Economies of scale and scope in the securities industry

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Economies of scale and scope for the securities industry are estimated for the first time using previously unavailable survey data and employing the translog multiproduct cost function model. The results reveal economies of scale for smaller specialized firms and diseconomies of scale for larger more diversified firms. Economies of scope do not appear to be important in the industry. If the Glass–Steagall restrictions are relaxed, the results suggest that banks can enter the securities industry with a brokerage division of moderate scale of about $30 million in revenues. The five million in new equity required suggests that only banks with assets over $1 billion and over $60 million in capital can enter the industry with a relatively modest investment. There are, however, a substantial number of banks with over $1 billion in assets who can be considered as potential entrants.

1. Introduction

The securities industry in the United States is undergoing significant structural changes. Merger activity has been extensive, firm activities have changed, competition with other industries has intensified, and further legal changes have been proposed in Congress. An understanding of the economics

of the industry is crucial for evaluating changing circumstances and for developing appropriate public policy.

One of the most serious deficiencies in our knowledge is the extent of economies of scale and scope in the securities industry. Lack of individual firm data in the industry has precluded this type of analysis as well as analysis of other aspects of the economics of this industry. In this study, we employ firm survey data which was previously unavailable and estimate economies of scale and scope in the securities industry utilizing the translog cost function estimation methodology.

Section 2 describes the securities industry and indicates the importance of uncovering the nature of scale and scope economies. In section 3, previous studies of economies of scale and scope in the financial sector are discussed with an emphasis on the studies which employ the methodology adopted here. Section 4 describes the survey data used and presents the model employed. Section 5 contains the empirical results and, finally, section 6 presents and evaluates implications of the study.

2. The securities industry

Firms in the securities industry perform various services including investment banking, brokerage activity, corporate financial strategy development, and portfolio management. Firms differ greatly as to the functions they perform with the largest frequently engaging in a wide variety of functions while the smallest usually concentrate on one or two particular areas. Larger firms may have offices nationwide and thousands of employees while smaller ones are usually confined to single offices and few employees.

In the past two decades the industry has been in tremendous flux. Larger firms have moved from private partnership to complex partnership or corporate forms of organization. The revenue mix has been radically altered with individual commission revenue down and institutional commission revenue increasing. Moreover, underwriting, trading and investing, and merger and acquisition fees have greatly grown in importance relative to all commission revenue. Firms have expanded into new products and the geographic focus has become more national and multinational in reach. More recently, competition from outside the industry has become important as banks, foreign merchant banking houses, and other financial institutions have offered securities-industry services. Improved technology has greatly increased transactions capacity and reduced per unit transaction costs.

Regulatory changes, such as the deregulation of commission charges and the introduction of shelf registration, have resulted in many other changes in the industry as well. As the result of poor performance, some firms have been dissolved and others merged into more successful operations. Capital requirements have grown substantially and the industry has become more inter-

national. Furthermore, under the Reagan administration, antitrust restrictions on mergers were substantially relaxed. This has given rise to a wave of take-overs, both within and outside the industry, dramatically stimulating the business of investment bankers and corporate financial advisors, who not only help to finance mergers and provide other corporate services to bidders and target firms alike, but who also have increasingly participated as principals in such transactions.

Not only do these developments affect the viability of firms in the securities industry and combinations among these firms and those outside the traditional confines of this industry. Many of the largest securities firms have been acquired by both financial and non-financial firms outside the industry. Among the best known examples of acquisitions of large securities firms are: Dean Witter by Sears; Bache by Prudential; Shearson by American Express; Kidder Peabody by General Electric; and Donaldson, Lufkin and Jenerette by Equitable. Evaluating economies of scale and scope in the industry helps us understand these acquisitions from within and from outside the industry and also provides guidance to future structural changes.

Further contention for markets and products has developed because of the increased competitive overlap between commercial banks and securities firms. While the Glass–Steagall Act initially separated these two industries, the realities of the marketplace have precipitated competitive forays into each other's traditional turf. For example, the money-market funds offered by securities firms differ but little from interest-bearing transaction accounts (deposits), which are offered by commercial banks. Domestic commercial banks directly and through subsidiary corporations have made inroads into various areas of investment banking, such as setting up mergers and acquisitions groups; have entered discount brokerages; have made markets in a wide range of municipal and government securities and currencies; and for some time have been attempting to change the Glass–Steagall restrictions on their underwriting of municipal revenue bonds and corporate bonds [see Kaufman and Mote (1988)].

