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Financial Liberalization, Bank Market Structure, and Financial Deepening: An Interest Margin Analysis

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Financial Liberalization, Bank Market Structure, and Financial Deepening: An Interest Margin Analysis

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Abstract

The paper shows that commercial banks' ability to lower deposit interest rates (market power) can increase deposit mobilization. Interest expenses saved can subsidize and lower fees on checking and branching services and thus help attract deposits. United States data illustrates the financial deepening effect of this market power. Commercial banks' ability to lower deposit interest rates diminishes when their deposits become closer substitutes to nonbank liabilities requiring greater interest rate competition. Lack of bank deposit market power, including through capital account mobility, may lessen financial deepening.

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I. INTRODUCTION

In light of developing countries' foreign debt problems and diminishing inflows of external financial resources, effective domestic resource mobilization has become increasingly important in economic development. Commercial banks represent the bulk of financial markets in most developing countries and have therefore been the focus of the finance and development literature. This literature emphasizes the virtues of financial deepening (high ratio of banking system deposits to gross domestic product) to increase domestic resource mobilization.

Many in this literature, McKinnon (1993), Shaw (1973), advocate the desirability of financial liberalization measures to free banks from financial repression (e.g., low deposit interest rate ceilings), raise deposit interest rates, and increase financial deepening.[1] Such deregulation is expected to encourage welfare-augmenting switches from the payment of implicit interest (e.g., subsidizing banking transaction services on deposit accounts and offering an extended system of branches) to the payment of explicit interest on deposit accounts. It may also encourage greater competition among financial institutions with benefits to consumers in terms of reduced interest margins. The resulting higher deposit interest rate is expected to increase household financial savings in the banking system by reducing cash holdings, inflation hedges (real goods holdings), and unproductive self-financed investments. As a result, the volume and quality of investment increases, enhancing output growth.

Others, Matutes and Vives (2000), Stiglitz (1994), Stiglitz and Weiss (1981), have argued that deposit interest ceilings may not be undesirable because they can help prevent banks from engaging in destructive competition. They claim that excessive competition among banks under an unregulated environment will increase deposit and loan interest rates, increase the cost of capital, and reduce investment. The higher loan interest rates will induce adverse selection problems on banks as the average quality of the pool of borrowers diminishes. The higher deposit interest rate may also reduce interest margins leaving less funds available for banks to support the operating costs of monitoring and screening borrowers. Deposit interest rate ceilings, said to avoid these negative effects on investment and its quality, are viewed by these authors as potentially desirable. With a ceiling, Chiappori and et al (1995) show that profit maximizing banks increase network size and lending rates are lower in the long run.

Much has been written on the desirability or not of financial liberalization to increase bank interest rate competition and raise financial deepening; This subject has also been the focus of much empirical work, see Fry (1995) for a survey. However, the often omitted truth in this literature is that banks compete in many different ways other than through interest rates. Also, many factors specific to banks' market structure affect their pricing behavior and thus

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[1]The term financial repression refers to interest rate controls although it is sometimes used in the literature to include other forms of government restrictions on the financial sector (Fry, 1995, p.6). The paper is primarily concerned with the liberalization of interest rates.

determinants of financial deepening. When bank market structure factors are taken into consideration, (i) financial liberalization does not necessarily lead to an increase in deposit interest rates, and (ii) in a liberalized financial sector, financial deepening and better quality investments do not necessarily result from a high deposit interest rate. A look at the dual input-output nature of bank deposits illustrates the point.

Deposits can be inputs for the production of bank loans (an intermediation service) or safekeeping services output provided to depositors (a nonintermediation service). In the former case, banks pay interest on deposits net of intermediation costs, and in the latter, depositors pay for safekeeping services. The same deposits may also be inputs to the provision of payment services (checking services) in which case depositors pay for the service. The net difference between interest payments and service fees may be positive or negative[2] for depositors depending on banks' market power, depositors' characteristics and preferences, and other market structure factors. Consequently, the combination of interest payments and service fees that maximizes financial deepening is not trivially determined. This combination, in turn, determines a bank's interest margin, the key variable in a liberalized financial sector. Even under financial repression, banks make management decisions regarding their interest margins taking regulatory and market structure constraints into consideration.

Despite the importance of market structure factors in bank interest margin management, the optimal determination of banks' interest margins given these factors is paid little attention in the financial deepening and development literature. In light of the above, the goal of this paper is twofold. First, develop a conceptual and empirical framework for analyzing optimal bank interest margins in a liberalized banking sector. In the framework, the interdependence between banks' intermediation and nonintermediation services is explicitly taken into account. The framework shows that the input-output nature of banking deposits may be such that profit maximization will lead banks to use their market power on deposits to subsidize nonintermediation service fees as a deposit raising strategy. This will foster financial deepening through a means other than explicit deposit interest payments. The framework is also developed to allow the empirical decomposition overtime of bank interest margins into four market structure components:

- Resource costs of bank operations;
- Oligopoly component (loan output market power which raises loan interest rates);
- Oligopsony component (deposit input market power which reduces deposit interest rates); and
- Risk component (a reserve for the uncertainty of banking activities).

This decomposition will allow in the second goal of the paper to empirically test the hypothesis that, in a liberalized banking sector, oligopsony power can result in a net increase

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[2]Most likely positive for time deposits.

in overall deposit levels. It does so by allowing implicit interest payments in the form of convenience branch banking and subsidized service fees. This possibility, which may depend on the stage of development of a country, is tested on United States (U.S.) banking data and lessons are drawn for developing countries.[3]

The model of the paper indicates that, in a liberalized banking sector, the higher are interest expenses relative to service fee revenues, the more profit maximizing banks will be willing to subsidize service fees as an alternative deposit raising strategy (an opportunity cost argument). This strategy will be pursued the higher the volume of deposits that can be raised for profitable lending by providing services (e.g., branching and checking services). Banks subsidize fees by reducing deposit interest rates provided they have market power on the deposit side. The U.S. banking industry data supports this hypothesis. Empirical results suggest that even without the deposit interest rate ceiling regulation prior to 1981, deposit market power has been present in the banking industry. The market power has also been conducive to a greater overall deposit level in the industry because it allowed implicit interest to be paid in the form of low service fees. Empirical results also suggest that the deposit interest rate ceiling regulation reinforced the positive effect of the deposit market power by rendering the market power binding.

The paper is organized as follows. Section II presents the banking model used to derive an optimal interest margin and its components, and discusses the main propositions of the paper. The section also provides a qualitative description of the U.S. banking data supporting the paper's banking model propositions. Section III outlines the empirical model used to construct time series of the optimal interest margin components. Section IV presents the empirical results of the interest margin equation and the results of the effects of the margin components on the level of deposits.

II. Bank Optimal Interest Margin

This section develops a conceptual and empirical framework for analyzing optimal bank interest margins in which the interdependence between banks' intermediation and nonintermediation services is explicitly taken into account.

The model

We assume that the banking industry is made of m banks, (i=1,..m), each bank i operating in each region j, (j=1,..n), defined as an area within a state. Each bank i will have aggregate deposits D_i consisting of the sum of deposits from the j separate regions in which it operates. Hence, total deposits in a region, D_j, will consist of all banks' deposits in that region, and total deposits in the industry will consist of the sum of deposits from all regions, so that:

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[3]The advantages of using U.S. data are explained in Appendix IV.

$$\sum_i \sum_j D_{ij} = D$$

Banks compete in homogeneous quantities and will offer deposits D (simultaneously hold assets) and nondeposit services Z (a composite good consisting of convenience bank branches, checking and deposit safekeeping services, and other nonintermediation related banking services). The banks are assumed to face downward sloping demand curves for loans and services and an upward sloping supply curve for deposits. This puts them in an imperfectly competitive environment.[4] The supply of deposits D and services Z are complementary goods in that an individual customer cannot use banking services without supplying deposits. The relationship is however not one of fixed proportionality.

Thus, an oligopolistic banking firm i faces a deposit supply function $D_j(r_{dj}, b_j)$ in region j which depends on interest rates r_{dj} —a function of its interest rate (r_{dij}) and that of its competitors ($r_{dij\text{-}i}$); and service fees b_j —a function of its service fee (b_{ij}) and that of its competitors ($b_{ij\text{-}i}$). Since banks compete in quantities, we will work with inverse functions.[5] Thus, bank i takes into account the influence on the regional deposit interest rate r_{dj} of its deposit quantity choices and those of its competitors, $D_j = D_{ij} + D_{ij\text{-}i}$, as well as its service fee choices and those of its competitors, $b_j(b_{ij}, b_{ij\text{-}i})$. For the latter however, an inverse demand function for nonintermediation services, $Z_j(b_j, r_{dj})$, is specified. This implies that the bank will take into consideration the influence on the regional service fee b_j of its nonintermediation services quantity choices and those of its competitors, $Z_j = Z_{ij} + Z_{ij\text{-}i}$, rather than prices. Given the above, each bank i faces the following regional deposit supply and services demand functions:

$$(1)\ b_j = S(Z_j, r_{dj})\ ;\ (2)\ r_{dj} = P(D_j, b_j)\ ; \qquad \sum_i Z_{ij} = Z_j \quad \sum_i D_{ij} = D_j$$

$$\frac{\partial b_j}{\partial Z_j} < 0 \quad \frac{\partial r_{dj}}{\partial D_j} > 0\ ; \quad \frac{\partial b_j}{\partial r_{dj}} > 0 \quad \frac{\partial r_{dj}}{\partial b_j} > 0$$

The first two sets of partial derivatives indicate a downward sloping demand curve for services and an upward sloping supply curve of deposits respectively. The next two sets of partial derivatives indicate the positive relationship between the service fee and the deposit rate. That is, an increase (decrease) in the deposit interest rate results in an increase (decrease) in the service charge. The reason is that, since the demand for banking services (safekeeping and payment purposes) brings complementary deposits, a rise in the service charge requires an

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[4]The model's results will not depend on the source of the market power.

