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A Fundamental Approach to Estimating Economies of Scale and Scope of Financial Products: The Case of Mutual Funds

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Abstract. We propose a 'Fundamental' approach to estimate the economies of scale and scope for financial institutions offering multi-product lines. We first estimate pure economies of scale from its fundamental definition, which is the marginal cost reduction that is to be achieved by single product firms of increasing size that offer the same product. Similarly, we estimate the economies of scope from its fundamental definition, as the marginal cost reduction achieved by the addition of a new product line. Operationally, we compare the cost of operating a say, 3 product-line financial institution with the cost of operating a portfolios of companies that are synthetically created from a control sample of financial institutions offering fewer, such as 2 and 1 similar product lines. When this approach is applied to mutual funds data, we find economies of scale for some fund type. The evidence on marginal cost economies due to increasing scope is rather weak. The results have practical implications for potential organizers and current management of investment companies.

Key words: economies of scale and scope, mutual funds, diversification

JEL Classification: G20, L11, G23

1. Introduction

A financial institution may choose to offer from one specialized financial product to several diversified products (the issue of scope), and at different size of operation (the issue of scale). The questions of whether scale (or scope) economies could be realized, and if not, what are the costs due to sub optimal scale or scope are of relevance to those who are interested in various private and public policy issues, such as, corporate restructuring including mergers and spin-offs, regulations and deregulation, and the optimal organizational form. Thus, there has been a continuing interest in the empirical estimations of scope (scale) economies and efficiencies among financial institutions. Not all financial institutions operate with the same degree of efficiency, some are better run than others due to higher quality management, better utilization of its resources, lower agency problems, etc. Ultimately, measuring efficiency is an empirical issue. However, there are several estimation problems that have to be solved, from the specification of the functional forms to the assumed behaviors of firms at or near the efficient cost frontier.[1] In this paper, we concentrate on the equally important but much neglected problem of the role of data can play in obtaining better estimates.

The methodologically correct approach to estimate economies of scale and scope is given by their fundamental definitions. Economies of scale are the marginal reduction in the costs of production as the firm increases in size while staying in the same line of business. Ideally, firms with different sizes offering the same product line may be used in cross sectional estimations. Economies of scope refer to the reduction in marginal costs when an additional product line is added to an $n-1$ product firm. The ideal data required are a control sample consisting of all $n-1, n-2, \ldots, 1$ combinations of the same n products. This would enable various calculations of marginal cost reductions by comparing the n product firms and its various replicating portfolios. The main data problem is the absence of actual firms that would enable the estimation under these conditions.

Estimating economies of scale needs a sample of specialized financial institutions that offer only the same single product over a wide range of outputs. Measures of scale economies for each product are separately estimated. Unfortunately, most financial institutions are multi-product firms, whether they add more products to capture economy of scope, or just simply responding to competitor's actions in keeping up with the Joneses may not be determined. The ideal conditions for estimating scope economies, however, is even more demanding, because, an n product-line firm could be compared to various combinations of single product firms, 2 product firms, 3 product firms, up to $n-1$ product firms. There are actually several definitions of scope economies, and the corresponding data requirements are also higher. For instance, scope economies for a three-product firm may be estimated as the difference in the costs of producing the same set of outputs between a three product firm where all three products are offered jointly to (i) a combination of three one product firms, or (ii) a combination of three two product firms. Thus the data requirements to estimate scale economy for firms offering 3 products (i, j, k) jointly are: a sample of 3 product (i, j, k) firms, samples of two product firms offering (i, j), (j, k), and (i, k) and samples of one product firms offering (i), (j) and (k). These data requirements would often not be met for many types of financial institutions, most notably, banks.[2] There is, however, one type of financial institution, the mutual funds, where these data requirements are met for at least some product line combinations. Fortunately, the mutual fund industry is far less homogeneous than other financial institutions. There are mutual funds offering from a single specialized product to as many as over a hundred funds in a fund family. We comb the mutual fund industry data base to obtain (1) a list of one product funds to estimate economy of scale for each product line or fund type, and (2) to estimate economy of scope, a sample of 2 fund families with their equivalent one fund families, and a sample of 3 fund families with their equivalent 2 fund families, and one fund families.

The paper is organized as follows: Section 2 discusses the sources of economies in the mutual fund industry; Section 3 outlines the estimation of economies under the ideal conditions. Data and research design are given in Section 4. The results are presented in the next four sections: Section 5 gives the estimates for economies of scale using single product firms, Section 6 presents the results for economies of scope for the two product case using the two fund and one fund sample, Section 7 presents the scope economy for the three product case using the three fund two fund and one fund sample. Section 8 summarizes and concludes.

2. Economies in the mutual funds industry

The cost function or expense behavior of mutual funds is of interest to their clients and potential investors. It may also offer insights to financial institutions, such as banks, which have recently entered the money management industry. For instance, they would want to know whether to expand quickly with the same fund to realize economies of scale, or to add new funds, via product extensions (offer another fund with the same fund objective) or product diversification (offer new funds with different objectives) to gain various economies of scope. Although the dollar magnitude of assets under the management of mutual funds rivals that of any financial institutions, there is very little formal research reported in this area. The exception being Baumol et al. (1990), a study of the US mutual funds in the mid 1980s, and Dermine and Roller (1992)'s investigation of the French mutual funds in 1990. Both aggregated the data by combining funds in the same fund family with different objectives (Baumol et al. use only two fund types where all equity funds are aggregated), or combining different funds in the same family that are of the same type (Dermine and Roller). Aggregation at this level may not be appropriate as different funds in the same family usually have different portfolio managers and are designed to attract different clienteles. Murthi, Choi and Desai (1997) use the data envelopment analysis, incorporating transaction costs such as expense ratio, turnover and loads in addition to risks as inputs to measure mutual funds performance. Economies of scale may not only increase, but could also decline due to a very large fund's inability to purchase certain security it wanted, to economize the information costs it expended. It remains an empirical question whether different funds in the same family, those with the same or different objectives, share the same cost structure.