Whether the proposals to change Glass–Steagall are attractive to banks, depends on the underlying economics of both the securities and banking industries. Some proposals advocate that these activities be operated as corporate entities separate from a commercial bank and as subsidiaries of the bank's holding company, while others, including at least one bank regulator, Mr. Seidman of the FDIC, argue that such activities can be safely conducted as subsidiary companies of commercial banking firms [see Cornyn et al. (1986) for a discussion of corporate separateness].

In the current climate the paramount issue is not whether Glass–Steagall restrictions should be eliminated, but the extent to which this should take place. In this determination the degree of scale and scope economies in the securities industry are of the utmost importance. There are no studies, of

which the authors are aware, that investigate the degree of economies of scale and scope that may be present in the securities industry. If there are significant economies of scale or scope in the securities industry, then entry may be limited to large banking firms or at least those of sufficient size to either merge with or establish new brokerage or underwriting firms which are large enough to capture the available economies by offering the entire range of securities services. Alternatively, if the securities industry does not exhibit extensive scale or scope economies, smaller banking organizations may be attracted to the securities business and be able to operate profitably at smaller scales. In this way, smaller commercial banking firms may be able to enter the securities industries by combining banking resources and services with those associated with securities firms to provide a more competitive array of integrated banking and securities services.

To best understand the competitive effects of proposed changes in the present law and the adoption of different organizational forms, the cost structure of firms conducting brokerage, securities underwriting and other such activities must be understood. This study provides the first empirical analysis of economies of scale and scope in the securities industry. These results will provide a useful basis for discussions of the evolving size distribution of securities firms, mergers within and outside the industry, and the interaction of the securities with the banking industry.

To make these estimates, however, data on individual firms are required. Few securities firms are publicly held and many of these have been acquired in recent years. Unlike other financial industries, such as banking, regulators do not collect and make publicly available the type of firm information necessary to analyze the industry. However, we have been able to acquire firm data which can be used to estimate economies of scale and scope. The nature of these data are discussed below after we review the economies of scale and scope studies performed on other segments of the financial sector.

3. Literature review of economies of scale and scope

Scale and scope economies studies are important both to help individual firms design growth and risk strategies and to help regulators design mergers and capital requirements policies. The banking industry has been examined most extensively but several studies have analyzed savings and loans, credit unions and insurance companies. Early studies such as Benston (1965) and Bell and Murphy (1968) suffered from restrictive measures of bank output but were unique in their use of a variety of bank functions as provided by the Federal Reserve System's Functional Cost Analysis data. Their analysis was also limited since their use of a Cobb–Douglas production function did not permit identification of a U-shaped cost curve. Benston, Hanweck and Humphrey (1982) utilized a translog cost function model which permits the

estimation of U-shaped average cost curves so that both economies and diseconomies of scale can be estimated.

Recent studies have concentrated on structuring cost function models that can simultaneously identify economies of scale, scope and product mix for financial industries.[1] Gilligan, Smirlock, and Marshall (1984) and Gilligan and Smirlock (1984) find significant cost complementarities between two outputs at the data set mean, the only point tested.[2] In addition, these papers estimate scope economies by approximating the costs of specialty firms using the cost function evaluated near zero for each of the outputs separately[3] and find scope economies of 17 to 42% arising from combined production in banking. In two studies using more than two bank outputs, Lawrence and Shay (1986) and Benston et al. (1987) find at least one pairwise combination to be significantly noncomplementary. The observed lack of uniformity in complementarities suggests that insufficient evidence is provided to draw meaningful conclusions regarding economies of scope in banking firms.[4]

In studies of Canadian credit unions [Murray and White (1983)] and studies of savings and loans [LeCompte and Smith (1985), Mester (1987)], no general significant cost complementarities are found. However, of all the studies using more than two output categories, only Mester (1987) attempts to test comprehensively for joint cost economies (subadditivity) and finds that a null hypothesis of no joint cost economies cannot be rejected.