[5]See Freixas and Rochet (1998), chapter 3, pp. 57-61 for a review of imperfect competition quantity models in banking.

increase in the deposit interest rate for a given volume of deposits from customers.[6] Therefore, to raise deposits, banks have the option of either paying explicit interest on deposit accounts, or provide subsidized banking services—implicit interest. Evidence of this complementarity between service fees and deposit rates is widely accepted in the literature, Rossi (1993), Michell (1988), Starz (1979), Vanhoose (1988).

Each bank i faces the following banking industry downward sloping inverse demand for loans:

$$(3) \quad r_l = L(D) + \varepsilon \qquad \frac{\partial r_l}{\partial D} < 0$$

Equation (3), a function of aggregate D, implies that a bank raises funds in a regional deposit market but the demand for loans, $D\,(r_l + \varepsilon)$, is at the aggregate industry level—e.g., at the state level in a country such as the United States.[7] Equation (3) follows Schroeter and Azzam (1991) and assumes that a bank simultaneously determines its demand for deposits and supply of loans (D).[8] The bank's supply of loans is proportional to its demand for deposits. The bank would thus set its policies to bring the deposit and loan quantities in line with each other. However, banks face uncertainties associated with the random nature of deposit flows, loan defaults, and monetary policy changes, making the loan supply interest rate a random variable. ε is assumed a normally distributed random disturbance affecting the loan rate with zero mean and variance σ^2_ε.[9]

Each representative bank faces the following implicit resource cost function for deposits (loans) and the composite banking service:

$$(4) \quad C_{ij} = C(D_{ij}, Z_{ij}) \; ; \; \frac{\partial C_{ij}}{\partial D_{ij}} > 0 \quad \frac{\partial C_{ij}}{\partial Z_{ij}} > 0 \; ; \; \frac{\partial^2 C_{ij}}{\partial D_{ij}^2} > 0 \quad \frac{\partial^2 C_{ij}}{\partial Z_{ij}^2} > 0 \; ; \; \frac{\partial^2 C_{ij}}{\partial Z_{ij}\, \partial D_{ij}} \leq \geq 0$$

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[6]See Mitchell (1988) for a model with this feature.

[7]This assumes an essentially retail deposit market where banks raise funds locally in the first instance and those funds can be lent to other banks in other regions to finance loans.

[8] Loans in the model should more generally understood to mean monetary assets

[9] By introducing ε in the loan demand rather than the deposit supply, we assume that the bulk of adjustment is done on the loan side. ε also affects the loan rate through its influence on banks' holding of excess reserves and liquid assets for liquidity risks. Appendix III provides an interpretation of ε related to borrowers default risks and random deposit flows. The additive assumption of the risk factor ε is for ease of computation as is done in other studies, Sealey (1980), and Zarruck (1989).

The first two sets of partial derivatives indicate an increasing marginal cost function. The second two sets of partial derivatives indicate that the cost function is convex in Z_{ij} and D_{ij}. The last partial derivative indicates economies (diseconomies) of scope if negative (positive).

Finally, since each bank faces an uncertain revenue function, it is assumed to be an expected utility maximizer. Thus, each bank has the following expected utility function in profits approximated by a second order Taylor expansion around the expected level of profits:[10]

$$(5) \quad EU(\pi_{ij}) = U(\overline{\pi_{ij}}) + U'(\overline{\pi_{ij}})\, E(\pi_{ij} - \overline{\pi_{ij}}) + \frac{1}{2} U''(\overline{\pi_{ij}})\, E(\pi_{ij} - \overline{\pi_{ij}})^2$$

$$(6) \quad \pi_{ij} = (r_l - r_{dj})\, D_{ij} + b_j\, Z_{ij} - C_{ij}\, (D_{ij}, Z_{ij})$$

Expected utility of profit is therefore given by:

$$(7) \quad E[U(\pi_{ij})] = U(\overline{\pi_{ij}}) - \frac{1}{2} U''(\overline{\pi_{ij}})\, D_{ij}^2\, \sigma_\epsilon^2$$

Equations, (1), (2), (3), (4), and (7) form the complete model:

$$(1) \quad b_j = S(Z_j, r_{dj}) \ ; \quad (2) \quad r_{dj} = P(D_j, b_j) \ ; \quad (3) \quad r_l = L(D) + \varepsilon$$

$$(4) \quad C_{ij} = C(D_{ij}, Z_{ij}) \qquad (7) \quad E[U(\pi_{ij})] = U(\overline{\pi_{ij}}) - \frac{1}{2} U''(\overline{\pi_{ij}})\, D_{ij}^2\, \sigma_\epsilon^2$$

Each bank i maximizes the expected utility of profits choosing the supply of loans—equivalently its demand for deposits—and the supply of services:

$$(8) \quad \underset{D_{ij},\, Z_{ij}}{\mathrm{Max}}\ \mathrm{EU}(\pi_{ij}) = \underset{D_{ij},\, Z_{ij}}{\mathrm{Max}}\ \{\mathrm{U}(\mathrm{E}\pi_{ij}) - \tfrac{1}{2}\, \mathrm{U}''(\mathrm{E}\pi_{ij})\mathrm{D}^2_{ij}\sigma^2_\varepsilon\}$$

The first order conditions (F.O.C) of the maximization yield the interest margin (9) and service fee (10) for an individual bank (they represent reaction functions):[11] [12]

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[10]No assumption is made regarding banks' attitude toward risk. The empirical study will reveal whether banks are risk neutral.

[11]σ_ε^2 is exogenous for bank i, a systemic risk. Indeed, it can be shown that: $\partial\sigma_\varepsilon^2/\partial D_i = 0$

[12]The equilibrium deposit level for bank i, obtained by simultaneously solving the reaction functions, is given later in the section.

$$(9) \quad [Er_l - r_{dj}] = \frac{\partial C_{ij}}{\partial D_{ij}} - D_{ij}\frac{\partial Er_l}{\partial D}\frac{\partial D}{\partial D_{ij}} + D_{ij}\frac{\partial r_{dj}}{\partial D_j}\frac{\partial D_j}{\partial D_{ij}}\left(1-\frac{\partial b_j}{\partial r_{dj}}\frac{Z_{ij}}{D_{ij}}\right) + \lambda_{ij}D_{ij}\sigma_e^2$$

$$(10) \quad b_j = \frac{\partial C_{ij}}{\partial Z_{ij}} - \frac{\partial b_j}{\partial Z_j}\frac{\partial Z_j}{\partial Z_{ij}}Z_{ij}\left(1-\frac{\partial r_{dj}}{\partial b_j}\frac{D_{ij}}{Z_{ij}}\right)$$

The relative measure of risk aversion of the representative bank is given by $-D_{ij}U''(\pi_{ij})/U'(\pi_{ij}) = D_{ij}\,\lambda_{ij}$, where λ_{ij} represents the Arrow-Pratt measure of absolute risk aversion. Risk neutrality would make banks expected profit maximizers ($\lambda_{ij} = 0$).

The first order condition (10) indicates that given the complementary between services and deposits ($\partial r_{dj}/\partial b_j > 0$), the greater the deposit to service ratio (D_{ij}/Z_{ij}), the smaller the service fee (b_j) to maintain optimality.[13] From the first order condition (9) we also see that as (D_{ij}/Z_{ij}) rises, the following limiting value holds:

$$\lim_{\frac{D_{ij}}{Z_{ij}}\to\infty}\left(1-\frac{\partial b_j}{\partial r_{dj}}\frac{Z_{ij}}{D_{ij}}\right) = 1$$

The limit implies that as (D_{ij}/Z_{ij}) increases, the deposit input price distortion $D_{ij}(\partial r_{dj}/\partial D_j)(\partial D_j/\partial D_{ij})$ in (9) is fully used to reduce deposit interest payments, increase the interest margin, and compensate for lower service fees in (10)—implicit interest. The price distortions (market power giving the ability to price discriminate) are therefore necessary for the implicit interest to occur. The intuition is that the bank's ability to pay lower deposit interest rates frees up additional resources to subsidize nonintermediation services if optimal. The larger the volume of loanable deposits D_{ij} raised per service offered Z_{ij}, the more the bank will be willing to subsidize service fees as an alternative deposit raising strategy for profit maximization. This can be more readily seen by multiplying and dividing the limit expression by b_j/r_{dj} to obtain:

$$\lim_{\frac{D_{ij}}{Z_{ij}}\to\infty}\left(1-\frac{\partial b_j}{\partial r_{dj}}\frac{r_{dj}}{b_j}\frac{b_j}{r_{dj}}\frac{Z_{ij}}{D_{ij}}\right) = 1$$

The limit expression says that in equation (9), the higher are interest expenses ($D_{ij}r_{dj}$) relative to services revenue (b_jZ_{ij}), the more services will be subsidized in equation (10), since they

[13] Inferences made directly from the first order conditions about the interest margin are analogous to those that would emanate, for instance, from a lerner index for mark-up pricing involving complementary goods (see, Tirole 1993, p. 70). See also Freixas and Rochet(1998, p.60)

bring complementary deposits (this is an opportunity cost argument). Note that the reduction of interest expenses does not mean a lack of competition but an increase in competition using another means. Deposit interest rate market power translates not directly but indirectly into profits while promoting financial deepening and banking services in the process. The bank is effectively price discriminating to the detriment of interest earning customers in favor of other customers. It does so by optimally internalizing the presence of complementarities between services and deposits. More competition in this form forces more of the market power to be used as a subsidy to services rather than pure market power profit. Very important in this regard is the fact that the subsidy of services does not necessarily mean pricing below marginal cost. Indeed, looking at (10) one clearly sees that $(b\text{-}C_z)$ is lower, meaning more competitive, the larger the volume of deposits obtainable per services offered (D/Z).