2.1. Sources of economics of scale in mutual funds

Unlike banks that are constrained by geographical restrictions such as regulations or physical presence, e.g., branches or ATM machines, mutual funds incur relatively little fixed costs. The major items are computers and software to process data flow from clients/shareholders, general administrative expenses, and information acquisition and analysis. Economies of scale may be achieved as part of these expenses in fixed costs, which could be spread out over an increasingly larger size of funds under the same management. Furthermore, as size increases, the cost per dollar under management declines, resulting in lower transaction costs, lower marketing, including sales and promotion costs, and lower acquisition costs per dollar of future revenues from the same clients once a relationship is established. For the very large fund families such as Fidelity, they may enjoy the extra advantage of investors never have to look elsewhere for specialization or diversification. Offsetting these possible savings are the additional expenses incurred to manage increasingly larger dollar amounts when portfolio managers and analysts are constrained by an upper limit they can process information (bounded rationality). These costs could be increasingly burdensome if the idiosyncratic components of individual securities are large. Furthermore, some of the potential costs, such as transaction costs, and information processing and analysis costs could initially decline but flatten out beyond a certain size. Overall, some scale economies

could be expected for the smaller size ranges, and for fund types involving similar securities, e.g., indexed, high dividend paying shares, or in the same industry. However, economies may not be significant when the stock's individual component is larger, e.g., more effort needs to be expended on analyzing small or foreign firms per dollar invested.

2.2. *Sources of economy of scope in mutual funds*

A mutual fund can increase its scope via product extension, by offering another fund in the same type as an existing fund but with some major or subtle differences to attract a different set of clienteles, or via product diversification, by offering new funds of different types (fund objectives). Scope economies could arise from the sharing of administrative, data processing, corporate marketing, general and macro information acquisition and analyses costs. It could also be realized from transaction cost reduction, e.g., a possible in-house crossing of buy and sell order in the same security, as well as reduced marketing cost from additional marginal contributions from the same clients in response to a greater variety of differentiated products. Potential offsetting costs, however, could also be relatively large. For one, fixed cost reduction may be limited as funds with different objectives require different set up and investment costs, and new portfolio managers may also need to be hired for new funds in the same type as existing funds. Furthermore, even if economies are possible among funds in the same fund family, the mutual fund family may be unable or even unwilling to utilize them. One reason is a mutual fund's need to differentiate among the products it offers, in terms of fund objectives, portfolio composition etc. The second reason is due to the competitions among portfolio managers, which could limit the extent of voluntary cooperation among them. Thus, not only will sharing be limited, duplication of effort may even be possible in the presence of both internal competitions and product differentiation. A priori, it would appear economies of scope might be less likely to be realized in a family of mutual funds.[3]

3. The ideal conditions to estimate economies of scale and scope

In this section, we discuss the conditions and the corresponding data requirements for estimating the 'pure' economies of scale and scope under the fundamental approach. In a single product firm, measuring economies of scale is relatively straightforward. A cost function can be estimated from a sample of single production firms operating at different sizes.[4] Economies of scope for a two-product firm is said to exist if the cost of producing two products jointly is less than the cost of producing the same two products separately.[5] Let x and $1 - x$ be the amount of two products A and B that are jointly produced by firm 1 at a cost of $C(A, B : x, 1 - x)$, and let $C(A : x)$ and $C(B : 1 - x)$ be the costs of producing the same products separately by firm 2 and firm 3. There is scale economy, no economy, or diseconomy when the joint production cost net of separate production costs $C(A, B) - [C(A) + C(B)]$ is negative, zero, or positive. Thus, by definition, the conditions in terms of data requirements for estimating economics of scope in producing A and B jointly

are to have: (1) firms that produce A exclusively, (2) firms that produce B exclusively, and (3) firms that produce various combinations of A and B.

When the number of products offered is three or more, say, a firm producing three products A, B, C, the concept of scope economy can take on new interpretations. While there is only one way to synthesize an equivalent two product firm from two one product firms as the replicating portfolio, there are two ways an equivalent three product firm could be synthesized: (i) from a combination of three one product firms, and (ii) from combinations of two product and one product firms. Consequently, there are two definitions of scope economy for three products (A, B, C),

$$\delta_1 = C(A, B, C) - [C(A) + C(B) + C(C)] \tag{1}$$

$$\delta_{2a} = C(A, B, C) - [C(A) + C(B, C)] \tag{2a}$$

$$\delta_{2b} = C(A, B, C) - [C(A, C) + C(B)] \tag{2b}$$

$$\delta_{2c} = C(A, B, C) - [C(A, B) + C(C)] \tag{2c}$$

Generalizing by summing terms yields,

$$\delta_3 = 3C(A, B, C) - [C(A, B) + C(B, C) + C(A, C)] - [C(A) + C(B) + C(C)] \tag{3}$$

where $C(A), C(B), C(C)$ are the costs of producing products A, B, and C separately. $C(A, B), C(B, C)$ and $C(A, C)$ are the costs of producing (A, B), (B, C) and (A, C) jointly, and $C(A, B, C)$ is the cost of producing A, B and C jointly. For identification purpose, we label definition (1) as the basic scope economies as it involves comparison with one product firms, and definition (2) as the marginal scope economies as it is comparing a n product firms with replicating portfolio constructed from firms with lesser scope of operations.[6]

