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Does Size Matter?
Economies of Scale in the German Mutual Fund Industry

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Abstract

In this paper, we analyze economies of scale for German mutual fund complexes. Using 2002-2005 data of 41 investment management companies, we specify a hedonic translog cost function. Applying a fixed effects regression on a one-way error component model there is clear evidence of significant overall economies of scale. On the level of individual mutual fund complexes we find significant economies of scale for all of the companies in our sample. With regard to cost efficiency, we find that the average mutual fund complexes in all size quartiles deviate considerably from the best practice cost frontier.

JEL Classification: G2**,** L25

Keywords: mutual fund complex, investment management company, cost efficiency, economies of scale, hedonic translog cost function, fixed effects regression, one-way error component model

1 Introduction

The investment industry is of increasing importance for both retail and institutional investors in Germany. What began with solely EUR 24 billion of assets under management in 1980 has become a nearly EUR 1.7 trillion industry by the end of 2007 (BVI (2008)). Despite this growth in the last years, the share of household financial assets held in mutual funds of approximately 15 % is relative low in comparison to a share of more than 23 % in the U.S. (BVI (2008), ICI (2008)). Therefore, the growing demand for retirement saving in Germany will fuel future growth and enforce competition not only between different kinds of financial institutions, but also within the mutual funds industry.

In this paper, we analyze economies of scale and cost efficiency for mutual fund complexes operating in the German market which are fundamental issues for understanding the role of the investment industry in the economy. Furthermore, the existence (or non-existence) of scale economies may support policy makers in implementing effective regulation to protect investors without preventing competition. For example, in the current European Commission's proposal to reform the UCITs directive (undertakings for collective investments in transferable securities, UCITS IV) it is mentioned that the objective of the reform is to "make it easier for the industry to achieve cost savings and specialization benefits across the single market." Cost efficiency is considered, because growing in size may result in frictional losses due to bureaucracy and related coordination costs as described e.g. in Williamson (1988).

We find that German mutual fund complexes exhibit significant economies of scale not only on average, but all of the complexes in our sample exhibit significant complex specific economies of scale. An even more interesting point is the corollary of this result that none of the complexes feature diseconomies of scale regardless of its size. But these scale economies decrease as the size of the mutual fund complex increases. Furthermore, large complexes exhibit considerable cost inefficiencies with regard to their smaller peers.

In the course of the paper, we follow SEC (1966) in defining a mutual fund complex as a "group of funds under common management".[1] In Germany, mutual fund complexes are of the contractual type. Hereby, the assets of the managed mutual funds are separated from the assets of the complex. The mutual fund complex becomes the

[1] We will use the term mutual fund complex in order to make clear that we are dealing with costs on the level of complexes and not on the level of funds.

trustee and the investors are the beneficiaries. From a legal point of view the mutual fund itself is a special asset pool which must be strictly separated from the complexes' own assets. This separation of assets provides investor protection in case of bankruptcy of the mutual fund complex which operates usually in the form of a limited liability company or a joint stock corporation. The unit certificates held by the investors are special securities representing a contractual claim of the unit-holder against the mutual fund complex. Yet, they do not represent the typical rights of a stock owner, e.g. unit holders cannot appoint new fund managers, directors, or board members. Another peculiarity of the German investment industry is the separation of retail and institutional funds. Retail funds are the classic mutual funds which are open for private and institutional investors alike. In contrast, institutional funds are only accessible to institutional investors that are incorporated legal entities. Institutional funds serve as a way to outsource the management of the assets of institutional investors within the framework of the German investment regulation. The major difference between the regulation of retail and institutional funds is the less restrictive reporting requirements for the latter.

There are three strands of literature regarding cost economies of scale in the mutual funds industry.[2] One part of the literature analyzes costs on the level of individual mutual funds (Ferris and Chance (1987), Ferris and Chance (1991), McLeod and Malhotra (1994), Dellva and Olson (1998), Rea et al. (1999), Ang and Lin (2001), Luo (2002), Golec (2003), and Malhotra et al. (2007)). These studies find strong evidence for cost economies of scale dependent on the asset size of the individual mutual fund. Contrary to these findings is the result of Droms and Walker (2001) who find no significant economies of scale for costs on the level of individual mutual funds.

But as already pointed out by Glazer (1970), there may be costs in operating a mutual fund complex which have to be borne by more than one fund. According to Sirri and Tufano (1993), mutual fund complexes may achieve economies of scale e.g. in trading and execution, customer record keeping and reporting, or marketing and distribution. By studying economies of scale on the level of individual mutual funds the costs for these shared activities are not properly considered. Therefore, another strand of the literature examines scale economies on the level of the single mutual fund thereby taking into account the assets of the mutual fund complex in different ways.

[2] Economies of scale may also play an important role in determining the performance of mutual funds. Due to our analysis of scale economies on the complex level, we cannot cover this issue. For more on this topic see e.g. Perold and Salomon (1991), Philpot et al. (1998), Indro et al. (1999), and Chen et al. (2004).

The studies of Tufano and Sevick (1997), Latzko (1999), Deli (2002), Dowen and Mann (2004), and Khorana et al. (2008) consider not only the assets under management of the mutual fund, but also the assets under management of the complex that the fund belongs to. They find strong evidence of cost economies of scale both at the level of the individual mutual fund and the overall complex. Lesseig et al. (2002) use administration and management fees as cost variables. They find economies of scale at the complex level for both cost specifications, but economies of scale at the level of the individual mutual funds are only present using administration fees as the cost variable. In the study of Korkeamaki and Smythe (2004) there are only economies of scale on the complex level. Christofferson (2001) and Berkowitz and Kotowitz (2002) use the number of funds of the complex as variable. They find evidence for economies of scale for the assets under management of the individual mutual funds as well as for the number of funds of the complex to which the funds belong to. Malhotra and McLeod (1997) consider the mutual fund complex by introducing a dummy variable. Again, there are economies of scale both on the level of the mutual funds and the complex.

Finally, there are studies of cost economies of scale which focus on the mutual fund complex itself. Baumol et al. (1990) investigate the cost structure of U.S. mutual fund complexes for the years 1982 to 1987. They find strong evidence of scale economies. This result is confirmed by Collins and Mack (1997) by using a more recent data set of U.S. mutual fund complexes for the time period 1990 to 1994. In their study of the French mutual fund industry for the year 1987, Dermine and Roeller (1992) detect scale economies for small to mid-sized institutions. Bonanni et al. (1998) confirm these results using data of the French mutual fund industry for the years 1987 and 1989.

In Germany, trading expenses are directly debited to the assets under management of the individual fund. The same applies to the costs for reporting and auditing. Therefore, scale economies for these costs on the complex level would directly be reflected on the fund level. The costs for marketing and distribution are paid by the investor in the form of a front-end load at the time of purchase. Typically, the front-end load is a percentage of the issue price of the fund unit. Thus, potential economies of scale in marketing and distribution will not be passed on to the investors. Instead, distributors and the mutual fund complexes reap the full benefits of potential economies of scale. This is one part of the costs we analyze at for scale economies. The main costs which accrue at the level of the funds relate to portfolio management, accounting including compliance with investment regulation, and the management of the shareholder accounts. These are the costs which have to be covered by the management fees debited to the fund's assets and these are the second type of costs we focus on in our analysis of economies of scale.