Rearranging (9) and (10), we obtain the following representation of the optimal interest margin and service fee for bank i:

$$(11)\quad [Er_l - r_{dj}] = \frac{\partial C_{ij}}{\partial D_{ij}} - \frac{\partial Er_l}{\partial D}\,\frac{\partial D}{\partial D_{ij}}\,\frac{D_{ij}}{D}D + D\frac{\partial r_{dj}}{\partial D_j}\,\frac{\partial D_j}{\partial D_{ij}}\,\frac{D_{ij}}{D_j}\,\frac{D_j}{D}\,(1 - \frac{\partial b_j}{\partial r_{dj}}\frac{Z_{ij}}{D_{ij}}) + D_j\,\lambda_{ij}\frac{D_{ij}}{D_j}\sigma_\varepsilon^2$$

$$(12)\qquad b_j = \frac{\partial C_{ij}}{\partial Z_{ij}} - Z\frac{\partial b_j}{\partial Z_j}\,\frac{\partial Z_j}{\partial Z_{ij}}\frac{Z_{ij}}{Z_j}\frac{Z_j}{Z}\,(1 - \frac{\partial r_{dj}}{\partial b_j}\,\frac{D_{ij}}{Z_{ij}})$$

Assuming symmetry across banks and regions, the interest margin and service fee for the average bank i in the industry can be written as:[14]

$$(13)\qquad Er_l - r_d = C_d - \eta^{-1}\theta_1 D + \omega^{-1}\theta_2 D\,\zeta_1 + \delta\sigma_\varepsilon^2 D$$

$$(14)\qquad b = C_z - \alpha^{-1}\theta_3 Z\,\zeta_2$$

Elements of (13) and (14) are defined in Appendix 1, Table 1, and explained below. Er_l and r_d are the expected loan and deposit interest rates of the average bank in the industry respectively. They correspond to the following interest margin components, time series of which need to be empirically constructed to evaluate their effects on bank deposit levels:

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[14] For a country such as the United states, the averaging is done at two levels: within a state and across states; the margin for bank i is:

$$[Er_l - r_d] = \frac{\partial C}{\partial D_i} - \frac{\partial Er_l}{\partial D}\,\frac{\partial D}{\partial D_i}\frac{D_i}{D}D + \frac{\partial r_d}{\partial D}\,\frac{\partial D}{\partial D_i}\frac{D_i}{D}\,D\,(1 - \frac{\partial b}{\partial r_d}\,\frac{Z_i}{D_i}) + D\,\lambda_i\frac{D_i}{D}\sigma_\varepsilon^2$$

C_{dt} = Marginal cost of loans (deposits)
$\eta_t^{-1}\theta_1 D_t$ = Oligopoly
$\omega_t^{-1}\theta_2 D_t\ \zeta_{1t}$ = Oligopsony
$\delta\sigma_{st}^{2} D_t$ = Risk

η_t^{-1}, ω_t^{-1} are the slopes of the loan demand and deposit supply of the public respectively. The smaller they are (i.e, more elastic) the more competitive are banks in supplying loans and attracting deposits (e.g., because of competition from nonbanks).

θ_1 and θ_2 for the average bank i can be interpreted as parameters indexing the degree of market power in the loan and deposit markets respectively. A value of zero represents the competitive case, 1 the monopoly case, and intermediate values oligopoly cases. Alternatively, θ can be interpreted as a bank's conjectural elasticity indicating its conduct as a result of its expectation of rival banks' reactions to its behavior.[15]

ζ_1 is the key variable of the paper indicating the degree to which and the way deposit input market power ($\omega^{-1}\theta_2 D$) is used. When ζ_1=1, oligopsony power is fully used to subsidize other banking services as indicated by the limit expressions discussed above. It is assumed that $\zeta_1 \longrightarrow 1$ only when $Z/D \longrightarrow 0$; Indeed if ζ_1=1 because $\partial b/\partial r_d$=0, then deposit market power translates into pure market power profit; $\partial b/\partial r_d \neq 0$ is therefore a key assumption in the paper. When $0 < \zeta_1 < 1$, only a fraction of the deposit market power is used to subsidize banking services. Finally, when $-\alpha < \zeta_1 < 0$, deposit interest rates are subsidized. In this latter case, high banking service fees in effect subsidize a higher than perfectly competitive deposit interest rate. The deposit interest rate would, of course, be bounded by the loan interest rate. From the preceding analysis we can infer that if, empirically, an increase in deposit market power ($\omega^{-1}\theta_2 D\zeta_1$) raises D, contrary to what would normally be expected, the reason would be that market power is used to subsidize services which bring complementary deposits.

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[15]This interpretation derives from the following (see Appendix I, Table 1 for the functional form of θ_2):

$$Since\ \sum_{i=1}^{m} D_i = D\ ,\ \frac{\partial D}{\partial D_i} = (\ 1 + \sum_{i \neq k} \frac{\partial D_k}{\partial D_i}\ ),\ hence\ \ \theta_2 = (\ 1 + \sum_{i \neq m} \frac{\partial D_k}{\partial D_i}\ )\ \frac{D_i}{D}$$

where $\Sigma\, dD_k / dD_i$ represents the sum of the effects on the industry deposit level of the $k \# i$ rival banks' reactions to bank i deposit change. If for instance an attempt by bank i to raise its deposit level D_i induces a total of k reactions with an effect of -1 , bank i cannot affect the industry deposit supply by varying interest rates. It will then assume a perfectly competitive environment and take the industry deposit supply as given $(\theta = 0)$. If the total reaction effects are < -1, then bank i's attempt to raise its deposit level ends up reducing the total industry deposit level$(\theta < 0)$ through for instance a price war. The nature of the oligopoly game yielding the latter result is unknown.

This hypothesis can be tested by running the following regression once time series of the margin components above are constructed:

$$(15) \quad D_t = \psi_1\, Cost_t + \psi_2\, Oligopoly_t + \psi_3\, Oligopsony_t + \psi_4\, Risk_t + E_t$$

where D =Deposit level, E = error term.

Equation (15) is the equilibrium bank deposit demand (loan supply) level D, derived by solving reaction functions (13) and (14) simultaneously to obtain:

$$(16) \quad D = \frac{-\alpha^{-1}\theta_3\,(Er_l - r_d - C_d) + \omega^{-1}\theta_2\,\frac{\partial b}{\partial r_d}\,(b - C_z)}{-\alpha^{-1}\theta_3\,\omega^{-1}\theta_2\,(1 - \frac{\partial r_d}{\partial b}\frac{\partial b}{\partial r_d}) + \eta^{-1}\theta_1\,\alpha^{-1}\theta_3 - \alpha^{-1}\theta_3\,\delta\sigma_\varepsilon^2}$$

Equation (16) is equivalent to:

$$(17) \quad D = \psi_A\,(Er_l - r_d - C_d) + \psi_B\,(b - C_z)$$

Ψ_A is a net interest margin effect compared to Ψ_is in (15) where the individual effects of gross margin $(Er_l - r_d)$ components are separately identified. Clearly, estimating (17) using the interest margin as the cost of intermediation instead of (15) would imply imposing a restriction of equality on Ψ_is which may not be true. In particular, a finding that oligopsony power increases the level of deposits would be against conventional wisdom. Such a finding is theoretically possible and can be verified by taking the partial derivative of (16) with respect to $(\omega^{-1}\theta_2)$. The intuition for the deposit increase is that revenues from additional services provided and ensuing complementary deposits lent exceed the loss of deposit interest rate market power used to subsidize services.

Additional insight can be obtained from the second order sufficient conditions ensuring equilibrium for each bank i. Second order sufficient conditions require that the profit function be concave in D_i and Z_i and that the Hessian be positive definite. Namely that:

$$\pi_{D_iD_i} < 0, \quad \pi_{Z_iZ_i} < 0, \quad \pi_{D_iD_i}\pi_{Z_iZ_i} - \pi_{Z_iD_i} > 0$$

$$\left[\, 2\frac{D}{D_i}\,(\eta^{-1}\theta_1 - \omega^{-1}\theta_2) - \lambda_i\sigma_\varepsilon^2 - \frac{\partial^2 C_i}{\partial D_i^2}\,\right]\left[\, 2\frac{Z}{Z_i}\,\alpha^{-1}\theta_3 - \frac{\partial^2 C_i}{\partial Z_i^2}\,\right] - \left[\frac{D}{D_i}\,\omega^{-1}\theta_2 - \frac{Z}{Z_i}\,\alpha^{-1}\theta_3 - \frac{\partial^2 C_i}{\partial Z_i \partial D_i}\,\right] > 0$$

The first two product brackets, π_{DiDi} and π_{ZiZi}, are negative as required and mean that bank i should keep producing D and Z up to the point where the combined risk adjusted benefits are exceeded by the increase in marginal costs.[16] The sufficiency conditions, however, indicates that, for profit maximization, bank *i* can go beyond these quantities if there are complementarities between *D* and *Z*. Since it is the case ($\pi_{DiZi} \neq 0$), bank *i* should continue producing *D* and *Z*, incurring net costs, up to the point where that net cost (product of π_{DiDi} and π_{ZiZi}) exceeds the net benefits from exploiting complementarities (the third bracket, π_{DiZi}). This condition is also guaranteed to be met since the negative sign in front of π_{DiZi} ensures that the marginal benefit function from exploiting revenues from complementaries is downward sloping. Note that all elements in the third bracket are positive if there are economies of scope between *D* and *Z*.

