.764	1.398	410	-8.832	-8.957	1.397	165	-8.490	-8.674	1.379
	$Out\,of\,State\,bank_{jt}$	3,063	0.017	0.000	0.129	410	0.007	0.000	0.085	165	0.036	0.000	0.188

Source: Statistics on Depository Institutions, FDIC.

Table 2: Cronology of the states' bank branching provisions 1994 – 2005

This Table presents the cronology of the bank branching provisions implemented by each state over the period 1994 – 2005, following the passing of the Riegle-Neal Act in 1994. The value is "1" if the provision has been implemented. Source: Johnson and Rice (2008).

State	Openness Index (w/o Recipr.)	Effective Date	NO Min. Age for Target Inst.	De Novo Branch Allowed	Single Br. Acquisition Allowed	Statewide Dep. Cap ≥ 30%	NO Recipr. Clause
Alabama	2 (1)	5/31/1997	0	0	0	1	1
Alaska	3 (2)	1/1/1994	0	0	1	1	1
Arizona	2 (2)	8/31/2001	0	0	1	1	0
	1 (1)	9/1/1996	0	0	0	1	0
Arkansas	1 (0)	6/1/1997	0	0	0	0	1
California	2 (1)	9/28/1995	0	0	0	1	1
Colorado	1 (0)	6/1/1997	0	0	0	0	1
Connecticut	3 (3)	6/27/1995	0	1	1	1	0
Delaware	2 (1)	9/29/1995	0	0	0	1	1
DC	5 (4)	6/13/1996	1	1	1	1	1
Florida	2 (1)	6/1/1997	0	0	0	1	1
Georgia	2 (1)	5/10/2002	0	0	0	1	1
	2 (1)	6/1/1997	0	0	0	1	1
Hawaii	5 (4)	1/1/2001	1	1	1	1	1
	2 (1)	6/1/1997	0	0	0	1	1
Idaho	1 (1)	9/29/1995	0	0	0	1	0
Illinois	4 (4)	8/20/2004	1	1	1	1	0
	2 (1)	6/1/1997	0	0	0	1	1
Indiana	3 (3)	7/1/1998	0	1	1	1	0
	4 (4)	6/1/1997	1	1	1	1	0
Iowa	1 (0)	4/4/1996	0	0	0	0	1
Kansas	1 (0)	9/29/1995	0	0	0	0	1
Kentucky	1 (1)	3/22/2004	1	0	0	0	0
	2 (1)	3/17/2000	1	0	0	0	1
	1 (0)	6/1/1997	0	0	0	0	1
Louisiana	2 (1)	6/1/1997	0	0	0	1	1
Maine	4 (4)	1/1/1997	1	1	1	1	0
Maryland	5 (4)	9/29/1995	1	1	1	1	1
Massachusetts	3 (3)	8/2/1996	0	1	1	1	0
Michigan	4 (4)	11/29/1995	1	1	1	1	0
Minnesota	2 (1)	6/1/1997	0	0	0	1	1
Mississippi	1 (0)	6/1/1997	0	0	0	0	1
Missouri	1 (0)	9/29/1995	0	0	0	0	1
Montana	1 (0)	10/1/2001	0	0	0	0	1
	0 (0)	9/29/1995			Opt out		
Nebraska	1 (0)	5/31/1997	0	0	0	0	1
Nevada	2 (1)	9/29/1995	0	0	0	1	1
New Hampshire	4 (4)	1/1/2002	1	1	1	1	0
	3 (3)	8/1/2000	0	1	1	1	0
	1 (0)	6/1/1997	0	0	0	0	1

(continued)