In this manner we follow the statement of Baumol et al. (1990) that an analysis of scale economies in the mutual fund industry requires the consideration of the operating processes which are implemented at the complex level. Therefore, our analysis of scale economies will be carried out on the level of mutual fund complexes.

Although the amount of assets managed by mutual fund complexes rivals the assets managed by other financial institutions in Germany[3], in contrast to the banking and insurance industry there is sparse empirical research on economies of scale for the investment industry in Germany.

To the best of our knowledge, we are the first to analyze scale economies for German mutual fund complexes. The investment industry in Germany is a natural candidate for such analysis. The value chain of German mutual fund complexes covers the major parts of the investment process. Consequently, evaluating the costs of single complexes allows us to evaluate the costs of the investment process in Germany as a whole. Employing a sample of mutual fund complexes for the years 2002 to 2005, we specify a hedonic translog cost function and then apply panel data estimation techniques. The calculated scale economies are significant for the overall sample as well as for all of the individual complexes. As expected the magnitude of the economies of scale is highest for the smallest quartile of complexes. More interesting still is the finding that the degree of scale economies even for the largest quartile of mutual fund complexes is significantly less than one. This implies that the investment industry in Germany has not yet reached its optimal size. With regard to cost efficiency, our results show that for all size quartiles cost efficiency considerably deviate from the sample optimum. Therefore, costs for mutual fund complexes may not only be reduced by increasing the number of funds, but also by enhancing the operating processes.

We contribute to the literature in several ways. First, we study scale economies on the level of mutual fund complexes which has scarcely been done before. Second, we analyze economies of scale for the German investment industry building upon a unique data set. Third, we study economies of scale for a balanced sample of mutual fund complexes over time, i.e. we do not only cover a longer time period, but also examine the same complexes over this time period. Fourth, we use the number of funds and not

3 At the end of 2006, private households in Germany invested EUR 1.5 trillion in bank deposits, EUR 1.1 trillion in insurance products, and EUR 0.5 trillion in mutual funds (Bundesbank (2007)). Comprehensive overviews of the German banking and insurance industries can be found in Hackethal (2004) and Maurer (2004), respectively.

the assets under management as output variable. Finally, we apply panel data estimation techniques.

The remainder of this paper proceeds as follows. The data and the applied econometric specifications are presented in section 2 and 3, respectively. The empirical results are discussed in section 4. Section 5 concludes and provides an outlook for further research.

2 Data

Our study is based on a combined time series and cross-section dataset for 41 German mutual fund complexes over the period 2002 to 2005. The primary sources of data were the balance sheets and income statements of German mutual fund complexes. We received additional data concerning the assets under management, the number of funds and the net fund flows from the German investment industry association (Bundesverband Investment und Asset Management e.V., BVI) and the Deutsche Bundesbank.

During the years covered by our panel the mutual fund industry in Germany exhibited growth in assets under management corrected for net fund flows of 7.34 % (BVI (2004), BVI (2006), BVI (2007)). This overall growth rate is composed of the growth rates for retail and institutional funds which are 9.27 % and 5.63 %, respectively. Since these numbers are net of fund flows, the difference in the growth rates of retail and institutional funds reflects the more conservative asset allocation of the latter due to regulatory requirements.[4] The overall growth in assets under management is accompanied by a minor decrease in the number of funds by 0.27 %. However looking at retail and institutional funds separately, there is a discrepancy in the growth in the number of funds. The number of retail funds grew by 5.36 % whereas the number of institutional funds decreased by 4.23 %. Since the number of institutional funds is approximately twice the number of retail funds, the increase in the number of retail funds more than compensates for the decline in the number of institutional funds. The sharp decline in the number of institutional funds can be explained by a change in German investment law at the beginning of 2004 which simplified the merger of funds for institutional investors.

In absolute terms the assets under management of the German investment

[4] The net growth rate reflects the average performance for the funds of the investment industry as a whole. The overall gross growth rate is 9.37 %. Therefore, net fund flows account for roughly 2 % in asset growth per year. The same applies to the gross growth rates for retail and institutional funds which are 11.41 % and 7.67 %, respectively.

management industry increased from EUR 862bn in 2002 to EUR 1.160bn in 2005. The corresponding numbers for retail (institutional) funds were EUR 382bn (480bn) in 2002 and EUR 545bn (EUR 615bn) in 2005. In this period of time the number of funds slightly decreased from 7,402 in 2002 to 7,064 in 2005. The number of retail funds increased from 2,077 in 2002 to 2,452 in 2005 and for institutional funds the number decreased sharply from 5,325 in 2002 to 4,608 in 2005. The number of mutual fund complexes which are members of the BVI increased from 72 in 2002 to 79 in 2005.[5]

Wherever possible (and appropriate) we divide our sample into subsamples. Firstly, we distinguish between the product types of security[6] and real estate funds. The majority of funds offered by German mutual fund complexes are of the first type. Very few mutual fund complexes offer real estate funds. Secondly, we differentiate between investor categories of retail and institutional investors. Since mutual fund complexes in Germany may offer security and real estate funds for retail as well as for institutional investors, it is possible (and it is the case in our sample) that companies belong to both product as well as to both investor categories.

Finally, we divide the total sample into four size quartiles based on the number of funds offered by the mutual fund complexes. Size quartile 1 contains the smallest 25 % of the complexes, size quartile 2 the next 25 % of the complexes, and so on.

Table 1 here

Since we are dividing our sample into size quartiles, one has to look at the stability of these quartiles. Therefore, table 1 represents the transition probabilities between the size quartiles for the period 2002 to 2005. The composition of the size quartiles remains relatively stable over time, in particular for the years 2003 to 2004. For the whole time period of the sample, more than 80 % of the complexes remain in their respective size quartile. Due to the balancing of our sample, this implies that the order of mutual fund complexes in our sample ranked on the basis of the number of funds changes in the sample period.

We deal with the exiting and entering of units over time which is a familiar problem of panel data by balancing our sample to mutual fund complexes for which data is available over the entire period.

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[5] A more thorough review of the German investment management industry can be found in Maurer (2004).

Table 2 here

To get an idea of the representativeness of our data compared to the industry, we report in table 2 the share of the number of funds of our sample and subsamples with respect to the total industry.[7] The shares of our sample are in the region of 70 % for each category, except for complexes offering real estate funds. These numbers are higher than the share of our sample of the number of companies which are a member of the BVI (on average 55 %). Since there are also mutual fund complexes which are not members of the BVI, the higher shares indicate that our sample contains complexes with a larger fund base. Therefore, extrapolating our results to the German investment industry as a whole should be done with caution.

Table 3 here

In table 3, summary statistics for the sample are reported. For the total sample, operating expenses correspond to approximately TEUR 2,118.82 per fund.[8] As was to be expected, the operating expenses are lowest (TEUR 128.06) for the largest 25 % of the mutual fund complexes, i.e. for size quartile 4. More interesting is the dispersion of this size quartile (TEUR 67.32) which is by far the lowest of all size quartiles. This indicates homogeneity in the cost structure of large complexes. Evaluating the values of operating expenses and average fund size for size quartile 1 should be done with caution, since this size quartile mainly consists of mutual fund complexes offering real estate funds. Therefore, the columns for size quartile 1 and for the product type of real estate funds resemble each other.