4. Data and research design

Among various financial institutions, the mutual fund industry seems to offer data closest to fit the ideal conditions to estimate economies. Although as an industry, a wide variety of fund objectives/types are offered, but there are funds that offer a single product, and others that offer two, three, or four types only. Information on fund type, outputs (dollar net asset value of each fund), expense ratios etc., for funds within a fund family are widely available. We choose a recent (March, 1994) period taken from the Business Week Mutual Funds Scoreboard. This database has 449 fund families offering 1,832 equity mutual funds. (See Panel A in Appendix 1 for a data summary). There are 174 usable one product funds, 61 two product and 18 three product funds where equivalent funds could be constructed from lower order funds (one and two products fund families offering the same types). In accordance with the usual interpretation of costs as related to production and operating costs, and not incentive to sell the funds such as loading charges, we use expense ratio (scaled by size) as the cost measure.

The quadratic cost function is used in the empirical analysis. It represents the most parsimonious functional form to allow estimates of economies, and to handle cases of zero output,[7] i.e., fund family not offering certain fund type. Scale economy for each fund type can easily be estimated from subsample of fund families with only one fund. Scope economy is estimated using two samples, (i) a sample of one and two product funds for the two product case, and (ii) a sample of one, two, and three product funds for the three product case. The model specifications are:

A. Two product funds

$$\begin{aligned}\text{Exp}_i = {} & \alpha_0 + \alpha_1 D_1 + \alpha_2 D_2 + \alpha_3 D_{12} + \alpha_4 TA_1 + \alpha_5 TA_2 \\ & + \tfrac{1}{2}\alpha_6 TA_1^2 + \tfrac{1}{2}\alpha_7 TA_2^2 + \tfrac{1}{2}\alpha_8 TA_1 TA_2 + \mu, \quad i = 1, 2, \ldots, n. \end{aligned} \tag{4}$$

where Exp_i is the dollar expense for fund family i that may produce either a single product (1 or 2) or a joint product 1 and 2. Fees paid by the mutual fund investors are not included for two reasons: 1) Fees may be expenses to the investors, but they are revenues to the mutual funds. 2) More importantly, fees have nothing to do with the cost of operations or production. D_1, D_2, and D_{12} are the properly scaled dummy variables such that α_1 and α_2 measure the fixed cost of producing product 1 or product 2 separately. α_3 measures the marginal cost of producing product 1 and 2 jointly, i.e., $\alpha_3 < 0$, implies $C(A, B) - [C(A) + C(B)] < 0$, and economies of scope is said to be present. α_4, α_6 measure the scale economy for product 1, and α_5, α_7 do the same for product 2. α_8 gives the marginal variable costs for scope economy of producing 1 and 2 jointly. Economies of scale is said to be present when $\alpha_5 < 0$, or $\alpha_7 < 0$ and economies of scope is present when $\alpha_5 < 0$, or $\alpha_7 < 0$, and $\alpha_8 < 0$ or $\alpha_3 < 0$.

B. Three product funds (from equation (3))

$$\begin{aligned}\text{Exp}_i = {} & \alpha_0 + \alpha_1 D_1 + \alpha_2 D_2 + \alpha_3 D_3 + \alpha_4 D_{12} + \alpha_5 D_{23} + \alpha_6 D_{13} \\ & + \alpha_7 D_{123} + \alpha_8 TA_1 + \alpha_9 TA_2 + \alpha_{10} TA_3 + \tfrac{1}{2}\alpha_{11} TA_1^2 \\ & + \tfrac{1}{2}\alpha_{12} TA_2^2 + \tfrac{1}{2}\alpha_{13} TA_3^2 + \tfrac{1}{2}\alpha_{14} TA_1 TA_2 + \tfrac{1}{2}\alpha_{15} TA_2 TA_3 \\ & + \alpha_{16} TA_3 TA_1 + \alpha_{17} TA_1 TA_2 TA_3 + \mu, \quad i = 1, 2, \ldots, n. \end{aligned} \tag{5}$$

where, in addition to the variables explained above, α_4, α_5, and α_6 are the marginal fixed costs of 2 product funds (1, 2), (2, 3), (3, 2) over their separate one product combination counterpart, α_7 is the marginal fixed cost of a three product fund over an equivalent three one product funds, α_{14}, α_{15} and α_{16} are one two product variable costs economies of scope for products pairs (1, 2), (2, 3) and (1, 3), and x_{17} is the marginal variable cost economies of scope for producing three products.[8]

The use of mutual fund data allows estimation of cost economies under the 'Fundamental' approach. However, it still falls short of the ideal conditions for the following reasons: (i) Mutual funds do not provide input weights or prices, although total input as fund expenses

are reported. Thus, some items of interest such as substitution between inputs, and cross relationships between inputs and outputs may not be estimated.[9] (ii) The sizes of funds in many one-product fund control samples used for scale economy estimation are smaller in comparison to the size of the n product funds, and hence the applicable inference space is smaller than desired. (iii) The data requirements for scope economies are relatively high, e.g., for n-product funds families, equivalent lower level fund families $n-1, n-2, \ldots 2, 1$ are needed. Thus, for practical purpose, the highest level of fund types in a family studied here is three, where we can find their equivalent two and one fund families to construct the synthetics. Thus, certain fund combinations, and especially those higher than three funds in the family may not be estimated. Nevertheless, we are able to make use of 253 out of the total of 449 fund families.