State	Openness Index (w/o Recipr.)	Effective Date	NO Min. Age for Target Inst.	De Novo Branch Allowed	Single Br. Acquisition Allowed	Statewide Dep. Cap $\geq 30\%$	NO Recipr. Clause
New Jersey	4 (3)	4/17/1996	1	0	1	1	1
New Mexico	2 (1)	6/1/1996	0	0	0	1	1
New York	3 (2)	6/1/1997	0	0	1	1	1
North Carolina	4 (4)	7/1/1995	1	1	1	1	0
North Dakota	3 (3)	8/1/2003	1	1	1	0	0
	1 (1)	5/31/1997	1	0	0	0	0
Ohio	5 (4)	5/21/1997	1	1	1	1	1
Oklahoma	3 (3)	5/17/2000	1	1	1	0	0
	1 (0)	5/31/1997	0	0	0	0	1
Oregon	2 (1)	7/1/1997	0	0	0	1	1
	3 (2)	2/27/1995	0	0	1	1	1
Pennsylvania	4 (4)	7/6/1995	1	1	1	1	0
Rhode Island	4 (4)	6/20/1995	1	1	1	1	0
South Carolina	2 (1)	7/1/1996	0	0	0	1	1
South Dakota	2 (1)	3/9/1996	0	0	0	1	1
Tennessee	3 (3)	3/17/2003	0	1	1	1	0
	3 (3)	7/1/2001	0	1	1	1	0
	2 (2)	5/1/1998	0	0	1	1	0
	1 (1)	6/1/1997	0	0	0	1	0
Texas	3 (3)	9/1/1999	1	1	1	0	0
	0 (0)	8/28/1995			Opt out		
Utah	3 (3)	4/30/2001	0	1	1	1	0
	3 (2)	6/1/1995	0	0	1	1	1
Vermont	4 (4)	1/1/2001	1	1	1	1	0
	3 (2)	5/30/1996	0	0	1	1	1
Virginia	4 (4)	9/29/1995	1	1	1	1	0
Washington	3 (3)	5/9/2005	0	1	1	1	0
	2 (1)	6/6/1996	0	0	0	1	1
West Virginia	3 (3)	5/31/1997	1	1	1	0	0
Wisconsin	2 (1)	5/1/1996	0	0	0	1	1
Wyoming	2 (1)	5/31/1997	0	0	0	1	1

Table 3: "Preliminary regression" and Multinomial Logit Results

This Table presents the results of the "preliminary" regression, and of the multinomial logit model, estimated with OLS and IV. In the preliminary regression, the deposit rate r^D_{jt} is a function of the explanatory variables x_{jt} and the openness index $Index_{jt}$. The fitted values of this regression are called $\hat{r}^D_{jt}$. The instruments used in the IV estimation of the multinomial logit model are $Index_{jt}$, $\hat{r}^D_{jt} \times SAV_{jt}$, $\hat{r}^D_{jt} \times MUT_{jt}$. Standard errors are clustered by state, and are in parenthesis. Significance levels: * <0.1, ** <0.05, *** <0.01. The data are from the FDIC (SDI and SOD).

Dependent variable:	r^D_{jt}	$\ln(s_{jt}) - \ln(s_{0t})$	
		OLS	IV
$Index_{jt}$	0.0001**		
	(0.0000)		
r^D_{jt}		-0.07	137.59**
		(0.24)	(54.49)
$r^D_{jt} \times SAV_{jt}$		0.84**	-14.59***
		(0.41)	(5.53)
$r^D_{jt} \times MUT_{jt}$		1.51**	5.83**
		(0.69)	(2.67)
SAV_{jt}	0.0071***	0.11***	-0.28
	(0.0001)	(0.02)	(0.19)
MUT_{jt}	0.0002	0.01	-0.16
	(0.0002)	(0.03)	(0.11)
$Empl\,per\,branch_{jt}$	-0.0011***	0.76***	0.90***
	(0.0001)	(0.00)	(0.06)
$Number\,of\,branches_{jt}$	-0.0009***	0.10***	0.23***
	(0.0001)	(0.00)	(0.05)
$Branch\,density_{jt}$	0.0001	0.77***	0.76***
	(0.0001)	(0.00)	(0.02)
$Out\,of\,state\,bank_{jt}$	0.0013***	-0.03**	-0.22***
	(0.0002)	(0.01)	(0.08)
Year FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Observations	50,332	50,332	50,332

Table 4: Results for Full Random Coefficients Logit Model

This Table presents the results of the full random coefficient logit model. The instruments used for r^D_{jt}, $r^D_{jt} \times SAV_{jt}$, $r^D_{jt} \times MUT_{jt}$ are $Index_{jt}$, $\hat{r}^D_{jt} \times SAV_{jt}$, $\hat{r}^D_{jt} \times MUT_{jt}$, with $\hat{r}^D_{jt}$ being the fitted value from the preliminary regression in Table 4. Standard errors are in parenthesis. Significance levels: * <0.1, ** <0.05, *** <0.01. The data are from the FDIC (SDI and SOD).