Differentiated by product type, real estate funds (TEUR 7,367.55) are clearly more expensive to manage than security funds (TEUR 272.04). This might reflect the lack of standardization for real estate funds due to the heterogeneity of the underlying property portfolios.

Institutional funds (TEUR 716.71) are less cost intensive than retail funds (TEUR 2,192.85). This result confirms the expectation that the costs of managing institutional funds are lower than for their retail counterpart, because of less reporting requirements

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6 Security funds comprise equity, bond, and money market funds.

7 Since the number of funds is used as output variable in the cost function, we also base our size calculations on this measure.

8 Operating expenses contain material costs, personal expenses, and depreciation as reported in the profit and loss statement.

and the fact that there is only one investor for most of the institutional funds. Again, a word of caution is in order here. In Germany, there are more mutual fund complexes offering real estate funds for retail than for institutional investors. Therefore, the statistics for complexes offering retail funds are biased by the higher share of real estate funds in the product range.

The average mutual fund complex in our sample offers almost 108 funds. For security funds and funds offered to institutional investors the number of funds is slightly higher (137 and 123, respectively). The number of retail funds is nearly the same as for the overall sample (109), whereas the number of real estate funds offered on average is only approximately 10. Therefore, size quartile 1 consists mainly of mutual fund complexes offering real estate funds.

Mutual fund complexes in our sample manage on average EUR 13bn of assets. The assets increase from size quartile 2 (EUR 3.72bn) to 4 (EUR 31.15bn) as anticipated. Again, the average assets under management reported for size quartile 1 of EUR 6.95bn are upwardly biased by the high share of complexes offering real estate funds. The assets under management of complexes offering security funds (EUR 14.69bn) are twice as large as the assets for complexes offering real estate funds (EUR 7.69bn) whereas the average assets of mutual fund complexes offering funds to retail or institutional investors are very similar (EUR 13.28bn and EUR 13.60bn, respectively).

An interesting result is that the average fund size and most notably its dispersion, is decreasing from the second to the fourth size quartile. Therefore, an increase in the number of funds is accompanied by a disproportionately lower increase in the assets under management. This is line with the expectation that mature funds are larger than newly launched funds.

The largest mutual fund complexes are also the oldest ones in our sample (29.70 years). Indeed, the size quartile for the largest complexes contains the first mutual fund complexes founded in Germany. The youngest complexes are in size quartile 2 and have a mean age of 12.59 years. Again, the age for size quartile 1 may be biased by the real estate fund complexes.

Finally, almost all of the companies in our sample (39.5) offer retail funds. The majority also offer funds to institutional investors (35.25). The major product types offered are security funds (32) whereas only a minority offer real estate funds (10.75).

3 Methodology

3.1 Econometric specification of the cost function

For our analysis of economies of scale we employ a hedonic translog cost function. The translog cost function is used because of its flexibility and advantages over other types of cost functions (see e.g. Christensen et al. (1973) and Caves et al. (1980)). The inclusion of hedonic variables allows us to also take into account the characteristics of the outputs. We model total costs *C* of a mutual fund complex as a function of one output level *y*, five hedonic variables $h_g, g = 1,...,5,$ and two dummy variables $d_l, l = 1,2$. Therefore, the hedonic translog cost function in its general form for company *n* at time *t* is specified as follows

$$\begin{aligned} \ln(C_{n,t}) = {} & a_0 + b_1 \ln(y_{n,t}) + \frac{1}{2} b_2 \ln(y_{n,t})^2 + \sum_{g=1}^{5} e_g h_{g,n,t} \\ & + \sum_{l=1}^{2} f_l d_{l,n,t} + u_{n,t}. \end{aligned} \tag{1}$$

In order to estimate equation (1), we utilize a one-way error component model for the disturbance, i.e.

$$u_{n,t} = \mu_n + v_{n,t} \tag{2}$$

whereby μ_n denotes the unobservable complex-specific effect and $v_{n,t}$ is the remainder disturbance.

Pooled ordinary least squares (hereinafter known as POLS) and random effects estimation by generalized least squares (hereinafter known as GLS) of equation (1) may yield biased and inconsistent estimates of the parameters if the individual effects are correlated with the included independent variables (see Hausman and Taylor (1981)). Since we include time-invariant variables in our cost function in form of dummy variables, such correlation will be present. This problem can be overcome by the within-transformation of the data followed by the running of an ordinary least squares regression on the transformed data resulting in the fixed effects estimator. But this transformation also wipes out all the time-invariant variables, so that in our case the coefficients of the dummy variables cannot be estimated by fixed effects (hereinafter known as Within). Therefore, we also apply an instrumental variables estimation procedure (hereinafter known as HT) following the approach of Hausman and Taylor (1981).

Furthermore, we test for fixed effects by performing an *F*-test (see e.g. Baltagi (2005)) and we also test for random effects using the *LM*-test derived by Breusch and Pagan (1980). In order to test the presence of a correlation between the individual effects and the independent variables, the specification test (Hausman (1978)) and its more general form by Chamberlain (1982), as described by Arellano (1993), are employed.

3.2 Measures of scale economies and cost efficiency

Following Fuss and Waverman (1981) and Baumol et al. (1990) we standardize the output variable in our analysis to have a mean of one. This standardization facilitates the calculation of the scale measure. Overall economies of scale (*OES*) are thus given by

$$\begin{aligned} OES &= \frac{\partial \ln(C)}{\partial \ln(y)} \\ &= b_1 + b_2 \ln(y). \end{aligned} \tag{3}$$

This measure of scale economies is referred to as ray scale elasticity which can also be expressed as (see e.g. Lang and Welzel (1996))

$$\left.\frac{\partial \ln(C(\lambda y))}{\partial \ln(\lambda y)}\right|_{\lambda=1} = \frac{\partial \ln(C(y))}{\partial \ln(y)} = \frac{\partial C(y)}{\partial y}\frac{y}{C(y)}.$$

Therefore, *OES* is the relative cost increase caused by a relative increase in output.[9]

Due to the standardization of the output variable, the evaluation of scale economies at the sample mean results in . In addition, we calculate complex specific economies of scale at the time-series means for the output variable of the individual complexes.

Scale economies are present if the *OES* measure is less than one. To test the statistical significance, the standard error of the *OES* measure has to be computed.

$$\begin{aligned} Std(OES) &= \left[Var(b_1 + b_2 \ln(y))\right]^{\frac{1}{2}} \\ &= \left[Var(b_1) + \ln(y)^2 Var(b_2) + 2\ln(y) Cov(b_1, b_2)\right]^{\frac{1}{2}} \end{aligned} \tag{4}$$

[9] Since we are considering only one output, we do not have to bother about the critical assumption of the ray scale elasticity that all outputs are raised proportionately.

By evaluating equation (4) at the sample mean, this reduces to

$$Std(OES) = \left[Var(b_1)\right]^{\frac{1}{2}} \tag{5}$$

Furthermore, from the estimated cost function, measures of overall cost efficiency will be calculated. Given equation (1) an indicator for overall cost efficiency is derived using the individual effects μ_n as in Lang and Welzel (1996). The mutual fund complex with the lowest intercept is the most efficient one in the sample and is assumed to be on the cost frontier, i.e. is assumed to be cost efficient. The efficiency measures of the other complexes are calculated relative to this complex. Therefore, overall cost efficiency (*OCE)* of mutual fund complex *n* is calculated as

$$OCE_n = \exp\left[\min(a_0 + \mu_1, ..., a_0 + \mu_n, ..., a_0 + \mu_N) - (a_0 + \mu_n)\right] \tag{5}$$

where $OCE_n \in \left]0,1\right]$ and $N = 41$.[10] Equation (5) provides a measure of the relative change in costs for complex *n*, if it would use the operating processes of the most efficient complex in the sample. Lower levels of imply higher levels of inefficiency.