5. Estimating economies of scale from one product firms

Table 1 presents the result of the estimated economies of scale for various fund types utilizing as control samples only one-product funds in the same fund type.[10] The estimated

Table 1. Scale economies of single product mutual funds by fund types

The table consists of funds that offer only a single product. There is no single product. Gold fund, as all gold funds in the sample belong to fund families offering more than one fund. Values in the parentheses are the p values. The estimated regression is of the form:

$$\mathrm{EXP}_{ji} = \alpha_{j0} + \alpha_{j1}(TA_{ji}) + \tfrac{1}{2}\alpha_{j2}(TA_{ji})^2 + \mu_{ji}, \quad j = 1, 2, \ldots 9, \quad i = 1, 2, \ldots N$$

Fund Type (j)	$\hat{a}_{j0}$	$\hat{a}_{j1}$	$\hat{a}_{j2}$	R^2	N_j
1. Growth	0.212 (0.01)	8.92×10^{-3} (0.00)	-5.39×10^{-7} (0.00)	0.99	7
2. Growth & Income	2.81×10^{-2} (0.91)	7.86×10^{-3} (0.00)	-1.97×10^{-7} (0.00)	0.56	13
3. Max Growth	0.030 (0.97)	2.33×10^{-2} (0.14)	6.15×10^{-6} (0.81)	0.97	8
4. Income	-5.52×10^{-2} (0.80)	1.05×10^{-2} (0.05)	-8.11×10^{-7} (0.27)	0.97	6
5. Balanced	3.29×10^{-2} (0.43)	1.24×10^{-2} (0.00)	-1.51×10^{-5} (0.02)	0.97	13
6. Small Firms	-0.185 (0.64)	2.03×10^{-2} (0.00)	-2.08×10^{-5} (0.01)	0.95	11
7. Specialty	0.096 (0.48)	9.59×10^{-2} (0.00)	2.07×10^{-6} (0.30)	0.97	10
8. Gold	—	—	—	—	—
9. International	0.998 (0.51)	1.05×10^{2} (0.00)	-1.51×10^{-7} (0.84)	0.96	12

Where EXP_{ji} is the dollar expense for mutual find i, type j. TA's are the total asset, or size of fund under management.

coefficients provide the 'pure' measure of scale economies for the eight fund types estimated. There is no risk of a confounding effect of scope that could arise from including sample firms in estimations with more than one product. Since sample sizes for various single fund samples are small and vary among fund type, the interpretation of the results should proceed with caution, especially with respect to type fund with rather small sample size such as fund type 4 (the income fund). Table 1 shows scale economies to be observed in half of the fund types. These are growth, growth and income, balanced and small firms funds. It is worth noting that these significant coefficients all reported the expected negative signs, supporting the presence of scale economies. Due to the relatively small sample size, as well as small dollar fund size, scale economies may not yet occur within the observed data set for the other funds: maximum growth, income, specialty, and international. Thus, there may be some truth to the belief that a fund family needs to achieve larger size in order to realize scale economies.

6. Estimating the basic economies of scope from the two products funds

This section provides estimates of economy of scope from the comparison of the costs (expense) of a two-product (fund type or objective) fund to an equivalent two single product funds. The data requirement is such that, for a two product fund family, say, a growth and international fund, to be included in this study, there must exist *actual* single product funds offering both of the products, e.g., growth and international. Our database yields 12 different combination of fund type satisfying this requirement (See Panel B in Appendix 1). To illustrate, there are 5 fund families that offer both a growth fund (type 1) and a small business fund (type 6), and there are also 77 one-product growth funds, and 11 one-product small business funds. Thus, we have a total of 93 observations, and the (1, 6) fund combination is chosen to be included in the study. A separate regression is estimated utilizing these 93 observations. There are two categories of two fund families. These are: (1) product extensions into the same fund type, i.e., (1, 1), (2, 2), (5, 5), (9, 9), and (2) product diversification into different fund types, i.e., (1, 2), (1, 4), (1, 5), (2, 5), (2, 6), (6, 9). The sample size for each regression ranges from a low of 14 to a high of 127. A priori, product extension is probably a hybrid of scale and scope expansion. It could achieve some of the cost savings from scale expansion but there are also offsetting duplicating costs involved with establishing a separate fund, such as different portfolio managers, marketing networks, etc. Furthermore, it could also lead to diseconomies of scope due to the fund family's top management desire to differentiate products, and from internal competitions between portfolio managers of the same fund family.

Table 2 presents the results. It should be reminded that the items of particular interests are $\alpha_3 D_{12}$ and $\alpha_8(TA_1 TA_2)$, which are functions of the marginal reduction in fixed and variable costs (if negative), between a two-fund family versus separate but synthesized one fund families. We find:

1. There is no single case with significant fixed cost scope economy. Although it may be of some consolidation that eight out of twelve coefficients (α_3) are of the hypothesized

Table 2. Scale and scope of two product mutual funds

The coding for fund types are: 1 = growth, 2 = growth and income, 3 = maximum growth, 4 = income, 5 = balanced, 6 = small firms, 7 = specialty, 8 = gold, and 9 = international. For example, a product pair (1, 2; 1&2) sample is a regression consisting of (i) all fund families offering both type 1 (= growth), and type 2 (growth and income) funds, (ii) all single product funds offering type 1, or type 2 funds only. The number under the parentheses are p values. The estimated regression for equation (4) is,

