DISCUSSION PAPER SERIES

No. 4817

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FINANCIAL ECONOMICS

Centre for Economic Policy Research

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Available online at: **www.cepr.org/pubs/dps/DP4817.asp**

ISSN 0265-8003

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Discussion Paper No. 4817
December 2004

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CEPR Discussion Paper No. 4817

December 2004

ABSTRACT

Advertising and Pricing at Multiple-Output Firms: Evidence from US Thrift Institutions*

We derive five hypotheses regarding market competition, price, and advertising from a theoretical model of a profit-maximizing depository institution, and test these conjectures in a simultaneous system of deposit interest rates and advertising expenditures for a data panel of 1,867 thrift institutions that offer 13 different deposit products in 666 local markets in the US between 1994 and 2000. We find some support for each of our hypotheses – branding, information, Dorfman-Steiner, structure-advertising, and structure-price – with the strength of the results often depending on the attributes of the deposit products or the characteristics of the thrifts.

JEL Classification: G21 and L10
Keywords: advertising, depository institutions and structure-performance

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*The views in this Paper are those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of Chicago or the Federal Reserve system. We are thankful for the comments and suggestions made by seminar participants at CERGE-EI, Prague, the Czech Republic; Ente Einaudi Foundation, Rome, Italy; European Summer Symposium on Financial Markets, Gerzensee, Switzerland; Federal Reserve Bank of Chicago, Chicago, USA; and Université Paris-Dauphine, Paris, France.

Submitted 06 December 2004

1. Introduction

While the strategic use of advertising to inform the marketplace, attract new customers, and influence the behavior of existing customers has been studied extensively for non-financial firms, we know relatively little about these issues for financial institutions. In the U.S., financial institutions traditionally have not used advertising as a competitive tool. In large part this is due to the fact that regulation had for years constrained the ability of financial institutions to price their products, expand their product offerings, and grow their franchises – thus, the potential returns from advertising have traditionally been limited for financial institutions. In recent years, however, most of these restrictive regulations have been lifted from the U.S. financial sector, and this has increased the incentives for financial institutions to advertise – especially depository institutions that compete in retail markets where advertising is a potentially powerful strategic tool.

This paper examines the strategic determinants and competitive impact of advertising expenditures in financial markets using data from 1,867 deregulated thrift institutions (savings and loans) operating in 666 local markets in the U.S. between 1994 and 2000. The thrift industry provides an excellent laboratory to examine these questions. Thrifts produce both standardized deposit products such as certificates of deposit, and non-standardized deposit products such as checking (NOW) accounts which vary in terms of fee structure, minimum balances, branch and ATM locations, and the quality of in-person (e.g., teller) services. Thrifts operate in hundreds of separate and well-defined local markets. And advertising has become an increasingly important expenditure in this industry, increasing by 21 percent (real dollars) during our sample period, even as the number of thrifts shrank by 34 percent.

We derive five testable hypotheses from a theoretical model of thrift profit-maximization. Four of these hypotheses involve advertising as an endogenous or exogenous argument: the *structure-advertising* hypothesis that advertising expenditures are determined by the level of concentration and inter-firm rivalry in local markets; the *branding* hypothesis that advertising creates a perception of product differentiation and hence reduces demand elasticities; the *information* hypothesis that advertising communicates actual product attributes; and the *Dorfman-Steiner* hypothesis that advertising expenditures

are set optimally as a function of their marginal revenue products. The fifth testable result is the standard *structure-price* hypothesis that product prices (in this case, deposit interest rates) are determined by the levels of concentration, own market share, and inter-firm rivalry in local markets. We test these hypotheses in a simultaneous equations system of deposit prices and advertising-to-deposit ratios. The system is estimated for 13 different deposit products – including NOW accounts, money market mutual accounts (MMDAs), and a variety of short-term, long-term, negotiable, and non-negotiable certificates-of-deposit (CDs) – using three-stage least squares techniques, with fixed thrift effects and fixed time effects.

In general, our findings suggest that thrift institutions use advertising in a strategic fashion similar to non-financial firms. We find support in the data for each of the four advertising-related hypotheses, although the degree of this support often hinges on the attributes of the deposit products themselves (e.g., product differentiability, switching costs) or on the characteristics of the thrifts themselves (e.g., ownership structure, strategic focus). For example, the data are consistent with the branding hypothesis only for NOW account deposit rates, and are consistent with the information hypothesis only for *non*-NOW account deposit rates. Support for the branding hypothesis is strongest among subsamples of thrifts for which investment in brand-building seems most reasonable (e.g., long-lived thrifts, thrifts with a strategic product focus). We find a systematically positive structure-advertising effect for stock-owned thrifts, but no similar effect for mutual-owned thrifts, suggesting that a strong profit motive is necessary for strategic use of non-price attributes. The Dorfman-Steiner hypothesis receives systematic support throughout the data. Finally, the data are consistent with the structure-price hypothesis for deposit products more likely to be owned by relationship-based customers (NOW accounts and long-tern CDs), but we find no similar evidence for short-run CD or negotiable CD products. We also find that stock-owned thrifts tend to exploit dominant market share positions by paying reduced interest rates to their core depositors, while mutual-owned thrifts tend to pass along the benefits of dominant market share to their core depositors.

2. Five main hypotheses

None of the five hypotheses that we derive and test in this paper are new, and they all have been tested previously in the empirical industrial organization literature. However, we derive each of these hypotheses from a single theoretical model of thrift profit maximization (presented in the following section), and to our knowledge this is the first study to test all of these hypotheses collectively for depository institutions. In the course of presenting and discussing these five hypotheses, we will cite only the seminal studies most directly related to our examination of these hypotheses and their effects at depository institutions. For a thorough review of the extant literature on advertising, pricing, and market structure, the interested reader can look to Bresnahan (1989), Scherer and Ross (1990), Schmalensee (1989), or Bagwell (2003).

The *structure-advertising* hypothesis posits that advertising is a strategic tool and its level is determined by the degree of market concentration and inter-firm rivalry. The most general framework for describing this relationship is the "inverted-U", first observed by Kaldor and Silverman (1948) and afterwards by many others, and for which Greer (1971) provides an explanation. At either end of a competitive spectrum – perfect competition on the left and pure monopoly on the right – there is no strategic reason for firms to advertise. In between these two extremes, however, firms in non-collusive oligopoly markets engage in attempts to steal customers away from their competitors, and one strategy is to differentiate their products from those of their competitors by advertising. Thus, in a cross-section of markets one would expect to see an inverted-U relationship: advertising per unit of sales would at first increase with market concentration; rise to a maximum for loose oligopoly markets; and then decrease with market concentration for tight oligopoly markets and monopoly markets. In this context, the Brozen (1974) hypothesis that advertising intensity increases with competition is consistent with the right-hand-side (downward sloping) portion of this inverted-U shape.

The *branding* hypothesis posits that advertising can be "persuasive" and used to create a perception of product differentiation even where no actual differentiation exists, and by doing so create

brand loyalty among customers (e.g., Braithwaite, 1928, Chamberlain, 1933, Bain, 1956 and, Comanor and Wilson, 1967). Successful product differentiation, whether real or perceived, reduces demand elasticity and hence allows firms to set prices that are less favorable to customers (e.g., Lambin, 1974, Boulding, Lee, and Staelin, 1994), for example, lower deposit rates in the case of thrifts. Branding is more likely to be effective for deposit products that already have some qualitative differences across firms, e.g., checking accounts which can vary in terms of locational convenience (branch offices, ATMs, internet banking) or personal service (availability and/or quality of human tellers).

The antithesis of the branding hypothesis is the *information* hypothesis, which posits that advertising can be "informative" and used to communicate actual and observable, rather than perceived, product attributes to potential customers (e.g., Chamberlain, 1933, Ozga, 1960, Stigler, 1961, Telser, 1964). This type of advertising is likely to be effective for products that vary across competitors in objective, measurable attributes which can be communicated in advertisements. For thrift institutions, these might be 'financial commodity' products such as certificates of deposit that are identical across competitors in every way except the contractual interest rate; thrifts are likely to advertise these products if they are offering a higher-than-market interest rate.

The *Dorfman-Steiner* (1954) hypothesis posits that a profit-maximizing firm will set its advertising expenditures optimally as a joint function of (a) its marginal revenue product and (b) its advertising elasticity of demand. In other words, firms advertise more when the benefits from advertising are high: if selling a marginal unit generates a large contribution to profits and/or if a marginal dollar of advertising yields large increases in sales. Note that under this hypothesis advertising has no strategic role, and is evaluated similar to other inputs to the production process.