Graphical Evidence from United States Data

The first order conditions (equations 9 and 10) of the model said that the interest margin would rise to allow nonintermediation service fees to fall if it is optimal to do so. In the process, financial deepening may be improved. This was because more services *Z* brought complementary deposits *D*. As the result, the larger interest expenses ($D*r_d$) were relative to nonintermediation services revenue ($b*Z$), the more opportunity cost would dictate that service fees be subsidized as an alternative deposit raising strategy. For this, banks would lower interest costs provided they have market power on deposits and nonintermediation services.[17]

Interestingly, looking at the U.S. banking industry data, Figure 1 shows that the average interest margin in the industry has been on a rising trend until 1981 when deposit interest rates were deregulated. This rising interest margin happened while the ratio of deposit interest expenses (r_d*D) to noninterest revenues ($b*Z$) rose (Figure 2), again until deregulation in 1981. According to the model, U.S. service fees should be subsidized as an alternative deposit raising strategy provided oligopsony power is available to banks.

As Figure 3 shows, before 1981 the nominal service fee had remained steady despite rising interest costs (Figure 4). In addition, Figure 4 shows that the U.S. interest rate ceiling regulation of 5 percent had not been a constraint on banks, on average, until 1980 when they lobbied to have it removed. A low service fee may therefore have been optimal regardless of interest rate regulation because of a relatively high ratio of deposits obtainable per unit of nonintermediation services offered (*D/Z*) as the model predicts.

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[16]This interpretation of the second order conditions results from the fact that, in the brackets, marginal revenues are downward sloping and marginal costs upward sloping, respectively, ensuring that costs will exceed revenues at some point. In the derivations, linear demand and supply functions are assumed for simplicity.

[17] See the discussion of the limit expressions and ζ_1 above.

Figure 5 shows the ratio of the logarithms of deposits and nonintermediation services (*lnD/lnZ*); This ratio, starting high, has been falling steadily. This indicates that the growth of deposits per unit of services offered was steadily being exhausted as a deposit raising strategy. As the ratio reached its asymptotic value in Figure 5, the subsidy on nonintermediation services was no longer justified. Deposit interest rate regulation had to be eliminated for banks to effectively compete for deposits. Indeed, by 1981, average deposit interest rate expense had reached the 5 percent ceiling (Figure 4).

The correlation between deposits and services can be appreciated from Figures 6 and 7 where the cross plots of the logarithms and growth rates of the deposits and services are shown. Figure 6 shows that the two series have a strong positive relationship. Figure 7, where the growth rate relationship is virtually a vertical line, confirms the steady fall in the level of deposits per unit of services that Figure 5 suggested. The cross-plot of growth rates should be around the same point if the growth rates of deposits and services were equal. The fact that it is somewhat vertical on the positive side implies that the ratio fell as deposits grew.

Even more striking is the fact that the apparent deepening in the U.S. banking industry occurred despite mostly negative average real deposit interest expenses and sometimes negative average real interest revenue in periods of high inflation. Figures 8 and 9 show the consumer price inflation rate, and the real average return on earning assets and deposit liabilities respectively. The average remuneration on deposits has been mostly negative.

Given the qualitative observations above, the U.S. commercial banking industry seems to support the financial deepening hypothesis of deposit interest market power combined with subsidized service fees. This will be tested econometrically once interest margin components are constructed.

Figure 1: Interest Margin (rl-rd)

Figure 2: Ratio of Interest Expenses to Noninterest Revenues (D*rd/b*Z)

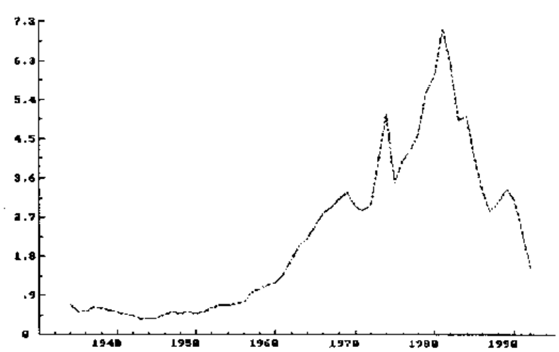


Figure 3 : Nominal service fee b

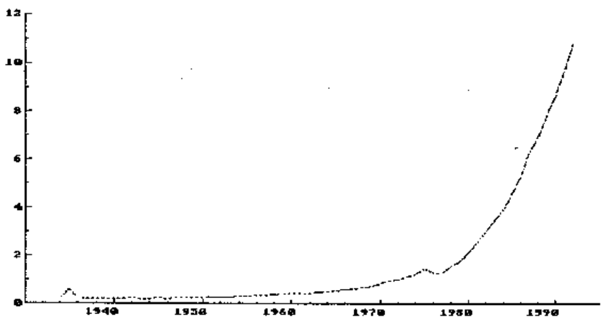


Figure 4 : Average Deposit Interest rate (rd)

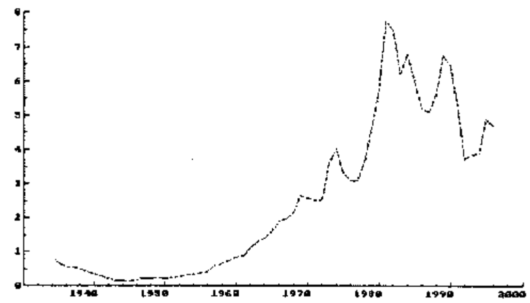


Figure 5: Ratio of the logarithms of Deposits and Services (lnD/lnZ)

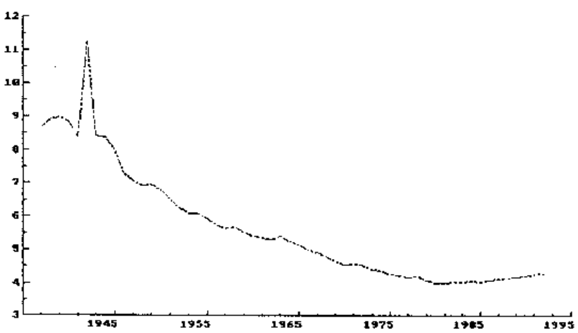


Figure 6 : Cross-plot of the logarithms of deposits and services (LD, LZ)

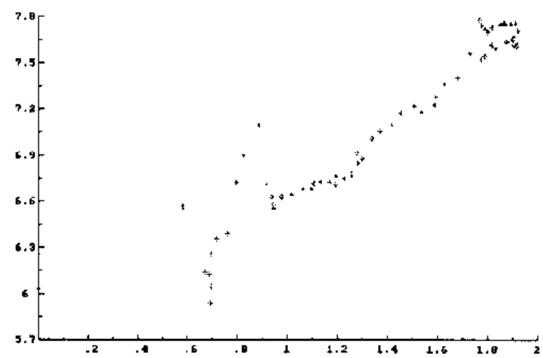


Figure 7: Cross-plot of the growth rates of Deposits and Services (DLD, DLZ)

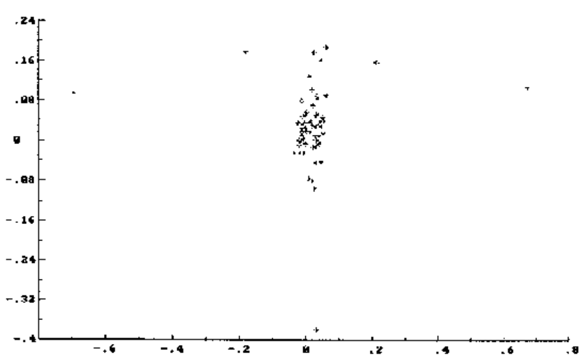


Figure 8 : Annual Consumer Price index inflation rate (inf)

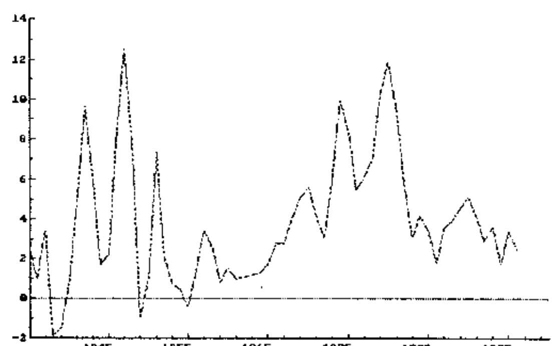
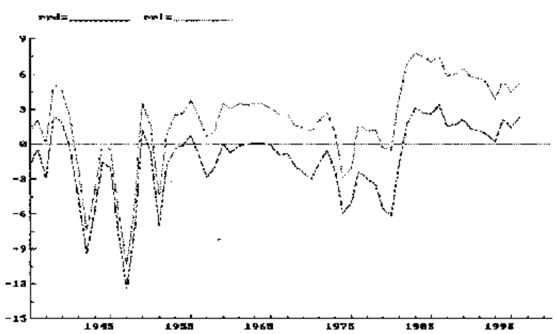