	Mean tastes ($\hat{\theta}$)	Random component ($\hat{\Sigma}$)
r^D_{jt}	203.65***	2.31***
	(0.07)	(0.01)
$r^D_{jt} \times SAV_{jt}$	-21.37***	0.29***
	(0.14)	(0.03)
$r^D_{jt} \times MUT_{jt}$	8.31***	5.54***
	(0.15)	(0.03)
SAV_{jt}	-0.43***	0.03
	(0.13)	(0.37)
MUT_{jt}	-0.35***	0.03
	(0.09)	(0.06)
$Empl\,per\,branch_{jt}$	0.78***	0.35
	(0.20)	(0.58)
$Number\,of\,branches_{jt}$	0.89***	0.05
	(0.04)	(0.12)
$Branch\,density_{jt}$	-0.08	0.48***
	(0.07)	(0.08)
$Out\,of\,state\,bank_{jt}$	-0.08	0.35
	(0.14)	(0.56)
Year FE	Yes	Yes
State FE	Yes	Yes
Observations	50,332	50,332

Notes: Objective function value: 3.71×10^{-14}.
Number of sets of starting values: 50. Convergence achieved in 49 cases.
Convergence tolerance: 10^{-16}.

Table 5: Annual per-depositor welfare change percentiles

This Table presents the annual per-depositor welfare change by percentiles. We compute the expected compensating variations for every market t, and multiply by the average deposit quantity in 2005 dollars in each market t. We then compute the 10th, 25th, 75th, and 90th percentiles, as well as median and mean, across markets. We also present these statistics focusing on particular years (1994 and 2005), and differentiating by presence of mutual savings banks. "States with low presence of mutuals" are those belonging to the first quartile for total deposits managed by mutual savings banks. "States with high presence of mutuals" are those belonging to the fourth quartile.

		N° Obs.	10%	25%	Median	Mean	75%	90%
All sample	r_{jt}^D do not change	564	0.00	0.00	0.08	0.36	0.44	1.09
	r_{jt}^D change	564	-0.56	-0.11	0.00	1.14	0.94	3.82
Year: 1994	r_{jt}^D do not change	47	-0.10	0.00	0.09	0.25	0.31	1.17
	r_{jt}^D change	47	-0.78	-0.10	0.14	0.93	1.09	4.39
Year: 2005	r_{jt}^D do not change	47	0.00	0.00	0.14	0.52	0.67	1.18
	r_{jt}^D change	47	-0.24	0.00	0.00	1.66	1.74	6.14
States with low	r_{jt}^D do not change	149	0.00	0.00	0.00	0.01	0.00	0.02
presence of mutuals	r_{jt}^D change	149	-0.01	0.00	0.00	0.17	0.00	0.00
States with high	r_{jt}^D do not change	132	-0.30	0.14	0.70	0.96	1.36	2.73
presence of mutuals	r_{jt}^D change	132	-2.06	-0.38	0.62	2.09	3.24	6.33

Table 6: Annual total welfare change percentiles

This Table presents the annual total welfare changes by percentiles. We compute the expected compensating variations for every market t and multiply it by the average deposit quantity in 2005 dollars and the total number of bank account choices in each market t. We then compute the 10th, 25th, 75th, and 90th percentiles, as well as median and mean, across markets. We also present these statistics focusing on particular years (1994 and 2005), and differentiating by presence of mutual savings banks. "States with low presence of mutuals" are those belonging to the first quartile for total deposits managed by mutual savings banks. "States with high presence of mutuals" are those belonging to the fourth quartile. Statistics are in millions of dollars.