The *structure-price* hypothesis posits that prices are determined by the structure of the local market (firm market shares and overall market concentration) and the degree of inter-firm rivalry supported by that structure. The original market structure hypothesis dates to Bain (1956): in the presence of entry barriers, high market concentration will convey collective market power to <u>all</u> of the incumbent firms, allowing them to charge higher prices (in our case, lower deposit rates), and as a result

earn higher profits. If high market concentration is due primarily to a single firm with a very high market share, then that dominant firm may enjoy market power and the ability to charge high prices and earn high profits, while the other incumbent firms may not. A competing theory known as the "market efficiency" hypothesis – generally associated with the University of Chicago (e.g., Demsetz 1973) – states that observed positive relationships between market structure and profits reflect the market positions gained by especially well-run firms. These efficient firms offer a better price-quality combination to customers, and hence gain both high market share (driving up market concentration) and earn high profits (by charging higher prices and/or having lower production costs). To disentangle these related phenomena in our empirical model, we interact local market concentration with thrift market shares; include a variable that measures thrift production costs; and use fixed thrift effects estimation to control for inter-thrift quality differences that are unobservable in the data.

3. Theoretical model

In this section we develop a theoretical model of market structure, price competition, and non-price competition for thrift institutions. The model builds on previous work by Klein (1971), Hannan (1991), and de Pinho (2000), and defines non-price competition broadly to include advertising or other variable expenditures that affect actual or perceived brand image or service quality. While the core theoretical implications of the model are standard, in estimation we augment the model to test a wider set of alternative theories of market structure and strategic price and non-price behavior.

We make several simplifying but reasonable assumptions about thrift production functions and business strategies. Thrifts purchase deposit liabilities and earn a margin by investing them in home mortgage loans. Thrifts are price-takers in competitive mortgage markets, but compete with rival thrifts in deposit markets by choosing deposit interest rates and non-price attributes.[1] Thrift *i* faces demand for

[1] In the empirical implementation of the model, we include both commercial banks and thrifts when measuring the degree of competition in deposit markets as these two classes of institutions are found to compete for the same deposits (Cohen, 2004, and Adams, Brevoort, and Kiser, 2004).

deposits $D_i(r_i, r_k, V_i, V_k)$. Deposit demand is increasing in the interest rate r_i paid by thrift *i* to its depositors; increasing in the level of the non-price attribute V_i offered by thrift *i* to its depositors; and decreasing in the price and non-price attributes of rival thrifts r_k and V_k.

Thrifts choose their price (r) and non-price (V) attributes to maximize their profits π as follows:

$$\pi_i = [p\tau_i - r_i] \times D_i - C_i(D_i, L_i, V_i) \quad (1)$$

where p is the exogenous rate earned by all thrifts on mortgage investments; $C_i(D_i, L_i, V_i)$ is a cost function that is increasing in deposits, loans, and non-price attributes; and $\tau_i = L_i/D_i$ is the loan-to-deposit ratio which can theoretically be greater than, equal to, or less than one. We treat τ_i as a long-run policy variable that varies across thrifts but is fixed in the short-run. If a thrift's choices of r_i and V_i attract higher (lower) levels of deposits D_i , then the thrift can immediately restore its τ_i policy by making more (fewer) loans L_i in the competitive mortgage market.

We treat r as an 'all-in' price of deposits in the theoretical model. This is appropriate for certificates of deposit (CDs) and for deposit transactions accounts that do not charge fees. In practice, however, some deposit products have a two-part price: an interest rate ***paid to*** the depositor in exchange of the use of her funds, plus a fee or fees ***charged to*** the depositor in exchange for various services (e.g., covering over-drafted checks). In the U.S., financial regulators require thrifts to report the interest rates they pay on a wide variety of deposit products; however, thrifts are not required to report deposit-related fees separately from other fee income. To the extent that fee structures are similar across thrifts, this mismeasurement of r should not substantially bias our results; in any event, this should be an issue only for checking accounts (primarily NOW accounts) and not for time deposits (CDs).

We treat V as a general non-price attribute in the theoretical model that is variable in the short-run. This would include such as expenditures on marketing, advertising, or promotions. This is appropriate because we observe the thrift data quarterly. In the empirical model we treat non-price

attributes such as the number of branches-per-depositor (locational convenience) or the number of employees-per-branch (personal service) as fixed thrift attributes that are exogenous in the short-run.

Differentiating (1) with respect to the deposit interest rate r_i and the variable non-price attribute V_i yields the following first order conditions:

$$\partial\pi_i/\partial r_i = -D_i + [p\tau_i - r_i - \partial C_i/\partial D_i] \times [\partial D_i/\partial r_i + (\partial D_i/\partial r_k)(\partial r_k/\partial r_i)] - \partial C_i/\partial r_i = 0 \quad (2)$$

$$\partial\pi_i/\partial V_i = [p\tau_i - r_i - \partial C_i/\partial D_i] \times [\partial D_i/\partial V_i + (\partial D_i/\partial V_k)(\partial V_k/\partial V_i)] - \partial C_i/\partial V_i = 0 \quad (3)$$

It will be useful to have on hand expressions for the firm-level price (r_i) and non-price (V_i) elasticities of demand. These deposit demand elasticities are defined as follows:

$$\varepsilon^r_i = [\partial D_i/\partial r_i + (\partial D_i/\partial r_k)(\partial r_k/\partial r_i)] \times (r_i/D_i) \quad (4)$$

$$\varepsilon^V_i = [\partial D_i/\partial V_i + (\partial D_i/\partial V_k)(\partial V_k/\partial V_i)] \times (V_i/D_i) \quad (5)$$

where ε^r_i and ε^V_i are assumed to be positive, and as assumed above $\partial D_i/\partial r_i > 0$, $\partial D_i/\partial V_i > 0$, $\partial D_i/\partial r_k < 0$, and $\partial D_i/\partial V_k < 0$. The conjectural variation terms $\partial r_k/\partial r_i$ in (4) and $\partial V_k/\partial V_i$ in (5) represent thrift *i*'s rational conjectures about the reactions of thrift *k*, respectively, to its price and non-price choices. As such, the degree of market competitiveness and inter-thrift rivalry is embedded in these terms. In a perfectly competitive market $\partial r_k/\partial r_i = 0$ and $\partial V_k/\partial V_i = 0$, while in a perfectively collusive market $\partial r_k/\partial r_i = 1$ and $\partial V_k/\partial V_i = 1$. Thus, as the market becomes less rivalrous the demand elasticities (4) and (5) will decline – in other words, demand becomes less elastic.

Substituting (4) and (5) into (2) and (3), respectively, and rearranging yields useful expressions for thrift *i*'s profit-maximizing levels of price and non-price attributes:

$$r^*_i = (p\tau_i - \partial C_i/\partial D_i) \times [\varepsilon^r_i/(1 - \varepsilon^r_i)] \quad (6)$$

$$V^*_i/D_i = [(p\tau_i - r_i - \partial C_i/\partial D_i) \times \varepsilon^V_i] / [\partial C_i/\partial V_i] \quad (7)$$

where the non-price attribute is scaled by total deposit demand. These two equations form the basis for our empirical investigation.

Although a closed-form solution for V_i/D_i is possible by substituting (6) into (7) and rearranging, we prefer the non-closed-form solution in (7) in which the non-price attribute is an explicit function of the deposit price. It is unlikely that thrifts choose V_i independent from r_i , or vice versa, and moreover the degree of interdependency between these two choice variables is likely to vary across deposit products. For example, the branding hypothesis discussed above, in which advertising creates a brand image which allows more favorable pricing, suggests a negative relationship between r_i and V_i for differentiable deposit products (e.g., checking accounts). In contrast, the information hypothesis discussed above, in which advertising informs the market above product attributes, suggests a positive relationship between r_i and V_i for non-differentiable deposit products (e.g., CDs). Hence, to test the branding hypothesis against the information hypothesis requires us to estimate the relationships in (6) and (7) as a fully simultaneous system of equations.

Standard 'structure-conduct-performance' predictions work in our model through the elasticity measures (4) and (5). An increase in market concentration that reduces competitive rivalry in prices (i.e., an increased conjectural variation term $\partial r_k/\partial r_i$) is reflected in equation (6) by a reduction in the price elasticity ε^r_i and hence a decrease in r_i. An increase in market concentration that reduces competitive rivalry in non-price attributes (i.e., an increased conjectural variation term $\partial V_k/\partial V_i$) is reflected in equation (7) by a reduction in the non-price elasticity ε^V_i and hence a decrease in V_i/D_i. The Dorfman-Steiner condition discussed above is embedded directly in equation (7), where advertising is positively related to both the profit margin from intermediation ($p\tau_i - r_i - \partial C_i/\partial D_i$) and the advertising elasticity of demand (ε^V_i).

The model yields other reasonable predictions as well. In equation (6), efficient thrifts (low $\partial C_i/\partial D_i$) will earn high margins ($p\tau_i - \partial C_i/\partial D_i$) and thus will be willing to pay higher interest rates to fund new business. This derived result is consistent with the market-efficiency hypothesis discussed above. In

equation (7), thrifts will spend more on non-price attributes if these can produce them in a cost-efficient fashion (low $\partial C_i/\partial V_i$).