Figure 9 : Real average interest rates on assets (rrl) and Deposits (rrd)



III. The Interest Margin Empirical Model

To empirically identify the margin components, the paper uses Bresnahan's (1982) method of identifying market power (the method is described in Appendix II). The complete empirical model is the following system which is nonlinear in parameters. A Nonlinear Two Stage Least Squares method is used so that only the interest margin equation (18) is estimated. The other equations provide instruments.

$$
\begin{aligned}
(18)\quad r_{lt} = {} & r_{dt} + (\beta_{11}+\beta_{12}\ln D_t + \beta_{13}\ln Z_t + \beta_{14}\ln W_t + \beta_{15}\ln R_t) \\
& - \theta_1 [(1/\beta_{31} + \beta_{33} r_{ct})] \ln D_t \\
& + \ln D_t (\theta_{20} + \theta_{21} G_1) [(1/(\beta_{41} + \beta_{43} r_{st})] [1 - (-\beta_{52}/\beta_{51})(\ln Z_t/\ln D_t)] \\
& + \delta\sigma^2_{st} \ln D_t
\end{aligned}
$$ [18]

Equivalent to

$$
\begin{aligned}
r_{lt} = {} & r_{dt} + (\beta_{11}+\beta_{12}\ln D_t + \beta_{13}\ln Z_t + \beta_{14}\ln W_t + \beta_{15}\ln R_t) \\
& - \theta_1 \ln D_t^{**} + (\theta_{20} + \theta_{21} G_1)(\ln D_t^{*} - \ln Z_t^{**}) + \delta \ln D_t^{***}
\end{aligned}
$$

when B_{ijs} are estimated as discussed in Appendix II.

(19) $\ln D_t = \beta_{30} + \beta_{31} r_{lt} + \beta_{32} r_{ct} + \beta_{33} r_{lt} r_{ct} + \beta_{34} \ln_t y_t$ *Loan demand*

(20) $\ln D_t = \beta_{40} cpi_t + \beta_{41} r_{dt} + \beta_{42} r_{st} + \beta_{43} r_{dt} r_{st} + \beta_{44} b_t + \beta_{45} \ln y_t$ *Deposit supply*

(21) $\ln Z_t = \beta_{50} + \beta_{51} b_t + \beta_{52} r_{dt} + \beta_{53} \ln y_{pt} + \beta_{54} b_t \ln y_{pt}$ *Services demand*

(22) $b_t = (\beta_{16} + \beta_{17}\ln Z_t + \beta_{13}\ln D_t + \beta_{19}\ln W_t + \beta_{20}\ln R_t)$ *Services supply relation*

$+\theta_3 [(1/(\beta_{51} + \beta_{54}\ln y_{pt})] [1 - (-\beta_{44}/\beta_{41})(\ln D_t/\ln Z_t)] \ln Z_t$

[18] See equations (11) and (12) for the theoretical details of equations (18) and (22). The equivalent of $\partial b/\partial r_d$ in (18) is $[-(\partial Z/\partial r_d)/(\partial Z/\partial b)] = -\beta_{52}/\beta_{51}$ and that of $\partial r_d/\partial b$ in (12) is $[-(\partial D/\partial b)/(\partial D/\partial r_d)] = -\beta_{44}/\beta_{41}$.

Variables are defined below.[19]

r_l	=	Average interest rate revenue (ratio of interest income to total interest earning assets).
r_d	=	Average deposit interest rate (ratio of interest expense to total deposit liabilities).
cpi	=	Consumer price index.
D	=	Real total deposit liabilities.
Z	=	Banking Services (Proxied as the sum of the per capital number of commercial bank offices and the per capita number of commercial bank employees).
b	=	Real average price of banking services (ratio of real non-interest income to banking services Z).
G_1	=	1 before 1981 (deposit interest rate ceiling regulation in the U.S.), 0 otherwise
Y_p	=	Real income per capita.
Y	=	Real income.
r_c	=	4-6 months commercial paper interest rate.
r_s	=	3-month treasury bill interest rate.
C	=	Real total noninterest expense.
W	=	Real wage of labor (ratio of real annual employee compensations to the number of employees).
R	=	Real price of capital (ratio of real annual bank expenses on premises and equipments to the real stock value of premises and equipments).

Estimated parameters are β_{ijs}, θ_1, θ_{20}, θ_{21}, and δ in equation 18.

The Interest Margin (18) combines the bank's loan supply and deposit demand relations. It is the counterpart of equation (13). The marginal cost components in the interest margin and the nonintermediation services equations (18 and 22) assume a translog cost function as is done in many banking studies.[20] The time varying slopes of the bank supply for loans $(1/\beta_{31} + \beta_{33}r_{ct})=\eta_t^{-1}$ and demand for deposits $(1/\beta_{41} + \beta_{43}r_{st})= \omega_t^{-1}$ in equation (18) are obtained from the public's loan demand and deposit supply equations. They are not perfectly correlated with D as explained in the description of the Bresnahan (1982) method (Appendix II). Equation (19) is the public's loan demand, the counterpart of equation (3). Equation (20) is the public's deposit demand, the counterpart of equation (2). The conduct variable index $\theta_2 =(\theta_{20}+ \theta_{21} G_1)$ is made time varying through its dependence on the deposit rate regulation dummy (G_1). σ^2_ε is proxied by conditional forecast variances ε^2_t from an autoregressive conditional heteroskedasticity (ARCH) model of the real average revenue on earning assets (rr_{lt}).[21] Equation (21) is the public's demand for nonintermediation services. It is the counterpart of equation (1). It partially depends on real income per capita which has a bearing on the demand for banking services Rocha (1986) and thus the elasticity to banking

[19] Real variables are deflated using the GDP deflator. Data sources are in Appendix I.

[20] $\ln C = \beta_{10} +\beta_{11} \ln D+ \beta_{12} \ln (D)^2 (\tfrac{1}{2})+\beta_{13} (\ln D \ln Z)+\beta_{14} (\ln D \ln W) +\beta_{15} (\ln D \ln R) +\beta_{16} \ln Z +\beta_{17} \ln (Z)^2 (\tfrac{1}{2}) +\beta_{18} (\ln Z \ln W) +\beta_{19} (\ln Z \ln R) +\beta_{20} \ln W+ \beta_{21} \ln R+ \beta_{22} (\ln R)^2 (\tfrac{1}{2}) +\beta_{23} (\ln W)^2 (\tfrac{1}{2}) + \beta_{24} (\ln R \ln W)$

[21] Box-Pierce test statistics and the Akaike criteria indicated that the ARMA (1,1) is the appropriate model for the real loan rate while lagrange multiplier tests confirmed that an ARCH (1,1) is appropriate for the square residuals of the ARMA model.

service fees. Equation (22) is the bank's supply relation for nonintermediation services. It is the counterpart of equation (14).

IV. Results : Interest Margin and Deposit Level Equations

Results of equation (18) which contains coefficients that will allow interest margin components to be constructed are presented in Appendix I, Table 2. Eight out of 15 coefficients are significant at the 5 percent significance level. Most important, among those are the coefficients measuring the oligopsony conduct variables (θ_{20}, θ_{21}). The average indicator of conduct in the sample period θ_{20} is negative. This indicates that an increase (decrease) in deposit interest rates is perceived to result in a decline (rise) in deposits for the average bank in the industry (see the discussion of θ in footnote 16, p. 11). The effect of deposit interest rate regulation, however, with θ_{21} positive, has been to reduce the perceived negative (positive) effect on deposit level of raising (reducing) deposit interest rates. A possible interpretation is that banks perceived an increase in deposit interest rates as less of a threat to their deposit base under deposit ceiling regulation than under a free market. This may be because they believed that a deposit interest rate price war would have an upper limit at the deposit interest rate ceiling, making their market power binding. The critical finding though is that oligopsony conduct is present.

The complementarity between deposit levels and nonintermediation services is also confirmed by the positive sign of $(-\beta_{52}/\beta_{51})$. Thus, a rise (fall) in the deposit interest rate increases (reduces) the demand for nonintermediation services ($\beta_{52} > 0$) and a rise (fall) in the service fee reduces (decreases) the demand for deposits ($\beta_{51} < 0$). This confirms the working hypothesis of the paper that $\partial b/\partial r_d > 0$. This complementarity may be at the source of the perceived negative effect on banks' deposit base of a deposit interest rate price war suggested by the negative sign of θ_{20} discussed above.

The oligopoly power θ_1 is not significantly different from zero. This indicates that the average market power on the interest earning assets side is practically nil in the U.S. commercial banking industry; Shaffer (1989) found the same result.[22] The time varying loan demand slope has the effects of the loan rate and the commercial paper rate with opposite signs since they represent the price of substitutes. The expected sign are however reversed. The loan rate has an unexpected positive sign on loan demand while the commercial paper rate has a unexpected negative sign. Coefficients of the time varying deposit demand slope are, however, significant and with the expected signs. A rise in deposit interest rates positively affects the level of deposits ($\beta_{41} > 0$) but rising treasury bill interest rates reduce the positive effect of the deposit interest rate on the level of deposits ($\beta_{43} < 0$).

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[22]Schaffer (1989) found a negative but insignificantly oligopoly conduct variable. This may be due to the fact that she did not distinguish oligopoly from oligopsony conduct which we found negative and significant.

