The University of Reading Business School

Department of Real Estate & Planning

Working Papers in Real Estate & Planning 06/06

The University of Reading

Property Funds: How Much Diversification is Enough?

By
Stephen L. Lee

University of Reading,
Business School,
Centre for Real Estate Research (CRER)
Reading, RG6 6AW
England

Phone: +44 118 378 6338, Fax: +44 118 378 8172, E-mail: S.L.Lee@reading.ac.uk

Abstract

It is well known that when assets are randomly-selected and combined in equal proportions in a portfolio, the risk of the portfolio declines as the number of different assets increases without affecting returns. In other words, increasing portfolio size should improve the risk/return trade-off compared with a portfolio of asset size one. Therefore, diversifying among several property funds may be a better alternative for investors compared to holding only one property fund. Nonetheless, it also well known that with naïve diversification although risk always decreases with portfolio size, it does so at a decreasing rate so that at some point the reduction in portfolio risk, from adding another fund, becomes negligible. Based on this fact, a reasonable question to ask is how much diversification is enough, or in other words, how many property funds should be included in a portfolio to minimise return volatility.

Keywords: *Portfolio Size and Risk, Property Funds*

Property Funds: How Much Diversification is Enough?

1. Introduction

One of the most important areas in real estate investment is the management of risks (Investment Property Forum, 2000). However, to achieve an acceptable level of risk reduction in the direct property market is extremely difficult (Byrne and Lee 2000a) accordingly indirect property investment vehicles have proved an attractive alternative (Baum, 2000). Research into the performance of property funds shows that investors receive returns commensurate with their risk (see for example Lee (1997) and Lee and Stevenson (2003) among others). The research however examined the performance of property funds only on a stand-alone basis. In other words, property funds are evaluated against benchmark indexes, without analysing possible gains from diversification among these funds. In reality, investors can choose more than one property fund to meet their own investment preferences and risk requirements. Additionally, since choosing a poor performing fund may easily eliminate the benefits of an investment in property, investing in only one property fund is likely to be sub-optimal. The reasons are twofold. Firstly, property funds that concentrate their investment in a single property-type raises the issue as to whether a single investment instrument can deliver consistent returns close to those of the broad based property market index that are used at the strategic asset-allocation decision. Secondly, a number of individual property funds have collapsed in the past due to the open-ended nature of such vehicles (Lee, 2002). Consequently, a better alternative for a risk-conscious investor maybe to diversify among a number of property funds to minimise portfolio volatility. This study examines this issue in the UK real estate market as there is a growing interest in funds of funds investment in the UK (Hope, 2003 and Wagner 2006).

It is well known that when assets are randomly-selected and combined in equal proportions in a portfolio, the risk of the portfolio declines as the number of different assets increases without affecting returns (Elton and Gruber, 1977). This is likely to result in better long-term risk-adjusted returns compared with a portfolio of asset size one. It also well known that with naïve diversification although risk always decreases with portfolio size, it does so at a decreasing rate, as more assets are added, so that at some point the reduction in portfolio risk, from adding another asset, becomes negligible. The same concepts can be applied to a portfolio of property funds. An investor who holds a large number of naively-selected funds can expect to have more stable returns than an investor who puts all his investment into one fund. Based on this fact, a reasonable question to ask is how much diversification is enough, or in other words, how many funds should be included in a portfolio to minimize return volatility. Holding only a few funds may imply under-diversification, exposure concentration, and, therefore, too much risk, while holding too many funds may result in over-diversification, the dilution of each fund’s contribution and the neutralisation of most diversification benefits. Hence, investors should be interested in the magnitude of potential gains from diversification and how many funds should be included in the portfolio to capture the greatest risk reduction benefits.

Evidence on the benefits of fund diversification are documented among US mutual funds by O’Neal (1997) and Potter (2001), Australian mutual funds by Brands and Gallagher (2005), managed futures by Billingsley and Chance (1996); hedge funds by

Park and Staum (1998), Amin and Kat (2002) and Lhabitant and Learned (2002), commodity traded funds by Henker and Martin (1998); US commingled real estate funds (CREFs) by Corgel and Oliphant (1991); and Australian listed property trusts by Newell et al (2000). Nonethless, a definitive answer to the question ‘how many funds should be enough’ has not yet been found. As an illustration, some studies suggest that an investor should hold between eight and ten funds (Billingsley and Chance, 1996, Henker and Martin, 1998; Henker, 1998; Lhabitant and Learned, 2002; and Newell et al, 2000). Amin and Kat (2000) and Ruddick (2002) show that one has to hold at least twenty hedge funds to fully realise the diversification potential. O'Neal (1997) demonstrated that portfolios with as few as four growth mutual funds halve the dispersion in terminal wealth for 5- to 19-year holding periods. Potter (2001) finds that there is still a fair proportion of risk that remains even after portfolios of twenty funds are created regardless of type of mutual fund, i.e. aggressive balanced and so on. In contrast, Corgel and Oliphant (1991) have argued that “despite high levels of unsystematic risk in open-end GREF returns, diversification schemes involving investment in two or more CREFs do not offer higher returns at lower risk than single fund investment.” Therefore, the question of the number of real estate funds to hold in a naively diversified fund portfolio is still open.