Product Pair		α_1	α_2	α_3	α_4	α_5	α_6	α_7	α_8	R^2	N
(1S, 1L;	1S&1L)	0.042	0.329	−0.367	8.47	8.76	0.56	−0.0004	0.20	0.98	82
		(0.88)	(0.00)*	(0.32)	(0.89)	(0.00)*	(0.92)	(0.00)*	(0.00)*		
(1, 2;	1&2)	0.146	0.071	−0.109	9.42	7.70	−0.0006	−0.0001	0.001	0.99	127
		(0.33)	(0.74)	(0.80)	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.06)*		
(1, 4;	1&4)	0.213	+0.00	0.319	8.91	9.70	−0.0005	−0.0006	−0.10	0.99	87
		(0.00)*	(—)	(0.78)	(0.00)*	(0.00)*	(0.00)*	(0.28)	(0.88)		
(1, 5;	1&5)	0.213	0.172	0.064	8.91	3.02	−0.0005	0.04	−0.03	0.98	104
		(0.00)*	(0.34)	(0.80)	(0.00)	(0.07)*	(0.00)*	(0.00)*	(0.00)		
(1, 6;	1&6)	0.212	+0.00	−0.290	8.92	10.90	−0.0005	−0.01	−0.02	0.98	93
		(0.01)*	(—)	(0.46)	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*		
(2S, 2L;	2S&2L)	+0.000	+0.000	0.063	16.28	7.86	−0.02	−0.0001	−0.17	0.99	39
		(—)	(—)	(0.95)	(0.60)	(0.00)*	(0.86)	(0.00)*	(0.89)		
(2, 5;	2&5)	0.028	+0.00	−0.126	7.86	15.78	−0.0001	−0.03	−0.005	0.99	55
		(0.88)	(—)	(0.85)	(0.00)*	(0.03)	(0.00)*	(0.45)	(0.61)		
(2, 6;	2&6)	0.028	+0.00	−0.246	7.86	18.97	−0.0001	−0.01	−0.05	0.99	50
		(0.89)	(—)	(0.86)	(0.00)*	(0.03)*	(0.00)*	(0.15)	(0.38)		
(2, 9;	2&9)	0.028	0.994	−1.546	7.86	10.51	−0.0001	−0.0001	0.35	0.99	51
		(0.93)	(0.21)	(0.57)	(0.00)*	(0.00)*	(0.00)*	(0.70)	(0.60)		
(5S, 5L;	5S&5L)	0.016	0.051	0.216	7 .30	11.99	0.89	−0.01	−0.03	0.99	16
		(0.87)	(0.58)	(0.93)	(0.82)	(0.00)*	(0.77)	(0.13)	(0.85)		
(6, 9;	6&9)	+0.000	0.997	−1.157	18.98	10.50	−0.01	−0.0001	0.005	0.98	25
		(—)	(0.34)	(0.70)	(0.02)*	(0.00)*	(0.28)	(0.77)	(0.49)		
(9S, 9L;	9S&9L)	0.271	4.069	−2.686	13.10	8.21	−0.06	0.0004	0.01	0.98	14
		(0.99)	(0.32)	(0.97)	(0.99)	(0.06)*	(0.99)	(0.69)	(0.99)		

Where Exp is the total expense incurred in operating either a two product, or one product funds P_1, D_2, D_{12} are dummy variables for fund that offers fund type 1, fund type 2, or both. TA_1 and TA_2 are the respective dollar under management under type 1 and 2.

S = small, and L = large to indicate the relative fund size (TA) for a two fund family whose funds are in the same type.

negative sign, in which half of the product extension two fund families but three-fourth of the product diversification two-fund families have the negative sign. It may also be of interest to note that all five of the two fund families with at least one fund in either small business or international have the expected negative signs. The overall results suggest possibly some small savings from sharing administrative and complementary resources, but not from the analysis and selection of similar investments.[11]

2. Significant variable scope economies are found for four two-fund combinations: (1, 1), a case of product extensions, shows diseconomies, while (1, 2), (1, 5) and (1, 6), which are product diversification fund families, report economies. The rest, although not significant, has five out of 8 coefficients with the expected negative sign. (All positive signs are fund families offering international funds).[12] Finding diseconomies or no economies for product extensions fund families lend support to the cost increasing effect resulting from the need for product differentiation and internal competitions.
3. The sign and magnitude of the coefficients $\alpha_4, \alpha_5, \alpha_6$, and α_7 reveal generally strong evidence of economies of scale. The effect may be slightly weaker among the product extensions cases as the effects of the own quadratic terms are partly captured by the cross product terms, since both funds in the family are of the same type.

7. Estimating economies from the three product funds

There are seven feasible three product combinations in the data set, i.e., there exist actual fund offerings for three product fund (i, j, k), and its lower level equivalent funds, the two product funds (i, j), (j, k) and (i, k), and one product funds, (i), (j) and (k). These three fund families are: (i) product extension/diversification funds, (1, 1, 2), (1, 1, 4), (1, 1, 5), (2, 2, 5) and (ii) product diversification funds, (1, 2, 5), (1, 2, 6) and (2, 6, 9). The details of the sample are listed in panel C of Appendix 1. The estimates from equation (4) give the following results for each of the seven three product combinations: (i) fixed costs of operating each fund type separately, $(\alpha_1, \alpha_2, \alpha_3)$, (ii) the basic marginal fixed costs of operating a two product fund family over two one product fund families, $(\alpha_4, \alpha_5, \alpha_6)$, (iii) the basic marginal fixed cost of operating a three product fund family over various combinations of one fund plus two fund favorites (α_7), (iv) the economies of scale estimates for single products, $i(\alpha_8, \alpha_{11}), k(\alpha_9, \alpha_{12})$ and $j(\alpha_{10}, \alpha_{13})$, (v) the variable costs economies of scope for two products $\alpha_{14}(i, j), \alpha_{15}(j, k)$, and $\alpha_{16}(i, k)$, and (vi) the variable cost economies of scope for three products, α_{17}, against combinations of one fund and two fund families.