Turning to the other interest margin coefficients, we find that although the marginal cost of deposits rises with deposits ($\beta_{11} > 0$) as expected, ($\beta_{12} < 0$) indicates the existence of deposit economies of scale. ($\beta_{13} < 0$) also indicates that increased nonintermediation services reduces the marginal cost of deposits (another justification to promote nonintermediation services). While wages have a positive relationship with marginal costs, the rental price of capital has a wrong negative sign (this may be due to the difficulty of measuring the rental price of capital as reported in other studies, Schaffer (1989). Finally, the coefficient on the risk variable is insignificantly different from zero.This is not surprising given the fact that the risk variable is weighted by the average bank's market share (see Appendix I, Table 1) and given the large number of banks in the U.S. (over 12000). Another argument could also be that banks maximize expected profit (risk neutrality) eliminating the risk variable.

Using the coefficients of equation (18) in Table 2, time series of interest margin components are constructed, and the effects of the components on the deposit level are estimated (Equation 15, Table 3). The results indicate that average oligopsony power ($D_t\, \omega_t^{-1} \theta_{20}\, \zeta_{1t}$) on deposit interest rates has been conducive to higher commercial bank deposit levels in the U.S. This result confirms the proposition of the paper that financial deepening is not inconsistent with market power on deposit interest rates in a liberalized financial sector. This result also confirms the earlier finding in Table 2 that banks perceived that interest rate competition reduces their deposit base ($\theta_{20} < 0$). Deposit interest rate ceiling regulation reinforced the positive effect of the average oligopsony power ($D_t\, \omega_t^{-1} \theta_{21} * G_1\, \zeta_{1t}$). The ceiling prevented excessive competition on deposit interest rates by rendering the market power binding, as suggested by the discussion of θ_{21} above. Oligopoly power ($\eta_t^{-1} \theta_1 D_t$) and higher marginal resource costs (C_{dt}) on the other hand have significant negative effects on financial deepening as is usually expected.

In light of these results, one cannot simply analyze the effect of deposit interest rates on financial deepening as is always done in the financial liberalization literature. Neither can one analyze the effect of the cost of intermediation as a simple interest margin on financial deepening. The effects of the individual components must be separated, as can be appreciated from the difference between equations (15) and (17). Also, though market power on deposits has fostered commercial bank deposit levels in the U.S., this would have been to a lesser extent without a deposit interest rate ceiling which made the market power binding. As Eichberger and Harper (1989) argue, when the market structure is oligopolistic and commercial bank products are sufficiently differentiated from nonbank financial institutions, interest rate ceilings guarantee that cartel interest rates will be binding.[23] Eichberger and Harper note that the increasing substitutability between the deposit-taking services of banks and the ones offered by nonbank financial intermediaries reduces commercial banks' cartel power. In such situation, a deposit interest rate ceiling, which previously helped reduce

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[23]As is well known, the Nash equilibrium in an oligopoly framework is not pareto efficient. The firms could increase their profits by effectively colluding. Interest rate ceilings can therefore represent a binding constraint that makes the collusive outcome effective.

competition amongst commercial banks, now restricts their ability to respond to price competition from nonbanks. Eichberger and Harper argue that this dynamic may be the reason, commercial banks, in many instances of financial liberalization, actively lobbied for interest rate deregulation. As shown in Figure 4, the U.S. deposit interest rate ceiling of 5 percent had not been binding on banks, on average, until 1980 when they lobbied to have it removed. One can then infer that the U.S. ceiling has prevented destructive competition from a financial deepening point of view.

V. Lessons for Developing Countries

Gurley and Shaw (1960) noted that commercial banks' liabilities consist of demand deposits in early stages of economic development while financial claims (interest earning liabilities) issued by nonbank financial institutions appear in later stages. Thus, the state of economic development should affect banks pricing behavior. Given the low income levels in early stages of economic development, small savers and demand depositors may be less sensitive to the deposit interest rate. They may be more responsive to the convenience of bank branches and payments services for savings safekeeping and transactions. This situation would justify bank reliance on implicit interest payments to raise funds.[24] By paying low deposit interest rates, depositors most sensitive to explicit interest payments will be lost. This may lead to financial disintermediation, reduce financial deepening, the expansion of credit and thus investment and growth. However, implicit interest payments reduce service fees and increase bank branches with a potential of fostering financial deepening in their own right. Market power on deposit interest rates is, however, necessary for the price discrimination to occur and implicit interest to be paid as shown in Section II. Therefore, policies that tend to reduce such market power may reduce financial deepening potential.

The paper's empirical results indicate that oligopsony power has been beneficial to the level of deposits in the United States commercial banking industry. The results also show that deposit interest rate ceiling regulation has reinforced this effect. This finding is consistent with other studies; Howard (1970) showed that implicit interest payments to U.S. households were significant in explaining both the number of checking accounts and average balances per account.

Since commercial banks form the bulk of financial markets in developing countries, the potential to induce financial deepening with low fee nonintermediation banking services may be lost if banks compete through deposit interest rates. Fry (1995, 453) notes that "the small amount of empirical evidence on branch proximity suggests that increased branch proximity

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[24]Tarkka (1995) presents a model where low income customers with low demand for bank services receive a subsidy for bank services and a lower interest rate than the market rate at the margin. High income customers on the other hand with high demand for bank services pay a price equal to the marginal cost of services and receive a market rate of interest at the margin.

has raised national saving ratios substantially (by 1 to 5 percentage points over a 20 year-period) in six Asian developing countries." In contrast, the empirical evidence shows that, when real deposit interest rates have any significant effect on national savings ratios, the magnitude is of no great policy significance (Fry 1995, 453).

In these observations are lessons for developing countries in the process of determining the appropriate regulation of their commercial banking industries. A concentrated commercial banking industry with market power on deposit interest rates is not necessarily undesirable. Few commercial banks competing via branch banking may be good for financial deepening. Deposit interest ceiling is not necessarily detrimental to financial deepening, provided monetary policy is committed to low inflation to avoid substantially negative real deposit interest rates as shown in other studies (Fry, 1995). Deposit interest rate ceiling, however, outlives its usefulness when commercial banks' deposits become close substitutes to nonbank financial institutions. This was the case in the U.S. when the average interest rate on deposits approached the ceiling. The ceiling has been useful by forcing banks to maximize cheap deposits (core deposits). When banks were no longer able to acquire cheap deposits, they had to increase their fee incomes (including through new fee based products).

The paper's finding that the ability to pay low deposit interest rates is necessary for subsidized services to occur has implications for early capital account liberalization. Such liberalization, by aligning deposit interest rates with world interest rates may reduce domestic financial deepening potential. Lower deposit market power reduces the extent to which banks can price discriminate. It prevents them from paying low deposit interest rates and achieve better domestic resource mobilization and greater banking services dissemination through implicit interest payments. Banks are thus forced to charge more for branch banking and other nonintermediation banking services. Given the potential unwillingness of depositors to pay higher service charges to cover operating costs, high deposit interest rates and short term foreign borrowing are likely to be the options banks will choose to fund their lending activities. These options, in turn, may lead to banking crises as macroeconomic conditions—e.g., exchange rate movements—directly affect banks' open foreign exchange positions. Such a banking system is in effect integrated with a high income market and a deposit base which values interest payments. Excessive reliance on a deposit base which values interest (i.e., more volatile noncore deposits), in turn, is more likely to cause bank liquidity difficulties in times of crisis.

In the same vain, in countries dominated by foreign banks financial deepening may be hampered. This is because they are less likely to open branches beyond urban areas, are less engaged in retail banking, and mostly concentrate on depositors that value interest payments. However, if the regulatory environment is such that these foreign banks compete in nonintermediation banking services, they may increase domestic banks' efficiency and foster domestic financial deepening.

Table 1: Interest Margin and Service Fee Variables Definition

Define

$C_{dij} = \frac{\partial C_{ij}}{\partial D_{ij}}$ *Deposits(loans) marginal maintenance resource cost of bank i.*

$\eta = \frac{\partial D}{\partial Er_l}$ *slope of the expected loan demand.*

$\omega_j = \frac{\partial D_j}{\partial r_{dj}} \frac{D}{D_j}$ *regionally weighted slope of the deposit supply.*

$\theta_{1ij} = \frac{\partial D}{\partial D_{ij}} \frac{D_{ij}}{D}$ *loan market conjectural elasticity of bank i*

$\theta_{2ij} = \frac{\partial D_j}{\partial D_{ij}} \frac{D_{ij}}{D_j}$ *deposit market conjectural elasticity of bank i.*

$\delta_{ij} = \lambda_{ij} \frac{D_{ij}}{D_j}$ *risk aversion weighted by the deposit market share of bank i*

$C_{zij} = \frac{\partial C_{ij}}{\partial Z_{ij}}$ *Nonintermediation services marginal resource cost of bank i.*

$\zeta_{1ij} = (1 - \frac{\partial b_j}{\partial r_{dj}} \frac{Z_{ij}}{D_{ij}})$ *fraction of deposit market power used*

$\alpha_j = \frac{\partial Z_j}{\partial b_j} \frac{Z}{Z_j}$ *regionally weighted slope of the nonintermediation services supply.*

$\theta_{3ij} = \frac{\partial Z_j}{\partial Z_{ij}} \frac{Z_{ij}}{Z_j}$ *nonintermediation services conjectural elasticity of bank i.*