3.3 Description of the variables

We define total costs (*C)* as operating expenses which are comprised of material costs, personal expenses, and depreciation as reported in the profit and loss statement. Personal expenses are the biggest part of the operating expenses. Since they are mainly fixed costs[11], an increase in the number of funds will result in less personal expenses per fund. Material costs generally include costs for leases, advertising expenditure, software licenses, advisory fees, and fees for outsourcing of services. Finally, depreciation costs include the depreciation of furniture and office equipment as well as software licenses.

To model mutual fund complexes we do not follow the literature and treat the number of funds instead of assets under management as output *y*. As already pointed out by Baumol et al. (1990), the definition of output for a mutual fund complex is not a

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[10] See e.g. Baltagi (2005) for the recovering of company specific intercepts $a_o + \mu_n$.

[11] Personal expenses can be treated as fixed costs, because the launch of new funds does not imply that new employees are recruited, e.g. fund managers and accountants are normally responsible for more than one fund.

trivial issue. In the literature on scale economies for mutual fund complexes, assets under management are usually considered as the output measure (Baumol et al. (1990), Dermine and Roeller (1992), Collins and Mack (1997), Malhotra and McLeod (1997), Bonanni et al. (1998), Latzko (1999)). We decide in favor of the number of funds as the output measure, because a fund is what one can best call the distinct product of a mutual fund complex. Thus, funds provide a reasonable basis for the aggregation of output within a complex (see Baumol et al. (1990)) on this point).[12]

The hedonic variables account for complex specific characteristics that may affect costs. First, we include the log of the assets under management as a control variable. Since assets under management are usually used as the output variable, we can check if the number of funds already captures all of the size effect we are interested in by including assets as control variable. We expect a negative impact of assets on costs.

To account for the different product types of security and real estate funds offered to retail and institutional investors we include the share of retail real estate, institutional security, and institutional real estate funds as control variables. We expect that the higher the share of real estate funds is, the higher the costs will be. Because each property in every fund is unique, there are no scale economies which can be exploited. Due to investor specific requirements in the portfolio construction for institutional funds there is less standardization in managing institutional funds than for retail funds. Therefore, we also expect higher costs for complexes offering institutional funds.

Differences in industry expertise and technology are captured by the log of age of the mutual fund complexes. Age is calculated as the difference between the respective time period and the year that authorization by the supervisory authority was granted. We do not know what sign to expect ex ante, because there might be two opposing effects. On the one hand, more mature complexes have had the time to establish efficient investment processes. On the other hand, these complexes may have become slack in their operations and therefore exhibit inefficiencies in their cost structure.

In addition, we include a dummy variable for the location of the mutual fund complexes' headquarters. This dummy variable takes on a value of one if the headquarter is located in the metropolitan area of Frankfurt/Main and zero otherwise. We choose this metropolitan benchmark location, because it is the most important financial center in Germany. There may be two opposing effects. On the one hand, the living costs and lease prices in Frankfurt/Main are one of the highest in Germany, so

[12] To check the robustness of our results we also estimated equation (1) with assets under management as output variable. The results are qualitatively the same and are provided by the authors upon

one might expect higher costs for companies located in this area. On the other hand, the industry expertise and competition in this area might be higher than in other areas which may result in lower costs due to more efficient operating processes. In our sample, approximately 56 % of the complexes (23 out of 41) are located in this metropolitan area.

A second dummy variable is included which takes on the value of one if the mutual fund company is a subsidiary of a corporation and zero otherwise. In Germany, most of the complexes are subsidiaries of banks, insurance companies or part of a financial conglomerate. Being a subsidiary may result in lower costs due to the provision of costless or cheaper than common resources by the parent company. But there is also the possibility that the subsidiary will be debited with higher than common costs for these resources. In our sample, approximately 90 % of the complexes (37 out of 41) are subsidiaries.

Following the notation in Greene (2003) of the HT estimator, we treat the number of funds, assets under management, and business share variables as time-varying and uncorrelated with the individual effects. We will denote these variables by x_1. Age is also time-varying, but assumed to be correlated with the individual effects. This variable is denoted as x_2. Finally, the dummy variables are time-invariant and correlated with the individual effects. They are denoted as z_2.

4 Empirical Results

The coefficients of the hedonic translog cost function, estimated with the one-way error component model by the different estimators described in section 3.1, are reported in table 4. The *F*-test for testing fixed effects and the *LM*-test for testing random effects are both highly significant at the 1 % level, so in both specifications individual effects are present. The Hausman-test as well as the Chamberlain-test are also significant at the 1 % level suggesting that correlation between the independent variables and the individual effects are present. Although, the test for the identifying restrictions of the HT model as described in Hausman and Taylor (1981) only rejects the null hypothesis of no correlation between the independent variables and the individual effects at the 10 % level, we choose the HT specification as the preferred model. This decision can be supported by the fact that the coefficient estimates for number of funds, assets under management, and the age variable are close to the efficient estimates of the within-

request.

specification. Only in respect of the business share variables are there considerable deviations in the estimates between these two models.

With the exception of the assets under management and the business share of institutional security funds all coefficients are significant at least at the 5 % level. The output variable both in linear and quadratic form has positive signs implying positive cost elasticity. The assets under management only have a minor effect on costs and the coefficient is not significant anyway. Thus, the number of funds already captures the size effect we are interested in.

The higher the share of real estate funds on the product range there is, the higher the costs are. The positive sign of the age variable suggests that more mature complexes do not benefit from technical progress. Mutual fund complexes that are located in the metropolitan area of Frankfurt/Main and which are subsidiaries face substantially higher costs.

The parameter estimates of the HT specification for the number of fund variables are used in equation (3) to calculate measures of economies of scale. For each size quartile, a typical mutual fund complex with the size quartile means of the variables entering the hedonic translog cost function is generated for each year and then averaged over all years. We evaluate the measures of economies of scale and cost efficiency for the overall sample and for each size quartiles.

Table 5 here

Table 5 represents the estimates of scale economies for the whole sample as well as for the size quartiles. The reported measure of scale economies can be interpreted as follows; if it less than one, economies of scale are present; if it is equal to one, there are constant returns to scale. Finally, if it is greater than one, diseconomies of scale are present.

As can be seen from table (5), there are significant economies of scale for the entire sample as well as for the size quartiles. The measures are considerably and statistically significant less than one. This result is qualitatively in line with the previous literature on scale economies on the level of mutual fund complexes. But our results are quantitatively far lower than the values presented by Dermine and Roeller (1992), Collins and Mack (1997), and Bonanni et al. (1998). The results that are the most similar to ours are reported by Baumol et al. (1990) who calculate measures of scale economies between 0.423 and 0.871 for different model specifications. The difference may be due to the fact that in the study of Baumol et al. (1990) only complexes offering money market funds are considered. The difference between our results and those of Dermine and Roeller (1992) and Bonanni et al. (1998) may be caused by the domination of complexes offering money market funds in their samples.