4. Empirical implementation

We estimate the interest rate equation (6) and the advertising intensity equation (7) as a simultaneous system, using a 1994-2000 panel of quarterly data for U.S. thrift institutions. The regression equations are specified as follows:

$$\begin{aligned} DEPRATE_{it} = f_8 (& ADV/TD_{it}, HHI_{it}, MS_{it}, HHI_{it}\times MS_{it}, \\ & RIVALRATE_{it}, TAU_{it}, INCGROWTH_{it}, \\ & COSTRATIO_{it}, LOWEQ_{it}, TIME_t, THRIFT_i) + e_{8,it} \end{aligned} \tag{8}$$

$$\begin{aligned} ADV/TD_{it} = f_9 (& DEPRATE_{it}, MARGIN_{it}, HHI_{it}, HHI^2_{it}, MS_{it}, HHI_{it}\times MS_{it}, \\ & RIVALADV_{it}, lnASSETS_{it}, INCGROWTH_{it}, \\ & INSTALLMENT_{it}, BUSINESS_{it}, IRAS_{it}, TIME_t, THRIFT_i) + e_{9,it} \end{aligned} \tag{9}$$

where the subscript *i* denotes thrifts and the subscript *t* denotes time in quarters. In equation (8) the dependent variable $DEPRATE_{it}$ is the deposit interest rate paid by thrift *i* in quarter *t*. In equation (9) the dependent variable ADV/TD_{it} is the ratio of advertising expenditures-to-total deposits for thrift *i* in quarter *t*. Note that the ADV/TD and DEPRATE variables also appear on the right-hand-sides of equations (8) and (9), respectively, making the system of equations fully simultaneous.

The five main hypotheses are specified in (8) and (9) as follows: The branding hypothesis predicts a negative coefficient on ADV/TD in equation (8); if advertising creates a brand image, then thrifts that advertise more should be able to attract deposits for below-market interest rates. The information hypothesis predicts a positive coefficient on DEPRATE in equation (9); if advertising is used to convey information, then thrifts that pay above market interest rates will advertise more. The Dorfman-Steiner hypothesis predicts a positive coefficient on MARGIN in equation (9), where MARGIN equals the time *t* difference between the nationwide average 30-year fixed mortgage rate and thrift *i*'s

average deposit interest rate; if thrifts set their advertising expenditures optimally as a function their marginal revenue products, then thrifts with large profit margins will advertise more.

The structure-price hypothesis predicts a negative derivative with respect to HHI in equation (8), where HHI is the Herfindahl index calculated using the deposit shares of both the thrifts and the commercial banks present in thrift *i*'s largest local market.[2] We interact HHI with MS, where MS is thrift *i*'s share of local market deposits – this specification allows us to estimate the structure-price (collusion) effect of HHI while holding MS constant, as well as a separate structure-price (dominant firm) effect for MS while holding HHI constant. Hannan (1991) first proposed this specification, arguing that the interaction term allows us to disentangle collusive effects from dominant firm effects. Note that we include the variable COSTRATIO – the ratio of non-interest operating expenses (excluding advertising) to total assets for thrift *i* – in equation (8) as a weak test of the competing market-efficiency hypothesis. A negative coefficient on COSTRATIO would support this hypothesis, as it would be consistent with both of the following: cost-efficient thrifts can afford to compete for deposits by paying high interest rates and/or thrifts offering high quality products that cost more to produce (e.g., lots of employees or branch offices) can retain their depositors while paying lower interest rates.

In general, the structure-advertising hypothesis predicts an inverted-U relationship between market concentration and advertising. A positive linear effect from the HHI and HHI×MS coefficients, coupled with a negative coefficient on HHI^2, would be suggestive of this relationship; the derivative with respect to HHI in equation (9) could be either positive, zero, or negative depending on how the distribution of HHI lies relative to the inverted-U. As discussed above, a positive derivative would suggest that thrifts substitute non-price competition for price competition as markets grow more

[2] Deposit products offered by thrifts and banks are considered to be substitutes by many households (see Hannan and Liang, 1995). For computational convenience we calculated HHI for the geographic market (MSA or rural county) from which thrift *i* drew its largest amount of deposits. We calculate the market share (MS) variable in similar fashion. Note that the average thrift collected 87.4% of its deposits from a single market. We re-estimated all of our regressions for a subsample of single-market thrifts that drew 100% of their deposits from a single MSA or a single county, and found robust results.

concentrated, while a negative derivative (Brozen, 1974) would suggest that increased market concentration reduces thrift competition across both price and non-price dimensions.

We include a number of additional right-hand-side variables in (8), some of which are proxies for variables that appear in the theory model. RIVALRATE is the unweighted average interest rate charged by rival thrifts ($k \neq i$) operating in thrift *i*'s home market.[3] This variable controls for variation in deposit rates that is idiosyncratic to the local market and not absorbed by the other right-hand-side variables; we a positive coefficient on RIVALRATE in equation (8). TAU is the ratio of total loans to total deposits for thrift *i*. Although in our theoretical model $\tau_i = L_i/D_i$ immediately reverts back to its long-run value, in practice it is likely that thrifts require some time to correct imbalances in this long-run policy variable. Thus, we expect a positive coefficient on TAU in equation (8) because thrifts with strong lending opportunities (relative to existing deposit balances) should be willing to pay higher rates to attract deposit funding. INCGROWTH is the annualized growth in personal income in thrift *i*'s home state; the expected coefficient on INCGROWTH in equation (8) is ambiguous: in economically robust markets deposits will be plentiful (downward pressure on rates) but bank and thrift demand for deposits to fund growing lending opportunities will be high (upward pressure on rates). LOWEQ equals one for thrifts with equity-to-asset ratios less than 2% and equals zero otherwise; the expected coefficient on LOWEQ in equation (8) is ambiguous: a positive sign would indicate that poorly capitalized thrifts succumb to moral hazard incentives and purchase deposits at above market rates; a negative sign would indicate that financially distressed thrifts attempt to save expenses by cutting rates paid to depositors.

We also include a number of additional right-hand-side variables in (9). RIVALADV is the unweighted average of the advertising-to-deposits ratios for rival thrifts ($k \neq i$) operating in thrift *i*'s home market. This variable controls for variation in advertising expenditures that is idiosyncratic to the local market and not absorbed by the other right-hand-side variables; we expect a positive coefficient on

[3] During our sample period, deposit rate and advertising expenditure data were available only for thrifts, and not for commercial banks. When there were no rival thrifts in thrift *i*'s home market, we measured RIVALRATE (and also RIVALADV) based on all thrifts operating in thrift *i*'s home state.

RIVALADV in equation (9). lnASSETS is the natural log of thrift *i*'s total assets measured in year 2000 dollars; we expect a negative coefficient on lnASSETS in equation (9), because larger firms can take advantage of well-known advantages of size in advertising (Arndt and Simon, 1983). We expect a positive coefficient on INCGROWTH in equation (9), because in economically robust local markets thrifts should get a relatively higher return to a given amount of advertising expenditures. We include three variables to control for thrift *i*'s product mix: INSTALLMENT is equal to the ratio of consumer installment loans to total assets; BUSINESS is equal to the ratio of commercial loans to total assets; and IRAS is equal to the ratio of IRA and Keogh accounts to total assets. The expected coefficient on these variables depends on their advertising elasticities: a positive sign would suggest that demand for these products is advertising-elastic, while a negative sign would suggest advertising-inelasticity.

We include a vector of quarterly dummy variables ($TIME_t$) in both equation (8) and equation (9) to absorb variation in the dependent variables due to intertemporal changes in market prices (e.g., Treasury rates, mortgage rates), technological change, and regulatory and supervisory trends. The system is estimated with fixed thrift effects ($THRIFT_i$), which we implement by differencing all variables from their sample means prior to estimation.

4.1 Data

The data used in our analysis come from a number of sources. We observed financial variables from the Thrift Financial Reports (TFRs) between the first quarter of 1994 and the last quarter of 2000. The beginning date was dictated by the availability of TFRs to us, and the end date was dictated by the availability of TFR Schedule YD (yield information on deposits) which was discontinued after year-end 2000. We relied on the Federal Deposit Insurance Corporation's (FDIC) annual Summary of Deposits data for local market share data for both banks and thrifts. The nationwide average 30-year fixed mortgage rate and the consumer price indices (to inflate dollar amounts when needed into year-end 2000 values) were obtained from the FRED II database of the Federal Reserve Bank of St. Louis. Annual data on personal income growth at local market level was obtained from the Bureau of Economic Analysis (BEA).