Table 3 presents the estimates of the 17 coefficients for each of the seven three product combinations whose sample size range from 60 to 161. Emphasizing the items of interest, we find that:

(1) There is no statistically significant basic fixed cost economy of scope for all seven three product fund families over their equivalent combination of one product families, i.e., $\alpha_7 = 0$ for all seven cases. It suggests that cost duplications for adding new product

Table 3. Scale and scope economies of three products mutual funds

This table presents the parameter estimates for seven three products mutual funds where all their two product funds, and one-product funds are offered separately by other fund families. For example, a three products fund offering type 2 = income and growth fund, type 6 = small firms fund, and type 9 = international fund, can be spanned by a combinations of three 2 products funds (2&6; 2&9; 6&9), and three one product funds (2, 6, and 9).

	Product Pair			
	1S, 1L, 2; 1S&1L, 1L&2 1S&1L&2	1S, 1L, 4; 1S&1L, 1L&4, 1S&4 1S&1L&4	1S, 1L, 5; 1S&1L, 1L&5, 1S&5; 1S&1L&5	1, 2, 5; 1&2, 2&5, 1&5; 1&2&5
α_1	0.042	0.042	0.077	0.148
	(0.91)	(0.88)	(0.68)	(0.28)
α_2	0.202	0.329	0.330	0.072
	(0.32)	(0.00)*	(0.00)*	(0.71)
α_3	0.070	+0.000	0.255	0.111
	(0.74)	(—)	(0.15)	(0.73)
α_4	−0.285	−0.367	−0.385	−0.110
	(0.67)	(0.31)	(0.25)	(0.78)
α_5	−0.685	−0.280	0.486	0.168
	(0.33)	(0.95)	(0.17)	(0.80)
α_6	0.027	25.591	−0.291	0.104
	(0.96)	(0.89)	(0.36)	(0.82)
α_7	−0.168	8.935	−0.533	0.442
	(0.88)	(0.92)	(0.50)	(0.70)
α_8	16.75	8.47	8.89	9.40
	(0.71)	(0.89)	(0.64)	(0.00)*
α_9	9.38	8.76	8.75	7.70
	(0.00)*	(0.00)*	(0.00)*	(0.00)*
α_{10}	7.70	9.82	1.14	4.13
	(0.00)*	(0.03)*	(0.54)	(0.15)
α_{11}	−0.61	0.56	−0.0007	−0.0006
	(0.71)	(0.92)	(0.99)	(0.00)*
α_{12}	−0.0006	−0.0004	−0.0004	−0.0001
	(0.01)*	(0.00)*	(0.00)*	(0.00)*
α_{13}	−0.0001	−0.0006	0.04	0.04
	(0.00)*	(0.42)	(0.00)*	(0.00)*
α_{14}	0.17	0.02	0.20	0.001
	(0.00)*	(0.00)*	(0.00)*	(0.04)*
α_{15}	0.001	0.15	−0.03	−0.02
	(0.03)*	(0.94)	(0.00)*	(0.00)*
α_{16}	0.31	−27.21	0.29	−0.03
	(0.26)	(0.90)	(0.08)*	(0.00)*
α_{17}	−0.002	0.03	−0.001	0.0006
	(0.39)	(0.90)	(0.03)*	(0.23)
R^2	0.99	0.99	0.99	0.99

From equation (5) Exp is the total expenses of the three, two and one relevant product funds. D_1, D_2, D_3, D_{12}, D_{23}, D_{13}, D_{123} are respectively the dummy variables for funds that offers fund type 1, type 2, type 3, both type 1 and type 2, type 2 and type 3, type 1 and type 3, and all three types. The parameter values α_8 to α_{16}, are in unit of 10^{-3}. TA_1, TA_2, and TA_3 are the dollar size of type 1, type 2, and type 3 funds in one, two or three products fund family.

Table 3. Scale and scope economies of three products mutual funds (*continued*)

	Product Pair		
	1, 2, 6; 1&2, 1&6, 2&6; 1&2&6	2S, 2L, 5; 2S&2L, 2S&5, 2L&5; 2S&2L&5	2, 6, 9; 2&6, 2&9, 6&9; 2&6&9
α_1	0.143	−0.005	0.027
	(0.31)	(0.99)	(0.93)
α_2	0.070	+0.000	0.000
	(0.73)	(—)	(—)
α_3	+0.000	+0.000	0.984
	(—)	(—)	(0.17)
α_4	−0.106	0.057	0.052
	(0.80)	(0.96)	(0.98)
α_5	0.431	−0.238	−1.139
	(0.70)	(0.79)	(0.58)
α_6	−0.160	−0.264	0.003
	(0.79)	(0.78)	(0.99)
α_7	−0.615	−1.412	0.471
	(0.51)	(0.89)	(0.85)
α_8	9.45	16.51	7.86
	(0.00)*	(0.76)	(0.00)*
α_9	7.70	7.86	18.93
	(0.00)*	(0.00)*	(0.00)*
α_{10}	18.85	15.76	10.54
	(0.00)*	(0.03)*	(0.00)*
α_{11}	−0.0007	−0.21	−0.0001
	(0.00)*	(0.89)	(0.00)*
α_{12}	−0.0001	−0.0001	−0.01
	(0.00)*	(0.00)*	(0.11)
α_{13}	−0.01	−0.03	−0.0001
	(0.00)*	(0.46)	(0.65)
α_{14}	0.001	−0.16	0.03
	(0.05)*	(0.89)	(0.68)
α_{15}	0.02	−0.005	0.005
	(0.60)	(0.65)	(0.32)
α_{16}	0.02	0.15	−0.10
	(0.00)*	(0.56)	(0.44)
R^2	0.99	0.99	0.99

could offset cost savings from sharing fixed costs in administration and processing etc. However, five out of seven coefficients are negative, a larger sample of three fund families may show some degree of scope economies.