As anticipated, there is a clear size trend related to the measure of economies of scale. This confirms the results of Dermine and Roeller (1992), Collins and Mack (1997), Bonanni et al. (1998). The most important point is that the largest 25 % of the mutual fund complexes in our sample still exhibit considerable scale economies which are contrary to results produced in previous literature. In Dermine and Roeller (1992) the five largest complexes exhibit a scale measure of 0.962. This result is confirmed in Bonanni et al. (1998) where the five largest complexes show diseconomies of scale with a scale measure of 1.33. The results in Collins and Mach (1997) also suggest that the largest complexes exhibit diseconomies of scale with a scale measure of 1.059. In our sample all complexes exhibit economies of scale and no diseconomies, irrespective of their size as in Baumol et al. (1990).

Another method to determine the degree to which economies of scale are related to the output level is by computing the rank correlation between the measure of economies of scale and the output measure (Baumol et al. (1990)). The rank correlation between the measure of economies of scale and the number of funds enables the assessment whether mutual fund complexes with relatively greater economies of scale offer relatively more funds to their clients. In our sample, the rank correlation coefficients are equal to one for each of the years 2002 to 2005 and for each of the regression specifications. This result is similar, but stronger than the rank correlations of 0.732 to 0.906 reported by Baumol et al. (1990). Therefore, the greater the output of the mutual fund complex measured by the number of funds, the smaller the degree of economies of scale.[13]

Figure 1 here

Figure 1 presents the estimated average hedonic translog cost functions for the mutual fund complexes in our sample. An increase in the number of funds implies a decrease in average costs. The decrease in costs is higher for smaller mutual fund complexes and the costs fall less the greater the number of funds offered. The relatively

[13] The positive values for the rank correlations result from the use of the cost elasticity as the measure for scale economies (see Baumol et al. (1990) on this point).

flat cost curves for high number of funds indicate that there might be some optimal number of funds. The median costs per fund are close to TEUR 100. The cost function following the HT and within specifications are similar to each other. The highest cost function is estimated by the GLS model indicating that the results of the GLS estimation are positively biased. The lowest cost function is estimated by the POLS model.

Figure 2 here

In figure 2 the estimated cost functions for the size quartiles are shown. As expected, it illustrates a clear size trend for the estimated costs. The corresponding median values decrease from approximately TEUR 10,000 for size quartile 1 to TEUR 450, TEUR 170, and TEUR 50 for size quartiles 1, 2, and 3. Again, the results for size quartile 1 are biased upwards due to the inclusion of the mutual fund complexes offering real estate funds. For size quartiles 1 to 3 the HT and within specifications are again very similar and the GLS results are the highest whereas the POLS results are the lowest. It is only in size quartile 4 that the results of the HT and the within models differ slightly.

Table 6 here

In table 6 we finally present results on overall cost efficiency. In order to measure cost efficiency we compare each individual complex with the most efficient complex in the dataset (in the respective size quartile) for each year and average over all years and complexes in the dataset (in the respective size quartile). A value of less than one indicates inefficiency.

The most efficient mutual fund complexes in our sample are the complexes in size quartile 3. But there is no clear size trend in the data with regards to scale economies, since the largest complexes are, together with the complexes in size quartile 2, the most inefficient ones. An explanation for this result might be that at a certain number of funds offered, mutual fund complexes no longer need to save costs by enhancing their processes, because the higher fees due to the increased size more than compensate the increase in operating expenses. The results for cost efficiency of size quartile 1 are interesting. Mutual fund complexes of this size quartile are by far more efficient than the next larger complexes as well as the largest complexes of our sample. Although size quartile 1 mainly consists of mutual fund complexes offering real estate funds which we expect to be more heterogenous than security funds, they are cost efficient in relative (not in absolute) terms.

To sum up, in our sample mutual fund complexes on the one hand exhibit economies of scale for all size quartiles and the degree of scale economies decreases as size increases. On the other hand, the operating processes for all size quartiles are far from cost efficient.

5 Conclusion

In our empirical analysis of a panel of 41 mutual fund complexes in Germany for the period from 2002 to 2005 we found evidence of strong and significant scale economies for the overall sample as well as the size quartiles. This finding is in line with previous research on scale economies for mutual fund complexes and individual mutual funds. Cost efficiency was shown to deviate considerably from the optimum. These results show that even the largest mutual fund complexes in our sample have not reached an optimal size as well as efficient operating processes.

The implications for mutual fund complexes are that they could increase their product range by issuing new funds or by merging with other complexes. Since a major part of costs is caused by back-office operations, it may be profitable to merge back-office operations of different mutual fund complexes.[14] We do not suggest that mutual fund complexes should grow without bounds, because growing in size corresponds to inefficiencies in the operating processes.

Despite this result of suboptimal size, it is interesting that we observe no merger activity for the mutual fund complexes in our sample during the period from 2002 to 2005. The reason for the absence of mergers is rooted in the subsidiary status of most of the complexes. This may impose a severe obstacle for mergers among mutual fund complexes in Germany.

For policy makers, there are also two implications. Firstly, an increase in size should not be prevented, but should possibly be encouraged. Secondly, incentives for enhancing the operating processes should be introduced, e.g. by allowing master-feeder structures for the pooling of assets from different mutual funds. Yet policy makers should also formulate measures which force the mutual fund complexes to give back most of the saved expenses due to scale economies to the investors. As mentioned in the introduction, the main costs of mutual fund complexes have to be covered by the management fees of the funds. But in Germany these management fees are, at least for retail funds, mostly fixed percentages of the assets under management. To enable investors participate in scale economies achieved at the level of the complex, the percentage of management fees may be reduced when the assets increase. In return, in order to ensure that at least the overhead costs are covered, a minimum management fee in the form of an absolute euro amount may be implemented.

As already mentioned in section 2, extrapolating these results to the German investment industry as a whole should be done with caution due to the bias in our sample towards larger mutual fund complexes. In spite of these limits to generalization, our results provide useful insights into the cost structures and cost efficiencies of German mutual fund complexes.

In further research one should analyze the interaction between scale economies and cost efficiency in more detail. Furthermore, the funds offered may be split into their major components for retail security and real estate as well as institutional security and real estate funds. This breakdown will also allow for analysing economies of scope which were not covered in this study. But in the case of separated fund categories, the problem of zero outputs has to be addressed. Since a Box-Cox transformation as used in Christensen and Greene (1976) comes with the disadvantage of the impossibility to estimate standard errors of the regression coefficients (see Greene (2003) on this point), a specification suggested by Pulley and Braunstein (1992), which is quadratic in outputs and log-quadratic in inputs may have to be employed.

[14] Indeed, in 2008 two of the largest mutual fund complexes merged their back-office operations.

References

ANG, J. S. AND LIN, J. W. 2001. A fundamental approach to estimating economies of scale and scope of financial products: The case of mutual funds. *Review of Quantitative Finance and Accounting* 16:205-222.

ARELLANO, M. 1987. Computing robust standard errors for within-groups estimators. *Oxford Bulletin of Economics and Statistics* 49:431-434.

ARELLANO, M. 1993. On the testing of correlated effects with panel data. *Journal of Econometrics* 59:87-97.