$\zeta_{2ij} = (1 - \frac{\partial r_{dj}}{\partial b_j} \frac{D_{ij}}{Z_{ij}})$ *fraction of nonintermediation services market power used.*

Table 2 : Average Interest Rate Revenue (r_l): Equation (18)--NL2SLS

Parameter	Estimate	Standard Error	T-statistic
β_{11}	1.199**	0.227	5.281
β_{12}	-0.752**	0.330	-2.279
β_{13}	-0.543	0.521	-1.043
β_{14}	2.331**	0.862	2.705
β_{15}	-1.183	0.817	-1.449
θ_1	0.096	0.225	0.424
β_{31}	2.645**	0.282	9.378
β_{33}	-0.086	0.370	-0.232
θ_{20}	-3.796**	0.247	-15.359
θ_{21}	1.882**	0.804	2.342
β_{41}	10.908**	0.697	15.661
β_{43}	-14.631**	0.849	-17.247
β_{52}	1.287*	0.779	1.652
β_{51}	-0.703	0.508	-1.384
δ	-0.004	0.052	-0.075

Maximum likelihood Estimate of $\sigma^2 = 1.81$

**5% significance
*10% significance

Note 1: The Nonlinear Regression was performed using a Quasi Newton Algorithm with convergence criteria set at .00001. The sample is 1934-1992. Sample variance of $r_l = 10.3$. Since the regression residuals variance is 1.81, 8.5 (about 82 percent) of the variance of r_l is explained by the estimation
Note 2: Several alternative starting values were tried. The above results remained best in terms of economically meaningful and significant coefficients, and model convergence. The software used was the Shazam EconometricSoftware, version 7.1.

Table 3: Equation 15 (Deposits)

Variable		Estimated Coefficient	Standard Error	T-statistic
Cost	(C_{dt})	-230.75**	53.75	-4.293
Oligopoly	$(\eta_t^{-1}\theta_1 D_t)$	-5196.7**	573.3	-9.064
Oligopsony1	$(D_t\,\omega_t^{-1}\theta_{20}\,\zeta_{1t})$	2723.5**	329.0	8.277
Oligopsony2	$(D_t\,\omega_t^{-1}\theta_{21}\,G_1\,\zeta_{1t})$	5523.9**	662.3	8.340
Risk	$(\delta\sigma_{\varepsilon t}^{2}D_t)$	106.42	90.83	1.172
Constant		571.61	370.9	1.541

R^2 .92

Variables are formed using results from Table 2:

$C_{dt} = (\beta_{11}+\beta_{12}\,lnD_t+\beta_{13}\,lnZ_t+\beta_{14}\,lnW_t+\beta_{15}\,lnR_t)$
$\eta_t^{-1} = (1/\beta_{31}+\beta_{33}r_{ct})$
$\omega_t^{-1} = (1/(\beta_{41}+\beta_{43}\,r_{st})$
$\zeta_{1t} = [1-(-\beta_{52}/\beta_{51})\,(lnZ_t/lnD_t)\,]$
$\sigma_{\varepsilon t}^{2} = \varepsilon^2_t = a_{20}+a_{21}(L)\,\varepsilon^2_{t-1}$, *where the real loan rate* $rr_{lt} = a_{30}+a_{31}(L)\,rr_{lt-1}+a_{32}(L)\,\varepsilon_{t-1}$

The total oligopsony component is $D_t\,\omega_t^{-1}(\theta_{20}+\theta_{21}*G_1)\,\zeta_{1t}$, comprised of the average oligopsony power in the sample period $D_t\,\omega_t^{-1}\theta_{20}\,\zeta_{1t}$ and the deregulation effect $D_t\,\omega_t^{-1}\theta_{21}*G_1\,\zeta_{1t}$. The slope dummy allows to determine whether oligopsony power has on average been conducive to financial deepening, and what the influence of deposit interest rate regulation has been on the average effect of this oligopsony power on deposits.

Sample 1934-1992. Regression were performed using the Shazam Econometric Software, version 7.1.

Data Source: The commercial banks' accounting data is available from the Federal Deposit Insurance Corporation (FDIC). The Federal Deposit Insurance Corporation, Division of Research and Statistics. "Historical Statistics on Banking; a Statistical History of the United States Banking Industry." September 1993. The FDIC data includes the following:
Interest income, Interest expense, Interest margin, Non-interest income, Non-interest expense (Operating costs), Provision for loan and lease losses, Net Operating Income, Interest earning assets, Deposit liabilities, Number of bank branches, Number of bank employees, Employee salaries and benefits, Expenses on bank premises and equipment.

Other data sources are:
1. The Statistical History of the United States. United States Bureau of Census (Various issues).
2. Moody's Bank and Finance Manual (Various issues).

IDENTIFYING OLIGOPOLY POWER: THE BRESNAHAN (1982) METHOD

Bresnahan's (1982) method of empirically identifying oligopoly power using aggregate industry data is used in the paper to find the empirical counterparts of the margin components in equation (13). To illustrate the Bresnahan method we ignore the oligopsony and risk components in (13) and assume that marginal cost is linearly in D and exogenous variables such as wages W, and the rental price of capital R to obtain equation the supply relation (1):

$$(1) \quad r_{lt} = \phi_1 D_t + \phi_2 W_t + \phi_3 R_t - \eta_t^{-1} \theta_1 D_t,$$

The objective is to estimate the degree of oligopoly power θ_1. Equation (1) has two endogenous variables, r_{lt} and D_t. An equation for loan demand D_t must therefore be specified for a consistent estimation of parameters. In addition, equation (1) has a derived variable $\eta_t^{-1} D_t = D_t^*$. For D_t^* not to be perfectly correlated with D_t, the loan demand slope η_t^{-1} must not be perfectly correlated with D_t. The loan demand equation must thus be specified as follows with the latter requirement in mind:

$$(2) \quad D_t = \beta_1 r_{lt} + \beta_2 Y_t + \beta_3 r_{ct} + \beta_4 r_{lt} r_{ct}$$

Y_t and r_{ct} are exogenous variables such as real income and a commercial paper rate (the price of a substitute), respectively. The slope of the loan demand function is then given by:

$$(3) \quad \eta_t = \frac{\partial D_t}{\partial r_{lt}} = \beta_1 + \beta_4 r_{ct}$$

and it is not perfectly correlated with D_t since it is independent of Y_t. Thus, (1) becomes:

$$(4) \quad r_{lt} = \phi_1 D_t + \phi_2 W_t + \phi_3 R_t + \theta_1 D_t^*$$

Measuring the oligopoly power θ_1 consists of simultaneously estimating the demand equation (2) and the supply relation (1) with restriction (3). Equation (2) is identified since it has r_{lt} as an endogenous variable and two excluded exogenous variables (instruments) are available from equation (1), W_t and R_t. Equation (1) is also identified since it has two endogenous variables D_t and D_t^* and two excluded exogenous variables are available from Equation (2), r_{ct} and Y_t. With estimates of η_t^{-1} and θ_1 time series of the oligopoly measure ($\eta_t^{-1}\theta_1 D_t$) can be constructed.

More generally now, the inclusion of the oligopsony and risk components in the supply relation (1) adds two endogenous variables ($\omega_t^{-1} D_t \zeta_{1t}$) and ($\sigma_{\pi}^2 D_t$), requiring each an instrument, D_t^{**} and D_t^{***} as shown in equation (5) below, not perfectly correlated with D_t. In line with the methods outlined above, an equation for the variance of profit, σ_{π}^2, will need to be specified so that ($D_t^{***} = \sigma_{\pi}^2 D_t$) is not perfectly correlated with D_t allowing δ to be consistent estimated. Similarly, for ($D_t^{**} = \omega_t^{-1} D_\tau \zeta_{1\tau}$) not be perfectly correlated with D_t so that θ_2 is consistently estimated, the following equations must be specified with the requirement in mind: (I) a deposit supply equation must be specified to estimate ω_t^{-1}; (ii) as well as a nonintermediation services (Z_t) demand equation for the estimation of the parameters in ζ_{1t} commanding the relationship between bank intermediation and nonintermediation services.

$$(5) \quad r_{lt} = \phi_1 D_t + \phi_2 W_t + \phi_3 R_t + \theta_1 D_t^{*} + \theta_2 D_t^{**} + \delta D_t^{***}$$

With the estimates of θ_2 and δ time series of the oligopsony ($\theta_2 \omega_t^{-1} D_t \zeta_{1t}$) and risk components ($\delta \sigma_{\varepsilon t}^2 D_t$) of the interest margin can be constructed. Time series of the marginal cost component will simply be ($\phi_1 D_t + \phi_2 W_t + \phi_3 R_t$).

The complete empirical model is specified in Section III of the paper. As Shaffer (1993) indicates, the Bresnahan "technique does not rely on any particular definition of local markets; estimates of θ are unbiased as long as the sample spans at least one complete market. If the industry comprises multiple markets, θ would represent the average degree of market power over the separate markets. Similarly, there is no requirement that all firms exhibit the same degree of market power, since θ reflects the behavior of the average firm in the sample". These remarks are particularly relevant for the United States banking industry data that the paper uses since U.S. banking markets are defined in terms of metropolitan statistical areas.