(2) Three products variable cost economies of scope (α_{17}) is found to be significant in one case (1, 1, 5) out of the seven. Here, only four out the seven coefficients are negative.

(3) The rest of the results generally indicate economy of scale, but there is absence of fixed cost economy of scope for two joint product funds and possibly variable costs diseconomies in several two-product funds, if they are offered jointly.

Overall, our results suggest that economy of scale in mutual funds is realizable even for funds with rather significant net assets. Economy of scope, however, is harder to come by. That is, offsetting cost increase could mitigate some potential cost savings, thus, render the net affect to be not significant, or at best, of rather small economies.

8. Summary and conclusions

This paper presents empirical estimates of economies of scale and scope for financial products using the 'Fundamental' definitions of scale and scope economies. It serves to illustrate what the estimates for economies are like under the ideal conditions where, for an n product firms, there exists all the proper lower level combinations, i.e., there are $n-1, n-2, \ldots 2, -1$ product firms.[13] The availability of one-product firms (specialized funds) allows for the estimation of pure economies of scope. The availability of three product funds plus their equivalent two product and one product funds enable a richer interpretation of marginal cost (of scope) of adding one product: it can be measured as a combination of three one product firms, or various combinations of two and one product firms. We find economies of scale for some but not all fund type/objectives, and rather weak, if present at all, economies of scope among the feasible combinations of products. Scope related cost increasing factors, such as the need to differentiate products and the discord from internal competitions among portfolio managers, could offset expected economies from administration, marketing, and other back office operations.

The results may have practical implications for organizers of investment companies and banks that are entering into fund management. Issues of interest are: whether there is a need to achieve scale and what product strategy to pursue, e.g., product extension versus product diversification, in order to realize greater potential for cost savings. Finally, these results may enable banks or investment companies to make 'pure play' calculations of potential gains from mergers. The next step in the empirical application is to estimate synergistic gains among various financial services firms that combine investment management, insurance, stock broker operations, investment banking, private banking, and the traditional commercial banks. Universal banks, from countries such as Germany where greater integration has been allowed for a long period, may be included for comparison and estimation.

Appendix 1: Data description

Panel A:

Size of Mutual Fund Family	Number of Families	Number Used in This Study
1	182	174
2	77	61
3	54	18
4 and above	136	N/A

Panel B: Breakdown of observations in each of 12 product pairs (Table 2)

Product Pair			Number of Observations			
TA_1	TA_2	TA_{12}	Total	TA_1	TA_2	TA_{12}
(1S,	1L;	1S&1L):	82	30	47	5
(1,	2;	1&2):	127	77	36	14
(1,	4;	1&4):	87	77	6	4
(1,	5;	1&5):	104	77	14	13
(1,	6	1&6):	93	77	11	5
(2S,	2L;	2S&2L):	39	18	18	3
(2,	5;	2&5)	55	36	14	5
(2,	6;	2&6)	50	36	11	3
(2,	9;	2&9)	51	36	12	3
(5S,	5L;	5S&5L):	16	7	7	2
(6,	9;	6&9)	25	11	12	2
(9S,	9L;	9S&9L):	14	6	6	2

Panel C: Breakdown of observations in each of 7 product pairs (Table 3)

Product Pair							Number of Observations							
TA_1	TA_2	TA_3	TA_{12}	TA_{13}	TA_{23}	TA_{123}	Total	TA_1	TA_2	TA_3	TA_{12}	TA_{13}	TA_{23}	TA_1
(1S,	1L,	2;	1S&1L,	1S&2	1L&2	1S&1L&2)	135	30	47	36	5	7	7	3
(1S,	1L,	4;	1S&1L,	1S&4,	1L&4;	1S&1L&4)	94	30	47	6	5	2	2	2
(1,	2,	5;	1&2,	1&5,	2&5;	1&2&5)	161	77	36	14	14	13	5	2
(1,	2,	6;	1&2,	1&6,	2&6;	1&2&6)	149	77	36	11	14	5	3	3
(2S,	2L,	5;	2S&2L,	2S&5,	2L&5;	2S&2L&5)	60	18	18	14	3	2	3	2
(2,	6,	9;	2&6,	2&9,	6&9;	2&6&9)	69	36	11	12	3	3	2	2

Appendix 2: The estimated value of *X*-inefficiency among single product mutual funds