Our data set includes 1,867 thrifts operating in 666 banking markets during 1994-2000.[4] Thrifts less than 6 years old were excluded from the data (DeYoung and Hasan 1997, DeYoung 2003). Of the 331 urban markets that existed during our sample period, 247 contained at least one thrift institution and hence are represented in our study. Rural markets are under-represented: of the 2,276 non-MSA markets that existed during our sample period, only 419 contained at least one thrift institution.

Summary statistics for all of the variables used in the regression equations (8) and (9) are displayed in Table 1.[5] This includes interest rates (DEPRATE) for the 13 different deposit products for which we separately estimate our model: NOW accounts, MMDAs, short-term CDs (time deposits with maturities less than 1 year), long-term CDs (time deposits with maturities greater than 1 year), and negotiable CDs (time deposits issued in amounts of $100,000 or more, that can be sold to other depositors). It is our hope that estimating our model for a variety of different deposit products will reveal how competitive price and non-price strategies vary across products with different characteristics.

For example, NOW accounts are checking accounts held by core depositors who differ from other types of depositors in a number of ways: they are more likely visit thrift offices, ATMs, or internet web sites; they incur higher switching costs due to set-up costs for direct deposit and automated bill-pay arrangements; and they are likely to have chosen their current thrift institution because of its physical location relative to their home or workplace. These characteristics make NOW account depositors less price inelastic, and probably make them more susceptible to advertising designed to create a brand image. In contrast, MMDA depositors – who have only limited check-writing and funds-transfers privileges and are subject to substantial minimum balance requirements – are likely to have selected their current thrift institution based on interest rates, which are substantially higher for MMDAs than for NOW accounts.

[4] The number of thrifts steadily declines during our sample period from 1,665 during the first quarter of 1994 to 1,064 during the last quarter of 2000.

[5] Some of the variables displayed in Table 1 are constructed by taking the ratio of two other variables. This construction process created a small number of substantial outlying values for some variables. To mitigate the potential influence of these values on our regression results, we 'Windsorized' all ratio variables using the 1st and 99th percentiles of their sample distributions.

These depositors are more price-elastic than NOW account holders, less susceptible to brand-image advertising, but more susceptible to advertising that communicates information on interest rates.

Certificates of deposit (CDs) are financial commodity products that differ across competing thrifts mainly in terms of their contractual interest rates. Thus, advertising aimed at selling these products will tend to focus on quantifiable price and maturity information. Still, there are some differences across types of CDs that may have implications for price and non-price competitive strategies. Short-term CDs are fully insured, small denomination financial commodity products sold directly to household customers to fill thrifts' short-term funding needs. Larger denomination negotiable CDs are also issued to fill thrifts' short-term funding needs, but these products – often referred to as "purchased funds" – are typically sold through brokers and are not insured beyond the first $100,000. Long-term CDs are fully insured, small denomination products that are often owned as savings vehicles by core depositors; as such (and unlike short-term CDs and negotiable CDs) they may exhibit some of the price inelasticity and susceptibility to advertising characteristic of core depositors.

Finally, we note two imperfections in the data we use to measure our dependent variables. First, our regression tests are specified on a product-specific basis, but our advertising variable ADV/TD is not a product-specific measure. Rather, the numerator in ADV/TD measures total advertising expenditures for thrift *i*. Thus, the magnitudes of any empirical relationships that we may find between product-specific interest rates and thrift-level advertising should be interpreted with some caution. Second, our measure of price – contractual deposit interest rates – is incomplete for NOW accounts or other deposit products that also impose service charges (e.g., minimum balance fees, over-draft protection, per check charges). In practice, this will matter only for checking (NOW) accounts, and is unlikely to matter for MMDAs or time deposits. We attempt to control for this by including a proxy for deposit service charges on the right-hand-side of our NOW account regressions: FEES/TD equals total noninterest fees collected by the thrift from its customers. Note that FEES includes both deposit-related and non-deposit-related items (which is unavoidable given the structure of the TFRs), and as such it may be a poor proxy for our purposes.

5. Contribution to the literature

Nearly all of the previous empirical literature on joint price and advertising competition uses data from non-financial firms (e.g., Nelson, Siegfried, and Howell 1992, Thomas 1999, and others). Relatively few studies have examined competitive advertising by financial firms – not surprising, given how unimportant advertising has traditionally been in this industry. In fact, until recently commercial banking companies were not even required by their regulators to report advertising and marketing expenses separately from other operating expenses. However, as new lending technologies, distribution systems, and evolving market structures have transformed the retail financial services industry, advertising has become an increasingly important strategic tool for depository institutions. This paper extends the existing empirical literature on price and advertising competition to the financial industry.[6]

Two extant empirical literatures on financial firms are most relevant for the purposes of this study. The first is the empirical literature that examines the structure-performance relationship in banking and thrift deposit markets. Berger and Hannan (1989) estimated price-concentration relationships for a number of different deposit products (MMDAs, Super-NOW accounts, and 3-, 6-, 12-, 30-month CD rates) offered by commercial banks; they found strong support for the structure-conduct-performance hypothesis, but little support for the efficient markets hypothesis. Corroborative evidence was provided by Calem and Carlino (1991), who found a negative relationship between local market concentration and the interest rates offered by commercial banks on MMDAs and 6-month CDs. These two studies relied on pooled cross-sectional time-series estimations to conduct their analyses.

The second extant empirical literature examines the determinants of advertising expenditures by depository institutions. Lapp (1976) finds that market structure affects advertising expenses in a manner consistent with the Dorfman-Steiner hypothesis for U.S. commercial banking companies, while Kohers and Simpson (1981) find no support for this hypothesis for U.S. savings and loans. Kohers and Simpson

[6] Ors (2004) provides a review of the empirical research on the advertising of depository institutions.

(1981), Hasan, Hunter, and Mathis (2000), and de Pinho (2000) all find that the advertising intensity of thrift institutions increases with competition, consistent with the Brozen hypothesis. Scott (1978) found support for the inverted-U hypothesis for U.S. depository institutions; however, Wolken and Derrick (1986) found no support for this hypothesis in an expanded version of Scott's model that included market entry and market size variables, and concluded that market power has no bearing on advertising intensity for commercial banks.

We advance both of these empirical literatures by melding them together. We simultaneously test the main hypotheses from both literatures – hypotheses about the impact of market structure on deposit prices on-the-one-hand, and hypotheses about the determinants of depository advertising on-the-other-hand – without constraining either deposit prices or advertising levels to be exogenous. Moreover, we estimate these simultaneous price and advertising relationships for an assortment of thrift deposit products with characteristics (liquidity, switching costs, differentiation by location or service quality) that may make them either more or less sensitive to image-creation or branding via advertising. Finally, unlike much of the existing literature, we estimate fixed-thrift effects models to control for unobservable characteristics such as product quality or locational convenience that may affect deposit rates.[7]

There is also an extant theoretical literature on price and advertising competition (Butters 1977, Stegeman 1991, Stahl 1994, and others). However, to our knowledge de Pinho (2000) is the only existing study that offers a theoretical model to explicitly link the market structure, deposit pricing, and advertising relationships explored in the earlier empirical literature on depository institutions. Although we do not attempt to extend this theoretical literature – we merely borrow de Pinho's theoretical set-up – our empirical implementation of his model is substantially richer.

First, although de Pinho derived a multiple equation theoretical model of price and non-price competition at depository institutions, in his empirical tests he specified the equations as reduced forms

[7] One exception is Rosen (2003).

and estimated them independent of each other.[8] In contrast, we specify his model to allow deposit prices and non-price attributes (advertising) to influence each other in a simultaneous system. Second, de Pinho used data on Portuguese depository institutions during a highly regulated time period when competition between these firms was constrained. In contrast, during our sample period U.S. depositories were relatively unregulated in terms of price, non-price, and geographic competition, and because of this we should be able to estimate more robust relationships between market structure, firm strategic behavior, and market prices. Third, de Pinho constructed an imputed price variable (deposit interest rate) by dividing interest expenses obtained from firms' income statements by the volume of year-end deposits obtained from firms' balance sheets. In contrast, we directly observe the contractual interest rates paid by thrifts on new deposit accounts opened during the final week of each quarter. Finally, de Pinho's data set included just 23 firms operating in a single nation-wide market over ten annual time periods, while our data set includes nearly two thousand thrifts operating in 666 local markets over 32 quarterly time periods.

6. Results

We estimated the empirical model (8) and (9) as a simultaneous system for the full 1994-2000 quarterly panel data set, using three-stage least squares techniques with thrift fixed effects. The thrift fixed effects control for unobservable and/or non-quantifiable variation across thrifts such as service quality, product quality, and locational convenience. Thus, the estimated coefficient magnitudes are *not* interpreted as cross-sectional elasticities, but rather as conditional variations in the dependent variables for individual thrifts in response to changes in their vectors of exogenous conditions. The system (8) and (9) was estimated separately for interest rates (DEPRATE) from 13 different deposit products. If a thrift did not sell the deposit product in question during a quarter, that thrift-quarter observation was dropped. The results are reported in Tables 2 and 3.