PROPERTIES OF ε

ε, the aggregate loan interest rate uncertainty, is assumed normally distributed with zero mean and variance σ^2_ε. Following Baltensperger (1972), the moments of ε are characterized as follows: Define $x_j > 0$ *or* < 0, the proportion by which a deposit account j is decreased in a given planning period. We assume that the probability that an account is decreased by a given proportion is the same for all accounts with expected value k and variance a^2. If the x_{js} are independent, for a number n of independent identical deposit accounts of value D_0, total deposit change for bank i is given by:

$$\varepsilon_i = \sum_{j=1}^{n} x_j D_0$$

ε_i is approximately normally distributed with expected value and variance:

$$E(\varepsilon_i) = D_0 \sum_{j=1}^{n} E(x_j) = D_0 nk = D_i k \qquad Var(\varepsilon_i) = D_0^2 \sum_{j=1}^{n} Var(x_j) = D_0^2\, na^2 = D_0^2\, n^2 \frac{a^2}{n} = D_i^2 \frac{a^2}{n}, \quad \therefore$$

$$\sigma_{\varepsilon_i} = D_i \frac{a}{\sqrt{n}}$$

a is the standard error of the random variable x_j. The more variable the deposit accounts the larger is a. Therefore, a will be larger for demand deposits compared to savings deposits and for the same standard error σ_ε a larger number of demand depositors will be needed compared to saving depositors for risk minimization. Since demand deposits and savings deposits are not explicitly separated in the paper's model,[25] a will depend on the deposit mix. If, the average proportion by which an account is decreased or increase is assumed equal to zero, $k=0$, then summing over m banks, we obtain:

$$\varepsilon = \sum_{i=1}^{m} \varepsilon_i, \quad E(\varepsilon) = 0, \qquad \sigma_\varepsilon = \sum_{i=1}^{m} D_i \frac{a}{\sqrt{n}} = D \frac{a}{\sqrt{n}}$$

We, therefore, have ε as define in (4) in the text. The larger the number of accounts n, the smaller the variance of deposit flows, and therefore, the smaller the variance of the loan rate. Note also that if x_j was instead the proportion of loan default losses, the moments of ε would be characterized in the same manner—for a given loan portfolio with default risk represented by the magnitude of a, the larger the number of independent borrowers, the smaller the risk of loan losses.

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[25]This mixed deposit account is equivalent to accounts with "automatic transfer from savings (ATS)" privileges. With ATS demand deposit accounts, "balances above a certain amount in a checking account are automatically transferred into a savings accounts that pays interest. When a check is written on the ATS accounts, the necessary funds to cover the check are automatically transferred from the savings account into the checking account" (Mishkin, 1995).

ADVANTAGES OF USING UNITED STATES DATA

The paper uses United States (U.S.) annual aggregated banking industry data (1934-92) to conduct the empirical investigations and we draw implications for developing countries. Using U.S. data for the study is desirable for reasons that make many developing countries' data less desirable.

First, in many developing countries, financial repression (deposit interest rate ceilings and high reserve requirements) was coupled with high inflation making real deposit rates substantially negative. As Rocha (1986) indicates, these high negative real deposit rates, forced banks to compete through branch networks. Regulatory issues may therefore have been the decisive factors in determining bank interest margins. In contrast, although the U.S. data cover times of interest rate ceilings prior to 1981 and deregulation thereafter, rarely have the ceilings been on average binding (see Figure 4). Yet the average real interest rate on total deposit liabilities have been negative in most of the sample (see Figure 9). Therefore, structural factors must have been the decisive factors in bank interest margin determinations.

Second, in many developing countries, close substitutes to banking services are difficult to measure. When substitutes exist, they often are available in informal markets where relevant interest rates cannot be accurately estimated. This lack of data undermines the researcher's capacity to satisfactorily study developing countries' bank competitive structure. The US commercial banks in contrast have been subjected to competition from nonbank financial institutions, the commercial paper market, and the bond market. This competitive environment has evolved over a long period of time and provides valuable data in studying the effect of financial market conditions as a whole on bank interest margin determination. In addition, the existence of implicit interest payments in the U.S. commercial banking industry is well documented, even after deposit interest rate deregulation in 1981 (Rossi, 1993).

Third, as Rocha(1986) notes, in many developing countries where external trade finance is very important, commercial banks may receive a high share of income in commissions and fees. The degree of openness of developing countries may therefore affect banks' cost structure. The U.S. provides an aggregation of banking data over fifty states that does not suffer the same difficulty.

Finally, the deregulation of deposit interest rates in 1981 provides a valuable instrument in estimating the effect of the deposit interest rate ceiling regulation on the oligopsony conduct index. In addition, although the U.S. has over 12000 commercial banks, more than 90 percent of all commercial bank deposits are held in banks owned by holding companies.These holding companies with controlling interest in several banks within a state and increasingly across states have effectively circumvented branching regulations (Mishkin 1995, p.290; Jayaratne, et al, 1996). The U.S. market is thus more concentrated than it appears. This state of affairs is consistent with the model in section II where several banks *i* operate in *j* regions, and the sum of their deposits within and across regions form the regional and aggregate commercial banking markets. The United States is therefore a good case study for this paper.

REFERENCES

Baltensperger, Ernst, 1972, "Economies of Scale, Firm size, and Concentration in Banking," *Journal of Money, Credit , and Banking*, Vol. 4, (August), pp. 467-88.

Bradley, Michael D., and Dennis W. Jansen, 1986, "Deposit Market Deregulation and Interest Rates," *Southern Economic Journal*, Vol. 53, (October), pp. 478-89.

Bresnahan, T. F., 1982, "The Oligopoly Solution Concept is Identified," *Economic Letters* 10, pp. 82-92

Chiappori, P-A. D. Perez-Castillo, T. Verdier, 1995, "Spatial competition in the banking system: Localization, cross subsidies and the regulation of deposit rates" *European Economic Review*, 39, pp. 889-918.

Eichberger, Jurgen, and Ian R. Harper, 1989, "On Deposit Interest Rate Regulation and Deregulation," *The Journal of Industrial Economics*, Vol. 38, (September).

Freixas, Xavier, and Jean Charles Rochet, 1998, "Microeconomics of Banking", MIT Press, second edition.

Fry, Maxwell J., 1995, "Money, Interest, and Banking in Economic Development," Second Edition, Johns Hopkins University Press.

Gurley, John G., and Edward S. Shaw, 1960, "Money in a Theory of Finance,"Washington, D.C.: Brookings Institution.

Howard, Keen Jr., 1979, "Household Demand for Demand Deposits:Do Nonpecuniary Payments Make a Difference?" Ph.D Dissertation, Bryn Mawr College.

Jayaratne, J., P.E. Strahan, 1996 "The Finance-Growth Nexus: Evidence from Bank Branch Deregulation". Quarterly Journal of Economics,Vol.111 n3, August 1996, pp.639-70.

Matutes, Carmen., and Xavier Vives, 2000, "Imperfect Competition, risk taking, and regulation in banking". European Economic Review 44 (200), pp. 1-34.

Mckinnon, R., 1993, "The Order of Economic Liberalization," The J.H.U. Press.

Mishkin, Frederic S., 1995, "The Economics of Money, Banking, and Financial Markets," Fourth Edition, HarperCollins College Publishers.

Mitchell, Douglas W., 1979, "Explicit and Implicit Demand Deposit Interest. Substitutes or Complements from the Bank's Point of View?" *Journal of Money, Credit and Banking*, Vol. 11, No. 2, (May), pp. 183-91.

_____, 1988, "Explicit Interest and Demand Deposit Service Charges. A Comment," *Journal of Money, Credit, and Banking*, Vol. 20, pp. 270-74.

Rocha, R de R., 1986, "Costs of Intermediation in Developing Countries: A preliminary Investigation," in *Industry and Finance Series*, Vol. 18: "High Interest Rates, Spreads, and the Costs of Intermediation," World Bank.

Rossi, Armond, 1993, "Implicit Rates of Return on Transaction Deposits, Time Deposits, and Loans," PhD. Dissertation, West Virginia University.

Schaffer, Sherill, 1989, "Competition in the U.S. Banking Industry," Economics Letters 29, pp. 321-23.

_____, 1993, "A Test of Competition in Canadian Banking," *Journal of Money, Credit, and Banking*, Vol. 25, No. 1, (February).

Schroeter, J., and A. Azzam, 1991, "Marketing Margins, Market Power, and Price Uncertainty," *American Journal of Agricultural Economics*, (November), pp. 991-99.

Sealey, C., 1980, "Deposit Rate-Setting, Risk Aversion and the Theory of Depository Financial Intermediaries," *Journal of Finance*, Vol. 35, pp. 1139-1154

Startz, Richard, 1979, "Implicit interest on demand deposits," Journal of Monetary Economics.

Stiglitz, Joseph E., 1994, "The Role of the State in Financial Markets," in Proceeding of the World Bank Annual Bank Conference on Development Economics, 1993, ed. by Michael Bruno and Boris Pleskovic.

Stiglitz, Joseph E., and Andrew Weiss, 1981, "Credit Rationing in Markets with Imperfect Information." *American Economic Review*, 73 (5, December): pp. 912-927.

Tarkka, Juha, 1995, "Approaches to Deposit Pricing: A Study in the Determination of Deposit Interest and Bank Services Charges," Bank of Finland.

Tirole, Jean, 1993. "The Theory of Industrial Organization" MIT Press.

Vanhoose, David D., 1988, "Deposit Market Deregulation, Implicit Deposit Rates, and Monetary Policy," *American Economic Journal*, Vol. 14, No. 4, (Dec), pp. 11-23.

Zarruk, E. R., 1989, "Bank Spread with Uncertain Deposit Level and Risk Aversion," *Journal of Banking and Finance*, Vol. 13, pp. 797-810.