One of the more comprehensive studies of banks [Berger, Hanweck, and Humphrey (1987)] attempts to resolve the inconsistencies in the previous research by not relying upon pairwise combinations, but instead developing four multiple-product measures of scale, scope, and product mix. These are evaluated and tested at the means of nine deposit size-classes in addition to

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[1]See Gilbert (1984) for survey of the literature on scale economies in depository institutions. The recent literature has concentrated on estimating multiproduct models that permit scale, scope and product mix economies to be identified and estimated. Because of our interest in all three issues, we will concentrate on the recent literature. In addition, see Berger, Hanweck and Humphrey (1986) for an extensive review of the literature and methodology of multiproduct estimation.

[2]Pairwise cost complementarities exist between outputs i and j when $\delta^2 2C(Q)/\delta Q_i \delta Q_j < 0$ when $C(Q)$ is the cost function and Q_i and Q_j are elements of the output vector Q.

[3]The translog cost function gives zero cost when any one of the outputs is zero. A Box–Cox transformation of the translog is sometimes used in its place [cf. Berndt and Khaled (1979)].

[4]Baumol, Panzar and Willig (1982) show that pairwise complementarities among all output pairs is a sufficient (but not necessary) condition for scope economies. A conclusion that scope economies are present, therefore, can be drawn from estimated cost complementarities only if at least one pairwise output combination shows significant non-complementarities and no pairwise combination shows significant non-complementarities. Similarly, scope diseconomies can only be found with at least one significant non-complementary and no significant complementarities. The test procedure for pairwise cost complementarities used in the banking studies follows Denny and Pinto (1978). If this stringent condition is not met, as is generally the case when more than two outputs are specified, no substantive scope or product mix conclusions can be drawn from the complementarity results alone.

the overall mean in order to assess the cost implications of changing all five outputs simultaneously. The basic results of this study are that banks of all sizes in states permitting branching are competitively viable, but that large banks in unit banking states are not, due to scale diseconomies at large unit state banking offices. Banks smaller than $50–$75 million in deposits tend to show statistically significant scale economies at the plant level. However, at the firm (bank) level, no scale economies were evident. In contrast, banks in unit banking states exhibited statistically significant scale diseconomies starting at about $200 million in deposits. Evaluation of product mix measures suggests the presence of slight cost diseconomies, which are likely explained by customer convenience, joint demand, and risk diversification factors. The finding of no product mix or scope economies is consistent with the savings and loan studies, but conflicts with some of the banking scope economy results. However, this conflict appears to rest primarily on methodological grounds, rather than being reflective of true differences in banking economies.[5]

4. Methodology and data

In this study we use the multiproduct, translog cost function.[6] The model is expressed as follows:

$$\ln C = \alpha + \sum_{k=1}^{3} \beta_0 \ln Q_k + \frac{1}{2} \sum_{k=1}^{3} \sum_{n=1}^{3} \Theta_{kn} \ln Q_k \ln Q_n + \tau_{BO} B + \tfrac{1}{2}\tau_{BB}(\ln B)^2$$

$$+ \sum_{k=1}^{3} T_{Bk} \ln B \ln Q_k + \sum_{i=1}^{2} \sum_{k=1}^{3} \Phi_{ik} \ln P_i \ln Q_k$$

$$+ \frac{1}{2} \sum_{i=1}^{2} \sum_{j=1}^{2} \phi_{ij} \ln P_i \ln P_j + \sum_{i=1}^{2} \alpha_j \ln P_i, \tag{1}$$

with the following restrictions for symmetry:

$$\Theta_{ij} = \Theta_{ji}, \quad \Phi_{ij} = \Phi_{ji}, \quad \text{and} \quad \phi_{ij} = \phi_{ji}, \qquad \text{for all } i \text{ and } j.$$

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[5]The finding of little product mix economies is not limited to banking. Insignificant product-mix economies or product-mix diseconomies are found in studies of the U.S. and Canadian telephone system [Evans and Heckman (1983), Fuss and Waverman (1981)] and gas and electric utilities [Sing (1985)]. However, as noted in the survey paper by Bailey and Friedlander (1982), other industry studies identify the existence of significant scope effects (e.g., in trucking, air transportation, auto production, and railroads). In a number of instances, however, these scope effects were limited to certain sized firms within an industry (trucking or energy production [Mayo (1984)]) or associated with only certain product mixes (auto production).