[8] De Pinho (2000) estimates a system of equations using SUR, thus allowing error terms to be correlated across equations, but does not, for example, allow advertising to affect deposit interest rate, or vice versa.

In general, our findings suggest that thrift institutions use advertising in a strategic fashion similar to non-financial firms. We find at least some support in the data for each of our five main hypotheses. Interestingly, the degree to which the data support these hypotheses often depends on the attributes of the different deposit products or, as revealed in the subsample regressions, the characteristics of the thrifts themselves. We find strong evidence consistent with the structure-price hypothesis for relationship-based deposit products like NOW accounts, but no similar evidence for short-run or negotiable CD products. This bifurcation of results for NOW accounts versus other deposit products is a re-occurring feature of our results: we find evidence consistent with the branding hypothesis only for NOW account deposit rates, and evidence consistent with the information hypothesis only for *non*-NOW account deposit rates. Support for the branding hypothesis is strongest among thrifts for which investment in brand-building seems reasonable, e.g., for long-lived thrifts and for thrifts with a strong strategic product focus. The Dorfman-Steiner and structure-advertising hypotheses both receive systematic support in the data, although the latter effect is non-existent for mutual-owned thrifts, suggesting that a strong profit motive is necessary for strategic use of non-price attributes. Mutual-owned thrifts are also less likely to exploit market share gains by paying reduced interest rates to their core depositors.

6.1 Results from equation (8)

We begin with the two hypotheses tested in equation (8), the structure-price hypothesis and the branding hypothesis. These results are displayed in Table 2.

Consistent with the structure-price hypothesis, the derivative with respect to HHI (reported at the bottom of the columns) is negative and significant for deposit products that entail some relationship, stickiness, or inelasticity between the thrift and the depositor. This effect is strongest, although economically small, for the checkable deposit products (NOW accounts and MMDAs). An increase in HHI from the sample mean to 0.18 (a critical level in U.S. antitrust guidelines) is associated with only about a 2 basis point reduction in these deposit rates. The HHI derivative is also negative and significant for long-term CD products – often used as a savings vehicle by these same core deposit customers – although the economic effect is smaller still for the interest rates on these products. This derivative is

either non-significant or positive for short-run and negotiable CD products; the degree of local market rivalry is likely to matter less for these deposit products, which are typically sold to raise funds in the short-run outside of local markets and to non-core customers.[9]

Holding HHI constant, NOW account rates also tend to decrease by small amounts with thrifts' own market share. A doubling of MS (from 6.6 percent to 13.2 percent of the local market) is associated with about a 3 basis point reduction in interest rates on these deposits. Thus, the data reflect the existence of pricing power at both the market-level (e.g., conveyed to all thrifts by high market concentration) and at the firm-level (e.g., conveyed to a single dominant thrift) for some deposit products in some local markets. The negative market share effect holds only for NOW accounts, however, and tends to be non-significant or positive for the other deposit products. The positive MS derivatives for negotiable CDs may indicate that thrifts with high market shares often need to go outside their local markets for short-run deposit funding. (Although the MS derivative is not our formal test of the branding hypothesis, its negative sign for NOW accounts is consistent with branding: a dominant market share may by itself convey a brand image, and allow a thrift to set more favorable prices on differentiable deposit products.)

The coefficient on COSTRATIO is usually negative and is statistically significant for about half the deposit products. As discussed above, this is consistent with the market-efficiency hypothesis. Although this is a rather weak test, it suggests that the competing hypotheses about market structure and prices are not necessarily mutually exclusive.

The branding hypothesis predicts a negative coefficient on ADV/TD. However, this coefficient is significantly positive in all cases *except* for the NOW account equation, where it is either negative or non-significant (depending on whether imperfect control variable FEES/TD is specified). As discussed above, NOW accounts are more likely than other deposit products to be "brandable" because thrifts can differentiate the attributes (e.g., free checking, internet banking) and service quality (e.g., access to

[9] These positive signs may be capturing the "rural deposit premium" paid by banks and thrifts in many rural markets, where local market concentration tends to be very high. DeYoung, Hunter, and Udell (2004) report that interest expenses as a percentage of assets are about 25 basis points higher for rural commercial banks than for similar-sized urban banks (table A1).

branches, tellers, and ATMs) associated with this core customer product, and can more efficiently target these captive customers with advertising messages (e.g., monthly statements, branch office promotions). The economic magnitude of this branding result is more substantial: in column [3] a doubling of ADV/TD is associated with a 22 basis point reduction in NOW account rates. The significantly positive ADV/TD coefficients for the remaining deposit rates foreshadow the information effect, which we test formally in equation (9).

We find further confirmation of the differences between checkable and non-checkable deposit products by comparing the estimated RIVALRATE coefficient across equations. Not surprisingly, this coefficient is significant and positive in all equations, but the magnitudes vary substantially. For CD products this coefficient ranges between 0.403 and 0.825, and is generally closer to 1 than to 0. This is consistent with a "law of one price" for financial commodity products that are not differentiable across firms. This coefficient is substantially smaller for NOW accounts and MMDAs, however, ranging only from 0.175 to 0.274; for example, the average thrift responds to a 100 basis point increase in market interest rates on checking accounts by increasing its own checking account interest rates by just 20 basis points or so. This is indicative of the switching costs in these deposit accounts, which make thrifts' own checking deposit demand curves relatively inelastic in the short-run (i.e., quarterly).

Several additional results in Table 2 are worth mentioning. The significant negative coefficient on LOWEQ – about 25 to 45 basis points on NOW accounts and 45 to 60 basis points on long-term CDs – may indicate that financially troubled thrifts cut costs by cutting rates paid to their most inelastic customers. However, we find only marginal evidence that undercapitalized thrifts respond to moral hazard incentives by offering higher rates to purchase 'hot money' – the LOWEQ coefficients are positive for short-run CDs and negotiable CDs with maturities of less than 6 months, but tend to be significant only at the 10 percent level. The negative sign on the FEES/TD coefficient suggest that this accounting line is a poor proxy for fees on checking accounts (which should vary positively with checking account interest rates) and is probably dominated by fees on non-deposit products (e.g., investment products and

services) or non-NOW deposit accounts (e.g., early withdrawal penalties). The coefficients on the TAU and INCGROWTH variables are either non-significant or follow no systematic pattern.

6.2 Results from equation (9)

We now focus on the three hypotheses tested in equation (9), the structure-advertising hypothesis, the information hypothesis, and the Dorfman-Steiner hypothesis. These results are displayed in Table 3. For consistency with Table 2 we include all 15 regressions, noting that the only data that change across the columns of Table 3 are the right-hand-side DEPRATE variables. Not surprisingly, the estimated parameters of (9) are quite robust across these columns.

We find an inverted-U shape between ADV/TD and HHI (positive coefficient on HHI and negative coefficient on HHI^2), but this relationship reaches its peak for values of HHI that are far above the sample means. Thus, we find a positive relationship between HHI and ADV/TD at the means of the data: an increase in HHI to the critical 0.18 level is associated with between a 2.2% and 5.6% increase in advertising expenditures. This is a substantial economic effect and, coupled with the negative structure-price effect found in Table 2, it suggests a strategic role for advertising: thrifts substitute non-price competition for price-competition as local markets become more oligopolistic.

Holding HHI constant, a doubling of a thrift's own market share is associated with a 1.8% to 4.9% decline in advertising expenditures – this makes economic sense, given that thrift *i*'s potential returns from advertising are proportional to its rivals' combined market shares (i.e., $1 - MS_i$). This 'potential returns' interpretation is consistent with our tests of the Dorfman-Steiner hypothesis. The coefficient on MARGIN is positive, statistically significant, and economically large: a 100 basis point increase in MARGIN is associated with a 2.3% to 4.7% increase in advertising expenditures.

We also find strong evidence consistent with the information hypothesis. The coefficient on DEPRATE is always positive and significant for short-term CDs, long-term CDs, and negotiable CDs, deposit products that thrifts use predominantly or exclusively to raise funds. These products are non-differentiable financial commodities, and vary across thrifts only in terms of the contracted interest rate. Hence, the most likely explanation for these positive coefficient estimates is that thrifts use advertising to

inform potential customers (e.g., via newspaper ads) or current depositors (e.g., via in-branch promotions or circulars included with account statements) that they are offering above-market rates on these products. A 50 basis point increase in these interest rates is associated with a 5% to 14% increase in advertising expenditures. The large magnitude of this effect is interesting – it implies that information about deposit prices is a primary role of advertising expenditures at thrift institutions.