BALTAGI, B. H. 2005. Econometric Analysis of Panel Data. John Wiley & Sons, Ltd., Chichester, 3rd edition.

BAUMOL, W. J., GOLDFELD, S. M., GORDON, L. A., AND KOEHN, M. F. 1990. The Economics of Mutual Fund Markets: Competition versus Regulation. Rochester Studies in Economics and Policy Issues. Kluwer Academic Publishers, Boston.

BERKOWITZ, M. K. AND KOTOWITZ, Y. 2002. Managerial quality and the structure of management expenses in the US mutual fund industry. *International Review of Economics and Finance* 11:315-330.

BONANNI, C, DERMINE, J., AND RÖLLER, L.-H. 1998. Some evidence on customer 'lock-in' in the french mutual funds industry. *Applied Economics Letters* 5:275-279.

BREUSCH, T., AND PAGAN, A. 1980. The lagrange multiplier test and its applications to model specification in econometrics. *Review of Economic Studies* 47:239-253.

BVI 2004. Investment 2004 - Daten, Fakten, Entwicklungen. BVI Bundesverband Investment und Asset Management e.V., Frankfurt am Main.

BVI 2006. Investment 2006 - Daten, Fakten, Entwicklungen. BVI Bundesverband Investment und Asset Management e.V., Frankfurt am Main.

BVI 2007. Investment 2007 - Daten, Fakten, Entwicklungen. BVI Bundesverband Investment und Asset Management e.V., Frankfurt am Main.

BVI 2008. Investment 2008 - Daten, Fakten, Entwicklungen. BVI Bundesverband Investment und Asset Management e.V., Frankfurt am Main.

CAVES, D. W., CHRISTENSEN, L. R., AND TRETHEWAY, M. W. 1980. Flexible cost functions for multiproduct firms. *Review of Economics and Statistics* 62:477-481.

CHAMBERLAIN, G. 1982. Multivariate regression models for panel data. *Journal of*

Econometrics 18:5-46.

CHANCE, D. M. AND FERRIS, S. P. 1991. Mutual fund distribution fees: An empirical analysis of the impact of deregulation. *Journal of Financial Services Research* 5:25-42.

CHEN, J., HONG, H., HUANG, M., AND KUBIK, J. D. 2004. Does fund size erode mutual fund performance? The role of liquidity and organization. *American Economic Review* 94:1276-1302.

CHRISTENSEN, L. R. AND GREENE, W. H. 1976. Economies of scale in U.S. electric power generation. *Journal of Political Economy* 84:655-676.

CHRISTENSEN, L. R., JORGENSON, D. W., AND LAU, L. J. 1973. Transcendental logarithmic production frontiers. *Review of Economics and Statistics* 55:28-45.

CHRISTOFFERSON, S. E. 2001. Why do money fund managers voluntarily waive their fees? *Journal of Finance* 56:1117-1140.

COLLINS, S. AND MACK, P. 1997. The optimal amount of assets under management in the mutual fund industry. *Financial Analysts Journal* 53:67-73.

DELI, D. L. 2002. Mutual fund advisory contracts: An empirical investigation. *Journal of Finance* 57:109-133.

DELLVA, W. L. AND OLSON, G. T. 1998. The relationship between mutual fund fees and expenses and their effects on performance. *Financial Review* 33:85-104.

DERMINE, J. AND RÖLLER, L.-H. 1992. Economies of scale and scope in french mutual funds. *Journal of Financial Intermediation* 2:83-93.

DEUTSCHE BUNDESBANK 2007. Monatsbericht.

DOWEN, R. J. AND MANN, T. 2004. Mutual fund performance, management behavior, and investor costs. *Financial Services Review* 13:79-91.

DROMS, W. G. AND WALKER, D. A. 2001. Persistence of mutual fund operating characteristics: Returns, turnover rates, and expense ratios. *Applied Financial Economics* 11:457-466.

FERRIS, S. P. AND CHANCE, D. M. 1987. The effect of 12b-l plans on mutual fund expense ratios: A note. *Journal of Finance* 42:1077-1082.

FUSS, M. AND WAVERMAN, L. 1981. Regulation and the multiproduct firm: The case of telecommunications in Canada. *In* G. Fromm (ed.), Studies in Public Regulation, pp. 277-313. Cambridge, Mass.: MIT Press.

GLAZER, D. W. 1970. A study of mutual fund complexes. *University of Pennsylvania Law Review* 119:205-282.

GOLEC, J. 2003. Regulation and the rise in asset-based mutual fund management fees. *Journal of Financial Research* 26:19-30.

GREENE, W. H. 2003. Econometric Analysis. Prentice Hall, 5th edition.

HACKETHAL, A. 2004. German banks and banking structure. *In* J. P. Krahnen and R. H. Schmidt (eds.), The German Financial System, pp. 71-105. Oxford University Press.

HAUSMAN, J.A. 1978. Specification tests in econometrics. *Econometrica* 46:1251-1271.

HAUSMAN, J.A., AND TAYLOR, W.E. 1981. Panel data and unobservable individual effects. *Econometrica* 49:1377-1398.

ICI 2008. Investment Company Fact Book. Investment Company Institute, 48th edition.

INDRO, D. C, JIANG, C. X., HU, M. Y., AND LEE, W. Y. 1999. Mutual fund performance: Does fund size matter? *Financial Analysts Journal* 55:74-87.

KHORANA, A., SERVAES, H., AND TUFANO, P. 2008. Mutual fund fees around the world. *Review of Financial Studies, forthcoming.*

KORKEAMAKI, T. P. AND SMYTHE, JR., T. I. 2004. Effects of market segmentation and bank concentration on mutual fund expenses and returns: Evidence from finland. *European Financial Management* 10:413-438.

LANG, G. AND WELZEL, P. 1996. Efficiency and technical progress in banking - empirical results for a panel of german cooperative banks. *Journal of Banking and Finance* 20:1003-1023.

LATZKO, D. A. 1999. Economies of scale in mutual fund administration. *Journal of Financial Research* 22:331-339.

LESSEIG, V. P., LONG, D. M., AND SMYTHE, T. I. 2002. Gains to mutual fund sponsors offering multiple share class funds. *Journal of Financial Research* 25:81-98.

LUO, G. Y. 2002. Mutual fund fee-setting, market structure and mark-ups. *Economica* 69:245-271.

MALHOTRA, D. K., MARTIN, A. AND RUSSEL, P. 2007. Determinants of cost efficiencies in the mutual fund industry. *Review of Financial Economics* 16:323-334.

MALHOTRA, D. K. AND MCLEOD, R. W. 1997. An empirical analysis of mutual fund expenses. *Journal of Financial Research* 20:175-190.

MAURER, R. 2004. Institutional investors in Germany: Insurance companies and investment funds. *In* J. P. Krahnen and R. H. Schmidt (eds.), The German Financial System, pp. 106-138. Oxford University Press.

MCLEOD, R. W. AND MALHOTRA, D. K. 1994. A re-examination of the effect of 12b-l plans on mutual fund expense ratios. *Journal of Financial Research* 17:231-240.

PEROLD, A. F. AND SALOMON, JR., R. S. 1991. The right amount of assets under management. *Financial Analysts Journal* 47:31-39.