		N° Obs.	10%	25%	Median	Mean	75%	90%
All sample	r_{jt}^D do not change	564	0.00	0.00	1.02	6.09	5.99	19.00
	r_{jt}^D change	564	-8.08	-1.17	0.00	22.02	11.11	64.58
Year: 1994	r_{jt}^D do not change	47	-0.78	0.00	1.11	5.57	4.65	16.87
	r_{jt}^D change	47	-6.92	-1.17	0.59	28.80	18.93	118.27
Year: 2005	r_{jt}^D do not change	47	0.00	0.00	1.68	8.41	10.82	28.39
	r_{jt}^D change	47	-3.53	0.00	0.00	23.32	23.66	108.19
States with low presence of mutuals	r_{jt}^D do not change	149	0.00	0.00	0.00	0.55	0.00	0.54
	r_{jt}^D change	149	-0.17	0.00	0.00	8.80	0.00	0.00
States with high presence of mutuals	r_{jt}^D do not change	132	-2.48	0.40	4.83	12.28	17.62	33.94
	r_{jt}^D change	132	-12.24	-2.25	5.95	25.73	40.86	82.93

Model of Banking under Investor and Customer Ownership

Setup

We consider an economy in which there are J perfectly differentiated banks competing, $j = 1, ..., J$. They are pure intermediaries with no equity, simply lending all deposits that they receive.

The total supply of deposits $q^D\left(r^D\right)$ is a function of the J-vector of each bank's deposit rate r_j^D, and includes the supply of deposits $q_j^D\left(r^D\right)$ to bank j. Thus each bank's deposit supply depends on the vector of deposit rates offered by all banks in the market. Likewise, total loan demand $q^L\left(r^L\right)$ is a function of the J-vector of each bank's loan rates r_j^L, and bank j faces loan demand $q_j^L\left(r^L\right)$.

We assume that each bank's deposit supply is increasing in its own deposit rate, i.e. that $\frac{\partial q_j^D\left(r^D\right)}{\partial r_j^D} > 0$. Equivalently, each bank's *inverse* deposit supply is increasing in its deposit quantity, i.e. $\frac{\partial r_j^D\left(q^D\right)}{\partial q_j^D} > 0$. We also posit that each bank's loan demand is decreasing in its own loan rate, i.e. $\frac{\partial q_j^L\left(r^L\right)}{\partial r_j^L} < 0$, so its *inverse* loan demand is decreasing in its loan quantity, i.e. $\frac{\partial r_j^L\left(q^L\right)}{\partial q_j^L} < 0$.

Each bank j' only choice variable is its deposit rate r_j^D. Notice that by choosing its deposit rate – given the deposit rate choices of its rivals – bank j's deposit quantity $q_j^D\left(r^D\right)$ is determined by the market supply function for deposits. Furthermore, given that all deposits are assumed to be used to make loans, bank j's supply of loans is also determined, being:

$$q_j^L\left(r^D\right) = q_j^D\left(r^D\right)$$

Also, with bank j's loan supply having been determined, its loan rate is in turn also determined by the market inverse demand function for loans, i.e.:

$$r_j^L\left(r^D\right) \equiv r_j^L\left(q_j^L\left(r^D\right)\right) = r_j^L\left(q_j^D\left(r^D\right)\right)$$

Banks engage in Bertrand-Nash competition. This means that they each choose their deposit rate taking the deposit rates of their rivals as given. Precisely, we assume that bank j chooses its deposit rate on the assumption that $\frac{\partial r_i^D}{\partial r_j^D} = 0$ for all $i \neq j$. We also assume the existence of a unique Bertrand-Nash equilibrium in pure strategies with positive deposit rates.

Objective Functions

Banks can be either investor-owned (IO) or customer-owned (CO). Investor-owned banks maximize only their profits, while customer-owned maximize their profits jointly with customer surplus.[19] In the case of customer-owned banks we assume that only the owners are customers of the relevant bank. This assumption can be relaxed by re-weighting the customer owners' objective function, but we do not do so here to highlight key differences between each bank type.

Investor-Owned Banks

Investor-owned banks maximize profits, which comprise loan revenue net of deposit costs and fixed costs:

$$\pi_j = r_j^L\left(q^L\right)q_j^L - r_j^D q_j^D(r^D) - F_j$$

Fixed costs F_j include all non-deposit related costs such as costs of labor, buildings, information technology, etc.. For simplicity we assume these fixed costs are nil. Given that each bank's choice of deposit rate determines its loan quantity and loan rate, we can write bank j's profit as:

$$\pi_j\left(r_j^D\right) = r_j^L\left(q_j^D\left(r^D\right)\right)q_j^D\left(r^D\right) - r_j^D q_j^D\left(r^D\right) \tag{8}$$

Customer-Owned Banks

Customer-owned banks value profits, but also the net customer surplus from deposit supply ($S_j^D\left(r_j^D\right)$), and the net customer surplus from loan demand ($S_j^L\left(r_j^D\right)$).[20] Those net surpluses

[19]We abstract from incentive issues within banks under each ownership type. For a non-banking model comparing customer and investor ownership in a situation of managerial moral hazard with multitasking, see Meade (2014).