Equally interesting is the striking difference in the DEPRATE coefficient between the two types of checkable deposit accounts. For NOW accounts, which are first and foremost transactions accounts, this coefficient is negative and significant. This is not at all consistent with an information effect – on the contrary, this is more consistent with branding effects – and it implies that thrifts accompany rate reductions in NOW accounts with increased marketing to assuage these core customers and reduce the chance of depositor run-off. For MMDAs, which are primarily savings vehicles even though they also allow the depositor a limited number of withdrawals by check or transfer, this coefficient is positive and significant – consistent with an information effect and implying that MMDA deposits are rate-sensitive.

Several additional results in Table 3 are worth mentioning. Not surprisingly, the coefficient on RIVALADV is positive and significant, but the magnitude is very small – a doubling of ADV/TD by market rivals is associated with at most just a 3.5% increase in a thrift's own ADV/TD. Thus, unlike thrift deposit prices which have a strong tendency to move together with rival thrift deposit prices (see results in Table 2), thrift advertising is little influenced by rival thrift advertising. Other significant influences on thrift advertising include local economic conditions, thrift size, and product mix. The coefficient on INCGROWTH is positive, another indication (consistent with the market share and Dorfman-Steiner effects in Table 2) that thrifts increase advertising expenditures as the potential returns from advertising increase. The coefficient on lnASSETS is negative, consistent with diminishing returns to advertising and/or size-based increases in the efficiency of advertising. The coefficients on the product mix variables likely reflect the degree of competition thrifts face in various lines of business. The data suggest that thrifts spend an above-average amount to advertise consumer installment loans, perhaps because thrifts are competing against banks, finance companies, and other thrifts for these customers. In

contrast, the data suggest that thrifts spend a less-than-average amount on advertising IRA and Keogh accounts, perhaps because these products are predominantly cross-sold to captive, core depositors.

6.3 Results from subsample regressions

We checked these results for robustness by re-estimating the model for a variety of data subsamples and re-specifications. Most of the robustness tests generated results that are fundamentally similar to the results reported in Tables 2 and 3. (To save space, we do not display the results of the robustness tests here. Full results are available upon request from the authors.)

For example, we excluded RIVALR and RIVALADV from the right-hand-side of the regression equations, because we were concerned that we may have over-specified the model by including these variables. This had little effect on any of our five main hypothesis tests, other than making the estimated structure-price relationship more stable across deposit products. The only other notable change was for the LOWEQ coefficient, which revealed stronger evidence that poorly capitalized thrifts paid moral hazard premia (70 to 150 basis points) on negotiable CDs.

Similarly, our five main hypothesis tests were generally robust to re-estimating the model for data subsamples: single-market thrifts that drew all of their deposits from a single MSA or a single county; urban thrifts that drew none of their deposits from rural counties;[10] mutual thrifts that were owned by their depositors; stock thrifts that were owned by equity holders; strategically focused thrifts with high concentrations (above the sample median) of mortgage loans; and survivor thrifts that existed in both the first quarter and the final quarter of the sample period. There were a handful of notable results in these subsample regressions.

The parameters of the 'inverted-U' relationship between HHI and ADV/TD differed substantially with ownership form. In the stock-owned subsample the inverted-U reaches its apex well to the right of the subsample mean for HHI, suggesting (as in the full sample) that the average stock-owned thrift increasingly engages in non-price competition as local markets become more oligopolistic. In contrast, in

[10] Urban depository markets tend to be decidedly less concentrated (median HHI = 1344) than rural markets (median HHI = 2361).

the mutually-owned subsample the inverted-U reaches its peak very near the subsample mean for HHI – and the derivative of ADV/TD with respect to HHI tends to be statistically non-significant – suggesting that firms with weak profit motives are less likely to use advertising as a strategic tool.

Running separate regressions by ownership type also revealed some evidence of possible agency effects among the stock-owned thrifts. For NOW accounts in the mutual thrift subsample regressions, the derivative of DEPRATE with respect to MS tended to be positive, suggesting these thrifts tend to pass along to core depositors any local market power gains (e.g., in lending or fee-based services). In contrast, this derivative was negative for NOW accounts in the stock subsample regressions, suggesting that managers of these thrifts use local market power gains to exploit the inelasticity of these core depositors.

Although we found only weak support for the branding hypothesis in the full sample results displayed in Table 2, we found somewhat stronger evidence of this strategic behavior among thrifts most likely to have strong incentives to invest in brand-building: the subsample of strategically focused thrifts and the subsample of survivor thrifts. The coefficient on ADV/TD in equation (8) was more often negative and significant for thrifts in these two subsamples. Firms with a strong strategic focus (in this case, thrifts that concentrate on traditional mortgage lending) have a clear message that is easier to convey via advertising. Firms with long time horizons (in this case, thrifts that are not looking to sell the franchise) have a greater incentive to invest in a brand image.

7. Summary

There is not a rich tradition among financial institutions of using advertising as a strategic tool. This is not surprising, because the strategic actions of the firms that provide retail financial services have been heavily constrained by government regulation of prices, product offerings, and geographic location. But in recent years most of these regulatory restrictions have been lifted, creating increased opportunities and incentives for retail financial institutions to advertise.

The strategic use of advertising has been studied extensively for non-financial firms, but we know little about strategic advertising expenditures by financial institutions. This study attempts to remedy this

deficiency. We closely follow the theoretical approach of de Pinho (2000) by modeling a profit-maximizing depository institution that sells loans in competitive markets but can choose its own deposit prices and deposit non-price attributes. Our contributions to the literature comes in the empirical implementation of this model: we derive a broader set of explicit, testable hypotheses from the theoretical model; we test these hypotheses in a fully simultaneous framework that is more consistent with the spirit of the theoretical model in which deposit prices and deposit non-price attributes are jointly determined; and we estimate the model using data that are drawn from a deregulated environment in which firms are better able to compete on price and non-price grounds.

We derive five testable hypotheses from the theory model: the structure-advertising hypothesis; the branding hypothesis; the information hypothesis; the Dorfman-Steiner hypothesis; and the structure-price hypothesis. We test these hypotheses in a simultaneous equations system of contractual deposit interest rates and advertising-to-deposit ratios using a panel of 32,000 quarterly observations: 1,867 deregulated thrift institutions offering 13 different deposit products (NOW accounts, money market mutual accounts, and a variety of short-term, long-term, and negotiable CD products) in 666 local markets in the U.S. between 1994 and 2000.

We find at least some empirical support for each of our five hypotheses, and this support is often conditional on the attributes of the various deposit products or the characteristics of the various thrifts. We find that higher advertising expenditures are associated with lower deposit rates for checking accounts owned by core customers, consistent with successful brand differentiation that enhances pricing power by reducing price elasticity. In contrast, we find that advertising expenditures vary positively with interest rates on standardized time deposit products that are typically sold to non-customers, consistent with the use of advertising as a tool to convey information (e.g., an offer of above-market interest rates). We find strong positive relationships between advertising expenditures and price-cost margins, consistent with the Dorfman-Steiner hypothesis that in profit-maximizing firms advertising expenditures will be determined by marginal revenue products. We find a positive relationship between advertising expenditures and market concentration among stock-owned thrifts, but no such relationship among mutual thrifts,

suggesting that a strong profit motive is a necessary condition for strategic advertising. And we find systematic evidence that increased local market concentration confers market power on the typical thrift institution, as evidenced by small reductions in interest rates paid to depositors.

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Table 1

Summary statistics. Quarterly unbalanced panel data for U.S. thrift institutions, 1994:Q1-2000:Q4.