PHILPOT, J., HEARTH, D., RIMBEY, J. N., AND SCHULMAN, C. T. 1998. Active management, fund size, and bond mutual fund returns. *Financial Review* 33:115-126.

PULLEY, L. B. AND BRAUNSTEIN, Y. M. 1992. A composite cost function for multiproduct firms with an application to economies of scope in banking. *Review of Economics and Statistics* 74:221-230.

REA, J. D., REID, B. K., AND MILLAR, K. W. 1999. Operating expense ratios, assets, and economies of scale in equity mutual funds. *Investment Company Institute Perspective* 5:1-15.

SEC 1966. Public Policy Implications of Investment Company Growth. House Report No. 2337. Securities and Exchange Commission, Washington.

SIRRI, E. R. AND TUFANO, P. 1993. Competition and change in the mutual fund industry. *In* S. Hayes III. (ed.), Financial Services: Perspectives and Challenges, pp. 181-214. HBS Press.

TUFANO, P. AND SEVICK, M. 1997. Board structure and fee-setting in the U.S. mutual fund industry. *Journal of Financial Economics* 46:321-355.

WHITE, H. 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica* 48:817-838.

WILLIAMSON, O.E. 1988. Corporate Finance and Corporate Governance. *Journal of Finance* 43:567-591.

Table 1
Transition probabilities for size quartiles

Year-to-year	2002-03				2003-04				2004-05			
	Quartile				Quartile				Quartile			
Quartile	1	2	3	4	1	2	3	4	1	2	3	4
1	90	10	0	0	100	0	0	0	90	10	0	0
2	9	91	0	0	0	100	0	0	9	82	9	0
3	0	0	100	0	0	0	100	0	0	10	90	0
4	0	0	0	100	0	0	0	100	0	0	0	100

This table shows the transition probabilities of the size quartiles from one year to the next. The numbers are given in percentages. Note that the number of companies in the second size quartile is 11 whereas the respective number for the other size quartiles is only 10. Therefore, the columns do not add up to 1.

Table 2
Representativeness of the sample

		Product type		Investor category	
Year	Total	Security	Real estate	Retail	Institutional
2002	69.40	72.89	42.86	73.87	68.30
2003	69.52	73.10	41.35	74.47	68.31
2004	69.79	74.00	39.17	73.32	68.36
2005	69.27	79.73	33.81	72.45	68.34

This table shows the representativeness of the used dataset. The numbers are given in percentages. The sample shares were calculated on the basis of the total number of funds. Note that mutual fund complexes in Germany can offer both security and real estate funds to retail as well as to institutional investors.

Table 3
Summary statistics of the dataset

	Total	Size quartile				Product type		Investor category	
	Sample	1	2	3	4	Security	Real Estate	Retail	Institutional
Operating Expenses in TEUR per fund	2,118.82	7,886.19	347.35	290.81	128.06	272.04	7,367.55	2,192.85	716.71
	(4,982.4)	(7,641.65)	(249.84)	(369.89)	(67.32)	(282.36)	(7,609.33)	(5,079.03)	(1,475.91)
Number of funds	107.82	4.97	26.16	87.42	320.88	137.00	9.58	109.39	123.23
	(150.97)	(4.09)	(10.25)	(28.40)	(170.21)	(159.19)	(15.37)	(153.35)	(157.23)
Total assets under management in EUR bn	12.98	6.95	3.72	11.03	31.15	14.69	7.69	13.28	13.60
	(16.32)	(4.56)	(3.46)	(14.47)	(19.84)	(17.97)	(4.61)	(16.58)	(17.05)
Average fund size in EUR bn	667.05	2,362.39	149.43	115.08	93.07	135.24	2,217.49	692.34	244.23
	(1,547.76)	(2,461.98)	(180.77)	(116.62)	(25.60)	(169.73)	(2,431.05)	(1,577.23)	(416.52)
Age in years	21.67	22.60	12.59	22.70	29.70	20.94	21.98	22.32	21.69
	(14.65)	(15.60)	(9.84)	(11.99)	(15.58)	(14.39)	(15.11)	(14.59)	(14.65)
Observations	41	10	11	10	10	32	10.75	39.25	35.25

This table presents summary statistics of the dataset. Reported are the equal-weighted mean values with standard deviation in parentheses. All money amounts are expressed in real terms. Note that mutual fund complexes in Germany can offer both security and real estate funds to retail as well as to institutional investors. Further note that size quartile 1 mainly consists of mutual fund complexes offering real estate funds. Operating expenses include material costs, personal expenses, and depreciation as reported in the profit and loss statement. Age is calculated as the difference between the respective time period and the year authorization of the supervisory authority was granted.

Table 4
Empirical results of the regression models

	Explanatory variable	POLS	GLS	Withinc	HT
x_1	ln(No. of funds)	0.3090	0.4402	0.3807	0.3847
		(0.0010)	(0.0000)	(0.0507)	(0.0000)
	ln(No. of funds)^2	0.1144	0.1227	0.1033	0.1047
		(0.0025)	(0.0000)	(0.0859)	(0.0001)
	ln(Assets under management)	0.4935	0.1354	-0.1019	0.0320
		(0.0000)	(0.0000)	(0.2446)	(0.3295)
	Business Share Retail Real Estate	0.1948	1.0751	5.0786	1.3440
		(0.3649)	(0.0000)	(0.0195)	(0.0016)
	Business Share Institutional Security	-0.8540	-0.1303	0.7879	0.2845
		(0.0012)	(0.0372)	(0.1640)	(0.1428)
	Business Share Institutional Real Estate	0.4538	0.8566	4.8579	1.1744
		(0.0700)	(0.0000)	(0.0237)	(0.0063)
x_2	ln(Age)	0.0521	0.3051	0.6766	0.5964
		(0.3186)	(0.0000)	(0.0225)	(0.0000)
z_2	Dummy Location	0.2404	0.1630	-	1.8456
		(0.0157)	(0.0000)	-	(0.0035)
	Dummy Subsidiary	0.3301	0.3523	-	2.7314
		(0.0420)	(0.0000)	-	(0.0387)

This table presents the estimated coefficients of the one-way error component model in equation (1) by the different estimators. The p-values reported in parentheses are calculated using robust standard errors following the procedure in Arellano (1987) based on White (1980). The number of observations for each regression is 164. x_1 denotes time-varying variables that are uncorrelated with the individual effects. Time-varying, but correlated variables are denoted by x_2. Finally, z_2 are time-invariant variables which are correlated with the individual effects.