[6]A multiproduct profit function approach was considered using a methodology similar to that of Mullineaux (1978). However, our data do not permit estimates of prices or their proxies calculated as revenue divided by the number of units of output. Consequently, our analysis will concentrate on the cost function.

The homogeneity restrictions imposed on the cost function are:

$$\sum_{i=1}^{2} \alpha_j = 1, \quad \sum_{i=1}^{2} \phi_{ij} = 0, \quad \text{and} \quad \sum_{i=1}^{2} \Phi_{ij} = 0, \quad \text{for all } j.$$

In addition, certain cross product terms are not included because of maintained hypotheses discussed below.

The variables used in the analysis are defined as follows:

C = total expenses;

Q_1 = revenue from brokerage operations (commissions, margin interest and fees from mutual funds sales);

Q_2 = revenue from underwriting and capital positioning operations (underwriting fees and gains on trading and investments for firms own accounts);

Q_3 = revenue from account supervision (account management fees, research services, mergers and acquisitions and other revenue);

B = the number of offices;

P_1 = labour cost (annual salary);

P_2 = cost of rental space per square foot.

This function permits the estimation of any form of ray scale economies and the testing of the degree product mix effects cost. Several interaction variables do not appear because of a prior maintained hypothesis of independence for the interactions involved. Estimates obtained from the cost function are the same as those obtained from a dual production function if certain regularity or duality conditions are met in the data. For this reason, the symmetry and homogeneity restrictions are imposed.

The data for estimating this equation (primarily data for the year 1983) were obtained from a survey of New York securities industry firms conducted in 1984 [see Young (1985)].[7] The New York District of the Securities Industry Association sponsored three studies of the industry,[8] each of whose main aim was to assess the impact of the securities industry on the New York area economy. Each study also addressed other relevant questions and the last contained much information from a survey of representative firms in the industry. The requested information covered the years 1980 and 1983, with much more complete information being received for 1983. The questionnaire was sent to 202 firms and 74 responded in full or part, a relatively high response ratio of 36.6% for such a non-regulatory

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[7] 1983 represents a year of reasonably good performance and some normality for the securities industry. In many ways the year is typical of the year before and those immediately following. Equity prices were generally upward and the deregulation and revenue mix changing trends of this era discussed above were well underway.

[8] See Keenan (1977), Keenan and Goldberg (1980) and Young (1985).

survey. The data were checked for accuracy against focus report data filed by these firms with the Securities and Exchange Commission. Since firms responded to a questionnaire at the behest of their industry association, we have further reason to believe that they did so with reasonable accuracy. The sample contained firms of all sizes, with an emphasis on larger and medium sized firms to ensure coverage of the industry. In this analysis, only 67 of the 74 firms are used because of incomplete responses for the others. In some cases, where reasonable, as explained below, we attempt to correct missing data from other sources. Although a serious deficiency of the securities industry data is the small sample size, one consolation is that this is the largest sample available for analysis of this industry. Other sources, such as annual reports, are less complete and are available for an even smaller number of firms.

To analyze issues concerning the diversity of firms in the securities industry, we have adopted a classification developed by the Securities and Exchange Commission and the Securities Industry Association and divided the sample of 74 firms into four groups. The groupings are a rough attempt to capture some of the differences among firms in product and geographic focus. Obviously the more specialized the product-geographic focus (say a single office New York City firm selling municipal bonds) the more likely it is to be a smaller firm. As can be seen from the groupings, there is more within group variation than is desirable – another reason for insisting that the securities industry follow other financial sectors in making available financial data for all firms. The groups used are:

Group 1: *National in scope*   (15)
        Full line brokers (9)
        Large investment banks (6)

Group 2: *Regional multi-product firm*   (21)
        Larger New York based (9)
        Smaller New York based (7)
        Large regionals (4)
        Medium regionals (1)

Group 3: *Specialized brokerage*   (20)
        Commission brokerage (9)
        Other specialized (9)
        Discount broker (1)
        Clearing broker (1)

Group 4: *Other specialized*   (18)
        Not elsewhere classified (18)
                                    ‾‾‾‾
                                    (74)

Table 1

Estimates of ray scale and scope economies.