variable	N	mean	standard deviation	minimum	median	maximum
ADV/TD	34,255	0.047	0.042	0.006	0.036	0.302
BUSINESS	34,570	0.015	0.026	0.000	0.002	0.130
COSTRATIO	34,567	0.006	0.003	0.002	0.006	0.022
HHI	34,405	0.142	0.080	0.025	0.124	0.820
INCGROWTH	33,481	0.053	0.024	-0.221	0.052	0.311
INSTALLMENT	34,570	0.015	0.028	0.000	0.003	0.155
IRAS	34,570	0.073	0.040	0.000	0.069	0.198
lnASSETS	34,570	5.013	1.401	0.325	4.827	11.950
LOWEQ	34,582	0.003	0.053	0.000	0.000	1.000
MARGIN	34,546	6.680	1.968	2.667	6.422	14.100
MS	34,284	0.066	0.093	0.001	0.018	0.638
RIVALADV	34,255	0.054	0.052	0.014	0.043	0.461
TAU	34,546	1.002	0.244	0.484	0.973	1.943
DEPRATE:						
NOW accounts	30,513	2.113	0.697	0.240	2.020	7.040
MMDAs	31,497	3.162	0.796	0.500	3.040	6.740
CDs (1-3 months)	28,339	4.083	0.791	1.000	4.130	10.000
CDs (3-6 months)	33,937	4.759	0.737	1.550	4.880	7.350
CDs (6-12 months)	34,000	5.183	0.723	2.250	5.250	8.070
CDs (1-2 years)	33,813	5.447	0.688	2.250	5.500	7.780
CDs (2-3 years)	33,313	5.587	0.641	2.250	5.600	7.850
CDs (>3 years)	31,459	5.776	0.627	2.250	5.760	9.200
neg. CDs (<1 month)	15,657	4.084	0.976	1.010	4.100	7.750
neg. CDs (1-2 months)	15,407	4.179	0.958	1.010	4.250	9.270
neg. CDs (2-3 months)	23,591	4.345	0.867	1.000	4.400	9.650
neg. CDs (3-6 months)	28,108	4.896	0.780	1.100	5.000	8.070
neg. CDs (6-12 months)	28,394	5.288	0.754	1.100	5.350	8.070
RIVALDEP:						
NOW accounts	30,513	2.100	0.448	0.500	2.120	5.800
MMDAs	31,497	3.171	0.477	0.500	3.150	6.300
CDs (1-3 months)	28,339	4.098	0.563	2.000	4.175	7.450
CDs (3-6 months)	33,937	4.767	0.606	2.230	4.895	7.250
CDs (6-12 months)	34,000	5.190	0.617	2.630	5.280	8.070
CDs (1-2 years)	33,813	5.453	0.580	2.800	5.500	7.510
CDs (2-3 years)	33,313	5.592	0.527	3.250	5.616	7.500
CDs (>3 years)	31,459	5.779	0.499	3.250	5.788	7.650
neg. CDs (<1 month)	15,657	4.093	0.655	1.010	4.155	6.815
neg. CDs (1-2 months)	15,407	4.186	0.652	1.010	4.249	7.735
neg. CDs (2-3 months)	23,591	4.346	0.614	2.000	4.426	7.050
neg. CDs (3-6 months)	28,108	4.898	0.630	2.200	5.022	8.070
neg. CDs (6-12 months)	28,394	5.291	0.634	2.200	5.378	7.400
Variables used to select subsamples:						
MSA	34,582	0.691	0.462	0.000	1.000	1.000
MUTUAL	34,582	0.571	0.495	0.000	1.000	1.000
Share of deposits in main market	34,284	0.874	0.213	0.029	1.000	1.000

Table 2

Regression results from equation (8). Dependent variable is DEPRATE. In columns [1] through [4] the DEPRATE is for checkable deposit accounts (NOW accounts and MMDAs). In columns [5] through [7] the DEPRATE is for short-term CD products. Each column was estimated simultaneously with the corresponding column in Table 3, using three-stage least squares techniques, and quarterly data on U.S. thrift institutions from 1994:Q1 through 2000:Q4. * and ** indicate statistical significance at the 5 and 1 percent levels, respectively.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]
	checkable deposit accounts				**short-term CD products**		
Definition used for DEPRATE:	**NOW accounts**	**NOW accounts**	**NOW accounts**	**MMDAs**	**CDs (1 to 3 months)**	**CDs (3 to 6 months)**	**CDS (6 to 12 months)**
ADV/TD	0.225 (0.17)	1.760 (1.30)	-4.640 (4.07)**	10.900 (7.39)**	4.220 (2.76)**	6.140 (4.60)**	5.330 (4.64)**
HHI	-0.351 (3.05)**	-0.390 (3.39)**	-0.127 (1.06)	-0.293 (1.65)	0.387 (2.41)*	0.383 (2.89)**	-0.007 (0.05)
MS	-0.128 (0.82)	-0.140 (0.90)	-0.111 (0.68)	0.971 (4.13)**	0.241 (1.22)	0.362 (2.04)*	-0.042 (0.25)
MS × HHI	-2.600 (3.92)**	-2.610 (3.92)**	-3.440 (4.89)**	-4.080 (3.93)**	0.246 (0.28)	-1.72 (2.18)*	-0.297 (0.40)
RIVALRATE	0.274 (28.71)**	0.251 (26.52)**	0.224 (23.10)**	0.175 (18.62)**	0.603 (76.51)**	0.764 (126.19)**	0.825 (149.45)**
TAU	-0.167 (5.67)**	-0.194 (6.61)**	-0.131 (4.14)**	-0.062 (1.52)	0.089 (2.11)*	0.028 (0.85)	0.007 (0.24)
INCGROWTH	0.111 (1.03)	0.070 (0.65)	0.166 (1.49)	-0.296 (1.88)	0.265 (1.87)	0.092 (0.80)	0.067 (0.62)
COSTRATIO	-7.480 (1.87)	-17.300 (4.38)**	-16.500 (3.37)**	-0.660 (0.11)	1.680 (0.25)	-3.100 (0.56)	-0.950 (0.19)
LOWEQ	-0.266 (2.26)*	-0.441 (3.89)**	-0.269 (2.69)**	0.062 (0.45)	0.279 (1.86)	0.204 (1.62)	-0.485 (4.32)**
FEES/TD	-0.107 (1.11)	-0.555 (5.80)**					
dDEPRATE/dMS	-0.498 (5.01)**	-0.511 (5.14)**	-0.600 (5.75)**	0.391 (2.71)**	0.276 (2.30)*	0.117 (1.07)	-0.084 (.81)
dDEPRATE/dHHI	-0.521 (6.56)**	-0.560 (7.05)**	-0.351 (4.27)**	-0.559 (4.51)**	0.403 (3.63)**	0.271 (3.04)**	-0.026 (.31)
Observations	28,442	28,442	29,028	29,913	26,911	32,214	32,244

(over)

Table 2 (continued)

Regression results from equation (8). Dependent variable is DEPRATE. In columns [8] through [10] the DEPRATE is for long-term CD products. In columns [11 through [15] the DEPRATE is for negotiable CD products. Each column was estimated simultaneously with the corresponding column in Table 3, using three-stage least squares techniques, and quarterly data on U.S. thrift institutions from 1994:Q1 through 2000:Q4. * and ** indicate statistical significance at the 5 and 1 percent levels, respectively.

	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]
	long-term CD products			**negotiable CD products**				
Definition used for DEPRATE:	**CDs (1 to 2 years)**	**CDs (2 to 3 years)**	**CDs (more than 3 years)**	**negotiable CDs (less than 1 month)**	**negotiable CDs (1 to 2 months)**	**negotiable CDs (2 to 3 months)**	**negotiable CDs (3 to 6 months)**	**negotiable CDs (6 to 12 months)**
ADV/TD	12.000	6.630	11.600	13.400	8.880	20.200	7.930	19.000
	(8.56)**	(5.55)**	(8.45)**	(4.72)**	(3.35)**	(8.63)**	(5.67)**	(12.07)**
HHI	-0.210	-0.104	-0.349	-0.206	-0.039	0.292	0.659	-0.049
	(1.47)	(0.82)	(2.31)*	(0.61)	(0.12)	(1.24)	(3.96)**	(0.28)
MS	-0.221	-0.079	-0.392	0.417	0.630	0.748	0.442	0.415
	(1.13)	(0.46)	(2.07)*	(1.17)	(1.88)	(2.66)**	(2.09)*	(1.78)
MS × HHI	0.477	-0.989	1.800	0.278	-1.770	-0.195	-1.070	0.938
	(0.55)	(1.32)	(2.13)*	(0.15)	(1.05)	(0.16)	(1.13)	(0.91)
RIVALRATE	0.749	0.736	0.615	0.403	0.469	0.491	0.717	0.728
	(109.90)**	(105.56)**	(69.76)**	(35.98)**	(42.43)**	(52.07)**	(103.52)**	(99.29)**
TAU	-0.067	0.004	-0.071	0.091	0.204	-0.109	0.084	-0.142
	(1.87)	(0.13)	(1.87)	(1.07)	(2.56)*	(1.54)	(2.17)*	(3.22)**
INCGROWTH	-0.103	-0.166	-0.253	-0.248	-0.167	0.129	0.045	-0.258
	(0.82)	(1.45)	(1.98)*	(0.90)	(0.66)	(0.62)	(0.31)	(1.63)
COSTRATIO	-13.700	-5.600	-13.800	-0.833	1.650	-21.600	0.325	-24.400
	(2.28)*	(1.06)	(2.26)*	(0.07)	(0.14)	(2.24)*	(0.05)	(3.66)**
LOWEQ	-0.609	-0.448	-0.499	0.429	0.470	0.331	0.311	-0.581
	(4.93)**	(3.53)**	(3.73)**	(1.69)	(1.95)	(1.30)	(2.05)*	(3.44)**
FEES/TD								
dDEPRATE/dMS	-0.153	-0.219	-0.136	0.456	0.378	0.720	0.290	0.547
	(1.27)	(2.10)*	(1.17)	(2.00)*	(1.74)	(4.05)**	(2.18)*	(3.74)**
dDEPRATE/dHHI	-0.179	-0.169	-0.231	-0.187	-0.154	0.279	0.588	0.013
	(1.85)	(1.95)*	(2.24)*	(1.00)	(.79)	(1.66)	(5.04)**	(0.10)
Observations	32,109	31,618	29,882	14,954	14,752	22,515	26,848	27,044