Table 5
Empirical results for overall economies of scale

	POLS	GLS	Within	HT
Total sample	0.3090	0.4402	0.3807	0.3847
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Size quartile 1	-0.0782	0.0249	0.0311	0.0297
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Size quartile2	0.1383	0.2571	0.2266	0.2282
	(0.0000)	(0.0000)	(0.0002)	(0.0000)
Size quartile 3	0.2793	0.4084	0.4130	0.4130
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Size quartile 4	0.4211	0.5604	0.4819	0.4875
	(0.0000)	(0.0000)	(0.0000)	(0.0000)

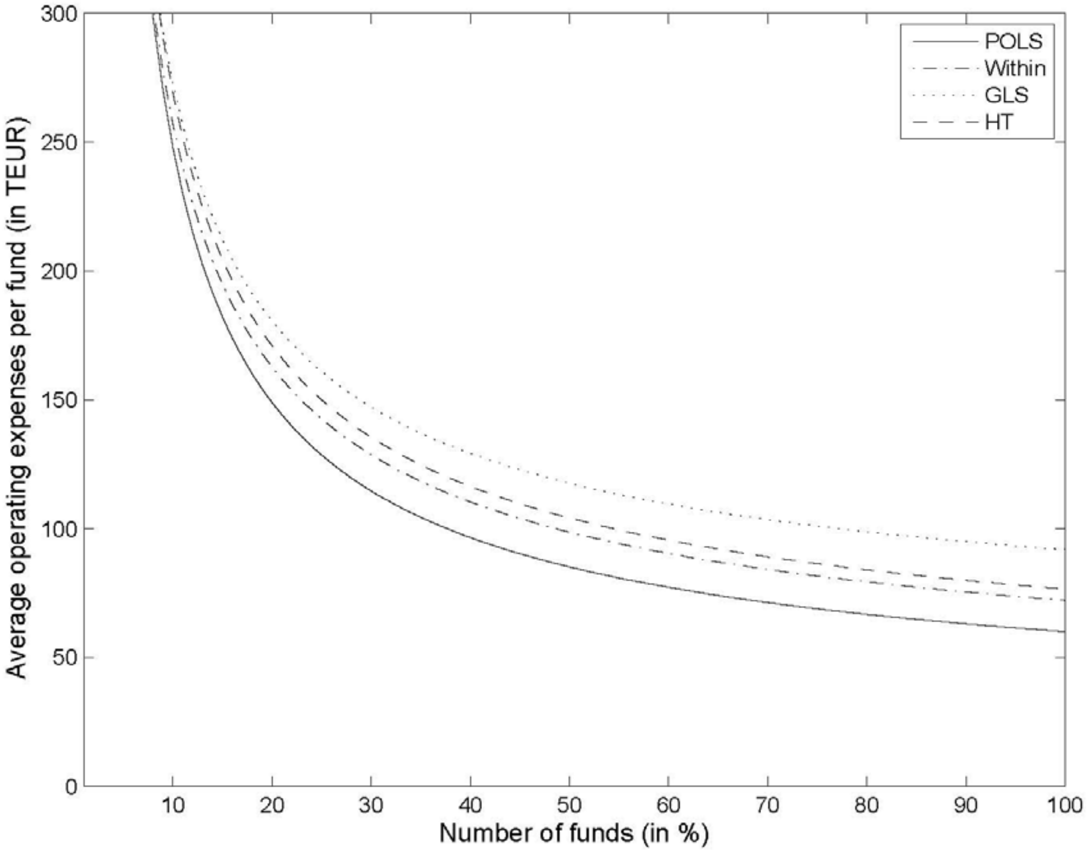
This table presents the results for economies of scale calculated by equation (2) on the basis of the different regression models. The reported values of scale economies for the size quartiles are the equal-weighted means of the scale economies parameters of the companies in the respective size quartile.

Table 6
Empirical results for overall cost efficiency

	GLS	Within	HT
Total sample	0.3853	0.0976	0.1902
Size quartile 1	0.4376	0.3682	0.3859
Size quartile 2	0.3864	0.3697	0.2545
Size quartile 3	0.4770	0.4289	0.5026
Size quartile 4	0.4085	0.3301	0.2819

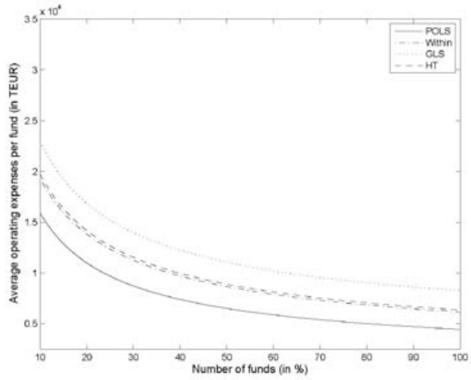
This table presents the results for cost efficiencies calculated by equation (2) on the basis of the different regression models with the exception of the POLS specification. The reported values of cost efficiency for the size quartiles are the equal-weighted means of the cost efficiency parameters of the complexes in the respective size quartile.

Figure 1
Estimated cost functions for the total sample

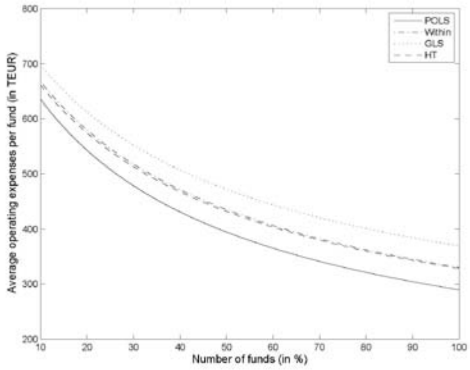


This figure presents the average operating expenses calculated by equation (2) for the total sample in TEUR per fund. The values on the abscissa correspond to the size quantiles of the number of funds for the total sample, i.e. the value of 50 equals the median of the number of funds that a mutual fund complex in our sample offers to investors. The solid line is the estimated average cost curve for the POLS model. The dotted line represents the estimated average cost curve for the GLS specification. The estimated average cost curve for the Within specification is displayed by the dash-dotted line whereas the dashed line is the estimated average cost curve for the HT model.

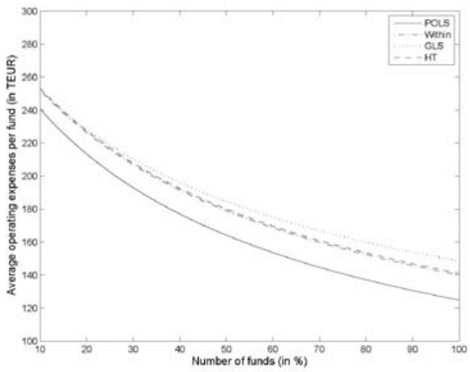
Figure 2
Estimated cost functions for the size quartiles



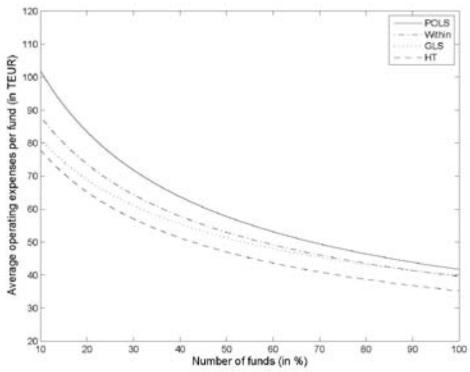
(a) Size Quartile 1



(b) Size quartile 2



(c) Size Quartile 3



(d) Size quartile 4

This figure presents the average operating expenses calculated by equation (2) for the different size quartiles in TEUR per fund. Panel (a) shows the average operating expenses per fund for size quartile 1, panel (b) for size quartile 2, and so on. The values on the abscissa correspond to the size quantiles of the number of funds for the respective size quartiles, i.e. the value of 50 equals the median of the number of funds that a mutual fund complex in the respective size quartile offers to investors. The solid line is the estimated average cost curve for the POLS model. The dotted line represents the estimated average cost curve for the GLS specification. The estimated average cost curve for the Within specification is displayed by the dash-dotted line whereas the dashed line is the estimated average cost curve for the HT model.

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