	Total Q ($ millions)	Number of observations	SCE	AG	$RSCE$	Scope
Group 1	825.69	14	1.33[a]	2.08[a]		0.83
Group 2	66.42	20	1.04	1.39[a]		0.15
Group 3	35.70	20	0.97	1.16[a]		0.04
Group 4	13.70	14	0.86[a]	0.82[a]		−1.42
Sample mean	186.51	68	1.16[a]	1.82[a]		0.44

[a]Statistically different from 1.0 at the 5% level of significance on a two-tailed test.

It should be clear that the 'specialized' firms in the fourth group are smaller firms. As might be expected, average size declines as the group number increases (table 1). We use the mean values of output and other variable measures to calculate the extent of economies of scale and scope for the average firm in each group.

5. Empirical results

The model was tested using the survey data. We used the natural logarithm of total expenses for 1983 as the dependent variable. Estimation using two alternative output measures were tried, revenue for 1983 and assets for 1983. Only the revenue results are reported here. These firms produce many products and total revenue is the best available index of total output. Assets is an inadequate measure for securities firms because, unlike with banks where it has been used, assets for large securities firms may contain large amounts of fixed facilities which do not vary with output. In addition, a major component of securities firms product is in the form of services so that revenues may more accurately measure this type of output than do assets. In fact, when assets were used, we obtained a substantially less responsive relationship between expenses and assets than between expenses and revenue.

The use of revenue as a measure of output may contain a bias if market prices for securities firms' services are systematically related to measures of quantities of securities service output. In cross-section estimation, the assumption of product prices being constant can be reasonably made since all measurement is made at a single point in time. Firms may be in the process of adjusting prices and output, thus making both endogenous in the long run, but there is no reason to believe a priori that there is a systematic relationship of price with size or product mix of firms.

In competitive markets prices should be reasonably uniform among firms. Only for markets characterized by product differentiation might there be a systematic relationship between price and firm size such that perhaps larger

firms are seen to offer more quality products. In such a case, higher prices would be associated with greater output and overall size. This would suggest that revenues would tend to be proportionately larger than cost indicating scale economies for larger firms. As our results in table 1 indicate, however, larger firms tend to experience diseconomies of scale and scope.

The number of offices is included to account for firms with a greater retail brokerage business than others and is roughly equivalent to a similar variable used in most banking studies. We assume equal cost of capital for all firms so this was excluded from the model. To obtain average salary we divide the three labor related expense items furnished by the firms by the total number of employees. Bonus systems in securities firms cause complications, but at least they are usually tied to profit levels, and not directly to revenue increases. For the factor price of office space we divided total rental expenditure by the number of square feet occupied. Note that (as is characteristic of the securities industry) all firms rented and did not own their office space. In the few cases where the factor costs were not available for firms we took the average factor cost for that type of firm and used it as the estimate of factor price. These data were obtained from Young (1985).

In a multiproduct production environment, the single product scale economy measure has an analogous measure in the concept of ray scale economies ($RSCE$). Ray scale economies are defined as the proportional effect on cost of a scale expansion along a ray in multiproduct-cost space holding constant the proportion of each of the outputs to the others. Ray scale economies are calculated as (δ is used as the partial derivative symbol):

$$RSCE = \frac{\delta \ln C(tQ)}{\delta \ln t}\bigg|_{t=1} = \sum_{k=1}^{3} \frac{\delta \ln C(0)}{\delta \ln Q_k}, \qquad (2)$$

where

$$SCE_k = \delta \ln C / \delta \ln Q_k = \beta_j + \sum_{i=1}^{3} \Theta_{ki} \ln Q_i + \tau B_k \ln B + \sum_{j=1}^{2} \Phi_{kj} \ln P_j, \qquad (3)$$

for all k. $RSCE$ values > 1.0 show scale diseconomies, $RSCE$ values $= 1.0$ show constant returns to scale and $RSCE$ values < 1.0 show scale economies.