To complete the analyses, we also estimate the value of *X*-inefficiency among the single product mutual funds. We use the single product mutual fund sample, not only that it provides a cleaner estimate of inefficiency, but it also solves the more practical problem of sample size, i.e., we have 174 single product funds, but only 12 feasible two product funds and 7 feasible three product funds. The procedure uses the thick frontier method. We first sort the one fund sample into 5 size groups and then choose the top 20% efficient funds in each size group, in terms of expense ratio. They are sorted as the funds on the efficient cost frontier for estimation purpose. Since our sample is consisting only of one product

funds, translog regression is used. The estimated regression equation gives the following estimates

$$\underset{(0.00)}{\text{In (expense)} = -3.825} + \underset{(0.08)}{0.54\,\text{Ln}(TA)} + \underset{(0.17)}{\tfrac{1}{2}(0.071)(\text{Ln } TA)^2}$$

where the p values are given in the parenthesis. $R^2 = 0.91$, $F = 143.3$, $N = 33$. The computed economy of scale for the funds on the efficient frontier is 22.5%, that range from −19% to +91%. Applying this set of estimates to the rest of the sample (funds that are in the interior of the efficient frontier) gives an X-inefficiency measure of 48.41%. The implication of inefficiency among mutual funds is a topic that is worth pursuing in future studies. With better data, i.e., greater coverage, it may be possible to have enough observations of multiproduct funds that has all lower fund combinations to enable separate estimates of parameters for the most efficient firms in 2, 3, 4 . . . product funds.

	Top 20% Pooled Sample				Other 80% Sample			
	N	MEAN	MIN	MAX	N	MEAN	MIN	MAX
Expense ratio (%)	35	0.71	0.00	1.170	139	1.57	0.77	5.0
Expense ($)	35	9.66	0.00	112.253	139	3.12	0.002	71.5
Total asset ($)	35	1513.36	0.80	19026.000	139	279.16	0.10	6502.6
Forecast expense ($)	35	10.36	0.02	145.067	139	1.57	0.007	39.6
Excess expense ($)	35	−0.70	−32.81	5.584	139	1.54	−0.007	31.5
Excess expense (%)	35	−89.14	−3109.72	37.849	139	48.41	−280.40	88.8
Scale economies	35	1.2248	0.8021	1.9083	139	1.2569	0.5890	2.667

Note: Forecast expense ($) = EXP(−3.825 + 0.540 ∗ Ln(TA) + $\frac{1}{2}$ ∗ 0.071 ∗ (Ln(TA)^2));
Excess expense ($) = Expense − Forecast expense;
Excess expense (%) = 100 ∗ (Excess expense)/Expense;
$ is in unit of million.

Notes

1. See Clark (1988), Berger et al. (1993) for review of empirical research and the list of estimation problems in this area.
2. Berger et al. (1993) recognize that lack of specialized one product firms as a problem in estimating bank economy.
3. Baumol et al. (1990) use a translog specification found average cost elasticity for economies of scale to range from 0.423 to 0.871, although the log quadratic term has a positive coefficient. The estimates for scope is mix. Dermine and Roller (1992) find scale economies, with elasticities in the range 0.69–0.87 for the smaller fund and diseconomies for the very largest funds. Similar results are claimed for economies of scope, although the estimated coefficients are much weaker, i.e., positive or insignificant.
4. The advantage of having specializing firms, i.e., those that produce A or B only for estimating scope economies is to avoid having to extrapolate well beyond the dense part of the data set, or even outside of the observed data, in the absence of the single product firms.
5. This definition is well recognized, (see Evans and Heckman (1984), Pulley and Humphrey (1993)). However, such global data are often not available, and thus the definition remains a theoretical construct, and various methodological approximations and assumptions are used in its place.

6. Baumol, Panzar and Willig (1982) provide a general definition of economies of scope that allows any partitions of outputs A, B, C. However, various concepts of scope economies as well as the data requirements are not addressed.
7. The problem with zero outputs associated with the translog function is well known. See for instance, Berger, Hanweck and Humphrey (1987). The quadratic cost function (Roller (1990)), or its varians (Pulley and Braunstein (1992)) have been suggested in its place.
8. Constraining $\alpha_4 = \alpha_5 = \alpha_6 = \alpha_{14} = \alpha_{15} = \alpha_{16} = 0$ yields the specification for testing equations (1).
9. Although rates of return for the funds are available, there are several reasons profit function is not estimated: (1) cost function is more commonly estimated, and thus enable a comparison of the results here with other studies. (2) Lakonishok et al. (1992) suggests that portfolio managers have little ability to charge higher fees for higher quality based on past performance, i.e., there is weak linkage between expense and returns. Actually, the Investment Company Act prohibits a compensation/expense structure that is based on performance. The exceptions are the off shore hedge funds which are not in our sample. (3) The variability of portfolio returns is greater than those of expense ratios, i.e., returns are noisier than expense. (4) The concept of efficiency due to output (return) is ill-defined in the area of investment, i.e., ability to produce high returns is more than inputs, or choice of product mix items.
10. The estimated fixed cost are constrained to be non negative, to avoid nonmeaningful results of negative fixed costs.
11. The statistical significance of the α_8 term could be affected by the number of two product fund families in each regression. The five regressions that have the larger number of two product fund families account for all four significant results. Thus, the other regression with fewer than five two fund families may have lower power of test, and thus examining the signs of the coefficients may have some value.
12. Scale efficiency, which is theoretically defined for firms at the efficient frontier, is found to be robust using data from off the frontier. See Berger and Humphrey (1991), McAllister and McManus (1993), Mester (1993). However, not using data on the efficient frontier is a problem in evaluating scope economies. (Berger and Humphrey (1991), Mester (1993)).
13. Ferrier et al. (1993) estimated separate cost functions for both a five product bank sample and a four product bank sample (those not offering real estate or commercial loans). Although it gives some local measure of scope economies under some condition, it gives neither the basic scope economies, nor the marginal scope economies of adding an additional product, from four to five, for all five outputs .

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