Table 3

Regression results from equation (9). Dependent variable is advertising expenditures-to-total deposits (ADV/TD). Each column was estimated simultaneously with the corresponding column in Table 2, using three-stage least squares techniques, and quarterly data on U.S. thrift institutions from 1994:Q1 through 2000:Q4. * and ** indicate statistical significance at the 5 and 1 percent levels, respectively.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]
	checkable deposit accounts				**short-term CD products**		
Definition used for DEPRATE:	**NOW accounts**	**NOW accounts**	**NOW accounts**	**MMDAs**	**CDs (1 to 3 months)**	**CDs (3 to 6 months)**	**CDS (6 to 12 months)**
DEPRATE	-0.0127 (5.88)**	-0.0307 (13.25)**	-0.0272 (12.27)**	0.0232 (15.13)**	0.0083 (13.24)**	0.0060 (13.94)**	0.0047 (11.77)**
MARGIN	0.0022 (9.13)**	0.0013 (7.44)**	0.0011 (6.37)**	0.0014 (8.01)**	0.0017 (9.64)**	0.0013 (8.31)**	0.0015 (9.17)**
HHI	0.0606 (4.36)**	0.0632 (4.31)**	0.0545 (4.22)**	0.0761 (5.92)**	0.0915 (6.06)**	0.0735 (5.38)**	0.0731 (5.33)**
HHI2	-0.0524 (2.31)*	-0.0662 (2.81)**	-0.0458 (2.28)*	-0.0637 (3.14)**	-0.0877 (3.68)**	-0.0738 (3.31)**	-0.0658 (2.92)**
MS	0.0022 (0.20)	-0.0001 (0.01)	0.0002 (0.02)	-0.0190 (1.70)	0.0062 (0.55)	-0.0003 (0.03)	0.0039 (0.35)
MS × HHI	-0.1260 (2.75)**	-0.2160 (4.30)**	-0.2150 (4.42)**	0.0003 (0.01)	-0.1350 (2.76)**	-0.1280 (2.72)**	-0.1400 (2.95)**
RIVALADV	0.0171 (4.88)**	0.0273 (7.45)**	0.0248 (7.66)**	0.0204 (6.54)**	0.0277 (7.22)**	0.0243 (7.19)**	0.0298 (8.69)**
lnASSETS	-0.0085 (11.69)**	-0.0098 (12.79)**	-0.0084 (12.71)**	-0.0065 (8.90)**	-0.0084 (11.43)**	-0.0064 (9.44)**	-0.0073 (10.62)**
INCGROWTH	0.0189 (2.57)*	0.0197 (2.45)*	0.0173 (2.24)*	0.0172 (2.33)*	0.0073 (0.92)	0.0101 (1.44)	0.0125 (1.79)
INSTALLMENT	0.0388 (3.08)**	0.0626 (4.79)**	0.0586 (5.24)**	0.0483 (4.43)**	0.0654 (4.84)**	0.0470 (3.87)**	0.0510 (4.14)**
BUSINESS	-0.0316 (2.61)**	-0.0021 (0.17)	0.0217 (2.00)*	0.0053 (0.51)	0.0242 (1.93)	0.0110 (0.98)	0.0068 (0.60)
IRAS	-0.0611 (4.30)**	-0.1120 (7.50)**	-0.1140 (8.35)**	-0.1040 (7.42)**	-0.1100 (7.22)**	-0.1020 (7.43)**	-0.1160 (8.38)**
FEES/TD	0.0854 (45.59)**						
dDEPRATE/dMS	-0.0157 (2.22)*	-0.0308 (3.99)**	-0.0304 (4.092)**	-0.0189 (2.72)**	-0.0129 (1.87)	-0.0185 (2.71)**	-0.0160 (2.32)*
dDEPRATE/dHHI	0.0374 (4.27)**	0.0302 (3.22)**	0.0273 (3.16)**	0.0579 (6.79)**	0.0577 (6.04)**	0.0440 (5.11)**	0.0452 (5.23)**
Observations	28,442	28,442	29,028	29,913	26,911	32,214	32,244

(over)

Table 3 (continued)

Regression results from equation (9). Dependent variable is advertising expenditures-to-total deposits. Each column was estimated simultaneously with the corresponding column in Table 2, using three-stage least squares techniques, and quarterly data on U.S. thrift institutions from 1994:Q1 through 2000:Q4. * and ** indicate statistical significance at the 5 and 1 percent levels, respectively.

	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]
	long-term CD products			**negotiable CD products**				
Definition used for DEPRATE:	**CDs (1 to 2 years)**	**CDs (2 to 3 years)**	**CDs (more than 3 years)**	**negotiable CDs (less than 1 month)**	**negotiable CDs (1 to 2 months)**	**negotiable CDs (2 to 3 months)**	**negotiable CDs (3 to 6 months)**	**negotiable CDs (6 to 12 months)**
DEPRATE	0.0067	0.0067	0.0083	0.0133	0.0105	0.0125	0.0070	0.0071
	(15.23)**	(12.51)**	(11.70)**	(16.76)**	(13.15)**	(22.68)**	(15.51)**	(17.18)**
MARGIN	0.0013	0.0017	0.0017	0.0015	0.0016	0.0014	0.0013	0.0014
	(8.18)**	(10.26)**	(10.17)**	(6.50)**	(6.72)**	(8.05)**	(7.85)**	(8.46)**
HHI	0.0611	0.0811	0.0809	0.1040	0.1340	0.0694	0.0890	0.0593
	(4.84)**	(6.04)**	(6.18)**	(5.07)**	(6.30)**	(4.79)**	(5.94)**	(4.58)**
HHI2	-0.0459	-0.0696	-0.0529	-0.1390	-0.1880	-0.0921	-0.1260	-0.0654
	(2.30)*	(3.20)**	(2.60)**	(3.50)**	(4.70)**	(3.91)**	(4.88)**	(3.35)**
MS	0.0019	0.0058	0.0091	-0.0013	-0.0053	-0.0218	-0.0094	-0.0111
	(0.17)	(0.54)	(0.83)	(0.09)	(0.35)	(1.88)	(0.82)	(0.97)
MS × HHI	-0.1360	-0.1330	-0.1580	-0.1770	-0.1650	-0.0949	-0.1530	-0.1390
	(2.88)**	(2.85)**	(3.32)**	(2.48)*	(2.31)*	(1.90)	(3.11)**	(2.85)**
RIVALADV	0.0221	0.0259	0.0213	0.0222	0.0289	0.0159	0.0287	0.0169
	(7.05)**	(7.71)**	(6.60)**	(4.79)**	(5.85)**	(4.50)**	(8.10)**	(5.29)**
lnASSETS	-0.0045	-0.0069	-0.0052	-0.0060	-0.0068	-0.0024	-0.0065	-0.0039
	(7.37)**	(10.23)**	(8.17)**	(7.16)**	(7.46)**	(3.69)**	(9.01)**	(6.21)**
INCGROWTH	0.0126	0.0157	0.0178	0.0114	0.0180	0.0025	0.0079	0.0135
	(1.80)	(2.17)*	(2.44)*	(1.02)	(1.64)	(0.29)	(1.04)	(1.78)
INSTALLMENT	0.0542	0.0617	0.0465	0.0230	0.0182	0.0322	0.0467	0.0202
	(4.95)**	(5.18)**	(4.16)**	(1.58)	(1.17)	(2.87)**	(3.79)**	(1.91)
BUSINESS	-0.0149	-0.0243	-0.0139	0.0467	0.0536	0.0484	0.0365	0.0239
	(1.47)	(2.20)*	(1.33)	(3.60)**	(3.80)**	(4.67)**	(3.20)**	(2.47)*
IRAS	-0.0844	-0.0958	-0.074	-0.0761	-0.0965	-0.0539	-0.1100	-0.0579
	(6.29)**	(7.06)**	(5.54)**	(4.15)**	(4.85)**	(3.96)**	(7.54)**	(4.39)**
FEES/TD								
dDEPRATE/dMS	-0.0174	-0.0130	-0.0133	-0.0264	-0.0287	-0.0353	-0.0312	-0.0309
	(2.55)*	(1.93)*	(1.94)*	(2.83)**	(3.01)**	(4.88)**	(4.33)**	(4.33)**
dDEPRATE/dHHI	0.0392	0.0526	0.0554	0.0530	0.0691	0.0370	0.0431	0.0315
	(4.72)**	(6.16)**	(6.42)**	(4.24)**	(5.40)**	(3.89)**	(4.60)**	(3.58)**
Observations	32,109	31,618	29,882	14,954	14,752	22,515	26,848	27,044