The simplest cost function estimates are those aggregating the separate outputs into a single measure of firm outputs. As a starting point, the results of scale economy estimates using an aggregate output measure are presented in table 1 under the column $SCEAG$. These results suggest that there are scale economies for the smallest group of firms and scale diseconomies for those near the mean output level and larger. As is discussed below, these above results differ in meaningful ways from those using the multi-product approach to the estimation of scale economies.

Ordinary least squares (OLS) estimations of eq. (1), incorporating the appropriate restrictions, can provide unbiased estimates. However, additional information can be incorporated to augment the single equation cost function. This information is derived from cost share equations from the cost functions of the form

$$S_j = \frac{\delta \ln C}{\delta \ln P_j} = \frac{P_j X_j}{C} = \alpha_j + \sum_{i=1}^{2} \phi_{ij} \ln P_i + \sum_{k=1}^{3} \Phi_{jk} \ln Q_k, \tag{4}$$

where S_j is the cost share of the jth input and x_j is the amount employed.[9] Since no new parameters are to be estimated using the cost share equations, the system of the cost function and cost share equations should provide more efficient estimates than simply the individual cost function. To estimate this system, cross-equation restrictions are imposed among the cost function and the cost share equations.

In practice, one cost share equation is excluded because the cost shares must add to one and one equation is redundant. In this study, the cost of capital equation is excluded. The estimation method used is the iterative Zellner seemingly unrelated regression algorithm. This method permits the error covariance matrix to be augmented on each iteration such that nonzero terms can appear in the off-diagonal elements.

The estimates presented in table 2 were calculated in 13 iterations. The explanatory power of the function is high as indicated by an adjusted R^2 of 0.87 with a highly significant F-statistic of 22 and a system weighted R^2 of 0.7.

To interpret these results for a multiproduct cost function, we first focus on ray scale economies. The *RSCE* estimates are provided in table 1 for each of the securities firm classifications and the overall mean. These values are calculated using the arithmetic means of the output variables for each group and the sample. At the overall mean, the *RSCE* estimate is statistically significantly greater than 1.0 with a value of 1.82 indicating diseconomies of scale. The largest and most diversified firms, Group 1, also exhibit statistically significant scale diseconomies. Comparing this result with the other extreme – the smaller, more specialized firms – the ray scale economy estimates show substantial and statistically significant economies of scale.

Our general conclusion with regard to the presence of scale economies is that securities firms experience economies of scale at smaller sizes, but that these economies of scale are exhausted when the firm reaches between $14 million and $36 million in total revenue, and at midpoints of about $40 million in assets and $4 million in equity. By contrast, many of the larger

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[9]Shephard's lemma as described in Diewert (1974). This method has been used in a number of financial institution studies such as Murray and White (1983) and Mester (1987).

Table 2

Multiproduct translog cost function estimation (ln C dependent variable).

Independent variable	Parameter estimate	T-value
Intercept	−6.4384	−7.894
$\ln Q_1$	0.1905	1.959
$\ln Q_2$	0.0353	0.494
$\ln Q_3$	0.1213	1.376
$(\ln Q_1)^2$	0.0471	0.757
$(\ln Q_2)^2$	0.0498	1.780
$(\ln Q_3)^2$	0.0241	0.774
$\ln Q_1 \ln Q_2$	0.1390	3.853
$\ln Q_1 \ln Q_3$	0.0194	0.401
$\ln Q_2 \ln Q_3$	−0.0378	−1.117
$\ln B$	−0.5908	1.753
$(\ln B)^2$	0.1052	−0.355
$\ln B \ln Q_1$	−0.0836	−0.568
$\ln B \ln Q_2$	−0.0317	−0.543
$\ln B \ln Q_3$	−0.0162	−0.272
$\ln P_1 \ln Q_1$	0.0115	1.586
$\ln P_2 \ln Q_1$	−0.0115	−1.586
$\ln P_1 \ln Q_2$	−0.0013	−0.273
$\ln P_2 \ln Q_2$	0.0013	0.273
$\ln P_1 \ln Q_3$	−0.0100	−1.587
$\ln P_2 \ln Q_2$	0.0100	1.587
$(\ln P_1)^2$	0.0251	7.703
$(\ln P_2)^2$	0.0194	1.749
$\ln P_1 \ln P_2$	−0.0445	−3.928
$\ln P_1$	0.4711	5.189
$\ln P_2$	0.5289	5.826