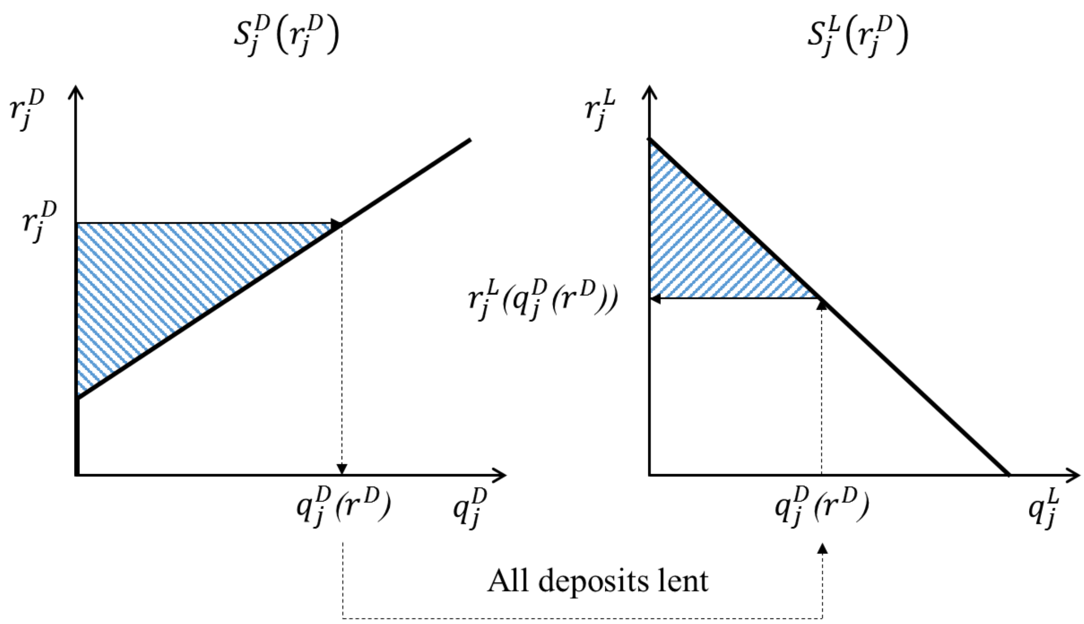
[20]Hence we treat customer-owned banks as a form of "Dual-Bottom Line Institution", as described in Ayadi et al. (2010).

are respectively:

$$S_j^D\left(r_j^D\right) = \int_0^{r_j^D} q_j^D\left(x\right)dx$$
$$S_j^L\left(r_j^D\right) = \int_0^{q_j^D\left(r^D\right)} r_j^L\left(x\right)dx - r^L\left(q_j^D\left(r^D\right)\right)q_j^D\left(r^D\right) \tag{9}$$

These surpluses are the shaded areas in Figure 7, in which we take linear deposit supply and loan demand functions simply for illustrative purposes. Note that customer owners are assumed to care about profits as well as surpluses, even in situations where they are precluded by their bank's charter from participating in distributions of earnings or retained earnings. This is because they must at least respect the bank's break-even constraint (i.e. cannot simply maximize surpluses if doing so results in losses).

Figure 7: Bank j's depositor and borrower surpluses



Solution

We solve our model with Bertrand-Nash equilibrium the relevant equilibrium concept. Thus each bank chooses its optimal deposit rate given the deposit rate choices of its rivals.