$N = 63 \qquad R^2 = 0.8694 \qquad F = 21.63^a$

	Cost share equations			
	Labor		Office space	
	Parameter	T-value	Parameter	T-value
Intercept	0.471	5.19[a]	0.529	5.83[a]
$\ln P_1$	0.019	1.75	0.19	1.75
$\ln P_2$	−0.045	−3.93[a]	−0.045	−3.93[a]
$\ln Q_1$	0.012	1.59	−0.012	−1.59
$\ln Q_2$	−0.001	−0.27	0.001	0.27
$\ln Q_3$	−0.010	−1.59	0.010	1.59

[a]Statistically significant from zero at the 5% level of significance on a two-tailed test.

and more diversified firms show scale diseconomies. To place this result into a banking perspective, banks having revenues of $25 million in 1983 (the midpoint of the securities firm minimum optimal size) had total assets in the range of $100–$200 million and equity of about $16 million at that time. Even though these banks were well above the average size banking

organization in 1983, they would need to increase equity by about 25% in order to enter the securities industry assuming market values equal book values.

Scope economies are measured for each group and the overall mean (table 1). Firms with economies of scope are those where the costs of joint production are less than the cost of specialty production at the same level of output for each product. Economies of scope are defined for this study as

$$SCOPE = 1.0 - [C(Q_1, 0, 0) + C(0, Q_2, 0) + C(0, 0, Q_3)]/C(Q_1, Q_2, Q_3).$$

(5)

In our definition, firms showing economies of scope have values of $SCOPE < 0$, diseconomies have values of $SCOPE > 0$ and no economies have values of $SCOPE = 0$.

Because the translog cost function takes on the value of zero whenever any one of the outputs is zero, an approximation must be used to estimate economies of scope with this functional form. The approximation used in this study is that the smallest output is at the $1 million level rather than zero. This value for revenue is considerably less than the mean for any output level for any of the groups of firms. Other approaches are available, such as the Box–Cox transformation or the estimation of a hybrid-translog function, however, these approaches also remain only approximations.

The results show that the Group 1 securities firms have diseconomies of scope, but that the smaller, specialty firms in Group 4 show economies of scope. Even though statistical tests are not made directly for $SCOPE$ (see tests for significant cost complementarities below), it should be noted that the results are consistent with those for scale economies. Specifically, the smaller, specialty firms exhibit economies of scale and scope. Thus, expansion by these firms toward Group 2 firm sizes in terms of total production and changes in product mix suggests that marginal costs can be reduced in the provision of all products.

In contrast, the opposite is the case for the larger, multiproduct firms. These firms exhibit diseconomies of scale and scope. Thus, these firms can reduce marginal costs by reducing size and migrating towards a product mix similar to that of Group 2.[10] However, the scope diseconomies may not be statistically significant so that changes in product mix may not have a significant effect on costs.

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[10]Even though these firms exhibit scale and scope diseconomies, they may still be highly profitable. Demand for their services and entry barriers can permit such firms to maintain profitability while operating at output levels and mixes that would otherwise be competed away.

Table 3

Interproduct cost complementarities by group and at the mean of the sample $(Q_j Q_j$ interaction coefficient in parentheses).

Output combination	Sample				
	Group 1	Group 2	Group 3	Group 4	Mean
Q_1, Q_2	0.006 (0.139)[a]	0.017 (0.139)[a]	0.033 (0.139)[a]	0.021 (0.139)[a]	0.002 (0.139)[a]
Q_1, Q_3	0.0003 (0.019)	0.003 (0.019)	0.004 (0.019)	−0.166 (0.019)	0.0002 (0.019)
Q_2, Q_3,	−0.0004 (−0.038)	−0.002 (−0.038)	−0.001 (−0.038)	−0.055 (−0.038)	−0.0001 (−0.038)

[a]Statistically significant at the 1% level of significance for a two-tailed test. No other coefficients are significant.