By direct differentiation of (8), bank j's first-order condition with respect r_j^D under investor ownership is:

$$\frac{\partial q_j^D}{\partial r_j^D}\left(\frac{\partial r_j^L}{\partial q_j^L}q_j^D + \left[r_j^L - r_j^D\right]\right) - q_j^D = 0 \qquad (10)$$

Turning to customer ownership, by direct differentiation of (9), we find that the sum of bank j's net depositor and borrower surpluses is increasing in r_j^D:

$$\frac{\partial}{\partial r_j^D}\left(S_j^D\left(r_j^D\right) + S_j^L\left(r_j^D\right)\right) = -\frac{\partial r_j^L}{\partial q_j^L}q_j^D\frac{\partial q_j^D}{\partial r_j^D} + q_j^D > 0 \qquad (11)$$

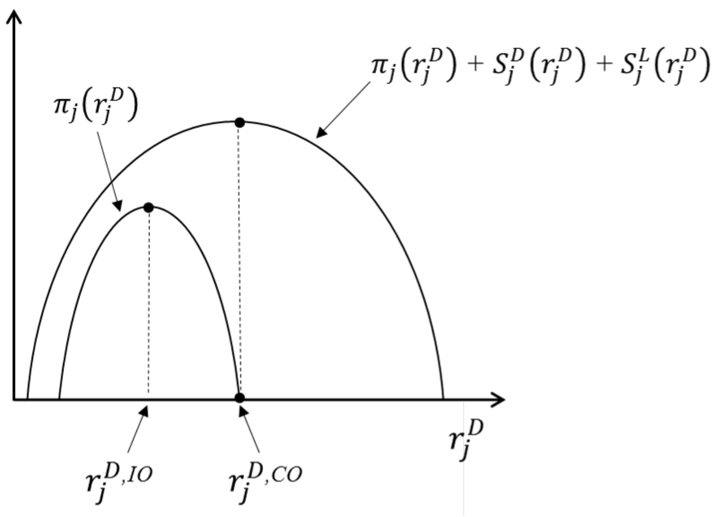
This is because $\frac{\partial r_j^L\left(q^L\right)}{\partial q_j^L} > 0$ and $\frac{\partial q_j^D\left(r^D\right)}{\partial r_j^D} > 0$ by assumption, and the remaining terms in the expression are positive by construction. The fact that total net surpluses are increasing in r_j^D can be understood by reference to Figure 7. Given an upward-sloping deposit supply function, an increase in r_j^D will cause q_j^D to also increase, thus expanding the shaded area representing depositor surplus. In turn, an increase in q_j^D leads to a corresponding increase in loan quantity q_j^L. Since loan demand is downward sloping, this causes a fall in r_j^L, thus expanding the shaded area representing borrower surplus. Hence an increase in r_j^D simultaneously increases both net surpluses. Then, to obtain bank j's first order condition with respect r_j^D under customer ownership, we add (11) to the left-hand side of (10). This yields:

$$\frac{\partial q_j^D}{\partial r_j^D}\left(r_j^L - r_j^D\right) = 0 \qquad (12)$$

Under customer ownership, since $\frac{\partial q_j^D}{\partial r_j^D} > 0$, bank j optimally chooses r_j^D so that it breaks even, with its marginal revenue r_j^L equaling its marginal cost r_j^D. Significantly, this is true even with the bank competeting oligopolistically.

We now characterize the optimal deposit rates under investor- and customer- ownership. Assuming that each bank's profit function is concave with an interior maximum, and that the customer owner's objective function is likewise, the situation is as depicted in Figure 8. If bank j is investor-owned, its profit-maximizing deposit rate choice is $r_j^{D,IO}$ as shown. By contrast, from (11) we know that the combined net depositor and borrower surpluses of bank j's customers are increasing in r_j^D, so customer-owned bank j optimally chooses $r_j^{D,CO} > r_j^{D,IO}$. This is because customer owners optimally trade off profits against depositor and borrower surpluses, with the result that they choose a deposit rate that is not profit maximizing. Indeed, it results in the customer-owned bank simply breaking even.

Figure 8: Optimal Deposit Rate Choices under Investor and Customer Ownership



To conclude, our stylized model of bank behavior under investor- and customer-ownership makes three predictions. Relative to investor-owned banks, customer-owned banks offer a higher deposit rate, charge a lower loan rate, and serve more customers. Indeed, by setting a higher deposit rate, they receive more deposits and issue more loans.