This latter caveat can be investigated by considering measures of inter-product cost complementarities (table 3). These values measure the change in marginal cost of one product as a result of a change in another, jointly produced product. Interproduct cost complementarities are therefore defined as $\delta^2 C/\delta Q_k \delta Q_n < 0$ and are computed as follows:

$$\frac{\delta^2 C}{\delta Q_k \delta Q_n} = \frac{C}{Q_k Q_n} \left[\frac{\delta^2 \ln C}{\delta \ln Q_d \delta \ln Q_n} + \frac{\delta \ln C}{\delta \ln Q_k} \cdot \frac{\delta \ln C}{\delta \ln Q_n} \right], \quad k \neq n. \tag{6}$$

The sign of $\delta^{2C}/\delta Q_k \delta Q_n$ depends on the sign of the first term within the brackets. This term is the estimated coefficient of the output interaction terms in the cost function of eq. (1) and presented in table 2. The other terms are restricted to be positive on theoretical grounds such that a negative value for the first term in the brackets is a necessary, but not sufficient, condition for the existence of interproduct cost complementarities between products k and n. Thus, if this term is positive, interproduct cost complementarities cannot exist and there may be significant interproduct cost non-complementarities.

Our results suggest that only for product pairs 2 and 3 are there cost complementarities. This arises because of the negative coefficient for the interaction term $\ln Q_2 \ln Q_3$ of −0.038 (tables 2 and 3). The remaining pairs have positive coefficients which is not consistent with interproduct cost complementarities leading to economies of scope. It can be shown, as discussed above, that the only meaningful negative interproduct cost comple-mentarity occurs when the value of this coefficient is negative. Otherwise, negative values occur because of negative marginal costs – a nonsense case.

The negative value for the coefficient between product pairs 2 and 3 is not statistically significant. Thus, it is not likely that our measures of scope

economies are statistically significant and that there are significant economies of scope. However, the product pair Q_1 and Q_2 has a coefficient value that is statistically significant with a value of 0.139 (tables 2 and 3). This demonstrates interproduct cost non-complementarities and supports the case for diseconomies of scope under certain output mixes and larger scales.

6. Conclusion

The results of this study portray an industry composed of smaller, specialized firms exhibiting economies of scale and larger, more diversified firms exhibiting diseconomies of scale. These findings indicate that some firms have expanded into scales of operation that may not be competitively viable in the sense that collections of smaller firms, producing the same product mix and level of output in the aggregate, can offer the same products and services at a lower cost.

Similarly, there are smaller securities firms that are not competitively viable since large firms could offer the same products and services at lower prices and remain profitable in the long run. Additionally, the results indicate that economies of scope may be unimportant in the securities industry. This means that being either a diversified or a specialty firm of minimum optimal scale will not place a firm at a cost disadvantage.

If the Glass–Steagall restrictions are relaxed, our results suggest that banks can enter the securities industry with a firm of moderate scale of about $25 million in revenues in 1983 dollars or about $30 million in 1988 dollars assuming a 4% annual inflation rate. In terms of banking investment in the securities industry in today's values, this size firm would require about a $5 million equity investment by a bank. This suggests that a bank with $1 billion in assets and $60 million in capital (a typical bank asset/capital ratio), would require about an 8% increase in capital to enter the securities industry. Such calculations suggest that only banks with assets over $1 billion will be able to enter the industry with a modest new capital investment. However, banking companies with assets in the $1–$5 billion range may find easier entry by the acquisition of smaller, regional securities firms or more specialized national firms where share exchange might substitute for actually raising new capital. The number of banking companies in excess of $1 billion in assets is about 300, suggesting a reasonably large number of possible entrants. In summary, our results indicate the potential for widespread bank entry into the securities industry, assuming the continued profitability of these firms and the industry. Such entry could have the effect of substantially stimulating competition within the securities industry, particularly in regional investment banking markets.

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