The present study makes a number of contributions to the literature. Given that research on property fund portfolio size and risk in the UK is non-existent this study provides the first look at this issue in the UK. Second, previous studies have generally only considered the impact of portfolio size on the standard deviation of returns whereas investors may consider other risk metrics when investing in property funds. For instance investors may consider tracking error risk (TER), the extent to which the property fund portfolio matches the return performance of a market benchmark of performance as of equally or greater importance when diversifying across a number of property funds, as Byrne and Lee (2000b) find that a direct real estate portfolio would have to contain over 1000 properties to have any chance of tracking the market. Next O’Neal, 1997 argues that terminal wealth standard deviation (TWSD) is a superior risk measure of risk for investors with long-term investment goals. Byrne and Lee (2002) apply this concept to direct real estate and find that whereas the traditional measure of risk time series standard deviation (TSSD) hardly declines with increases in portfolio size TWSD shows a rapid and sustained reduction. This paper therefore provides the first empirical evidence on the impact of portfolio size on these alternative risk metrics (TER and TWSD) in the UK property fund market. Third, while the literature has documented the impact on higher return distribution moments for hedge funds and mutual funds (Cromwell et al, 2000; Lhabitant and Learned, 2002; Amin and Kat, 2002 and Brands and Gallagher, 2005), no study has not examined the impact of increased portfolio size on such statistics within a property fund portfolio, even though it is well known that property returns are non-normal (Young and Graff, 1995). Accordingly, this study examines the effect of increasing portfolio size on skewness and kurtosis as a function of the number of funds in the portfolio. Finally, a holding in property is often advocated to investors because real estate offers risk reduction benefits and return enhancement capabilities for the mixed-asset portfolio. However, if an investor tries to minimise within property risk by holding a large number of property funds the desirable benefits attributed to property in the mixed-asset portfolio may be undermined. It is necessary to examine the impact of the number of property funds in a portfolio on its correlation with the major alternative asset classes; shares and bonds.

The relationship between size and risk for portfolios is analysed using of increasing size a data set of 19 tax-exempt property funds using quarterly data over the 9 years from 1994 Q4 to 2003 Q3. The study shows that portfolio risk (standard deviation) is a decreasing function of the number of funds, while mean performance remains constant as the number of property funds in the portfolio increases. Additionally, with increased portfolio size the alternative measures of risk such as TER and TWSD decrease at an even faster rate than the traditional measure of risk (standard deviation). However, adding additional property funds to the portfolio leads to a slight increase in negative skewness but a diminution in excess kurtosis. Finally, increasing the number of property funds, to reduce within property fund portfolio risk, as little or no impact on the diversification benefits of a property fund portfolio in the mixed-asset portfolio.

The rest of this article is organised as follows: the next section briefly explains the analytical relationship between risk and size for randomly-selected portfolios. Section 3 describes the data. The methodology and results are presented in section 4 and Section 5 concludes the study and suggests further areas of research.

2. The Relationship between Portfolio Size and Risk

Markowitz (1952) showed that the variance of a portfolio of N assets is given by the following equation:

$$\sigma_p^2 = \sum_{i=1}^{N} w_i^2 \sigma_i^2 + \sum_{i=1}^{N} \sum_{\substack{j=1 \\ j \neq i}}^{N} w_i w_j \sigma_{i,j} \qquad 1$$

where: σ_p^2 = portfolio variance

σ_i^2 = the variance of asset i;

$\sigma_{i,j}$ = the covariance between assets i and j;

N = the number of assets

From equation 1 Elton and Gruber (1997), show that if we assume that each asset has the same risk as the average variance ($\overline{\sigma}_i^2$) of all assets, and that the covariance terms between each pair of assets is equal to the average covariance ($\overline{\sigma}_{i,j}$) across all assets, and if we further assume a naïve equal-weighted investment strategy equation 1 simplifies to:

$$\sigma_p^2 = \frac{1}{N}\overline{\sigma}_i^2 + \frac{N-1}{N}\overline{\sigma}_{i,j} \qquad 2$$

This shows that as the number of assets in a portfolio increases the first term on the RHS of the equation tends to zero and so the risk of the portfolio tends to the risk of the average covariance across the assets $\overline{\sigma}$.

However, naïve diversification is not necessarily the most efficient way of constructing portfolios. Markowitz (1995) showed that efficient portfolio combinations, i.e. ones which minimising portfolio risk for a given level of expected return, is achieved by analysing the individual assets' expected return, variance and correlations and assigning portfolio weights based on the relative magnitudes of these values. Typically, this results in very few asset combinations within the portfolio, with some assets achieving very high allocations and zero weights on others and although the resulting portfolios are optimal in the statistical sense, the results would be unacceptable to any prudent investors and are at odds with most people's view of diversification, i.e. holding a large number of assets. In addition, studies show that investors ignore the inter-correlations between investments when constructing portfolio (Brennan and Torous, 1999). Thus, although the Markowitz model is in theory a better approach, naïve diversification is widely used in practice (e.g., Lhabitant and Learned, 2002).

The reason why the naive approach is so commonly used is that such portfolios are a very reasonable alternative when information on individual expected returns, variance and correlations is limited, and therefore, the estimates for these parameters may not be reliable (see Kalberg and Ziemba, 1984 and Chopra and Ziemba, 1993 among others). Indeed, DeMiguel et al. (2005) find that the large estimation error in the input parameters overwhelms the gains from optimisation. In other words, the use of optimisation techniques with a high estimation risk can be potentially quite significant in terms of lost benefits, as evidenced by Brennan and Torous (1999). In contrast, the 1/N rule does not rely on estimation of moments of asset returns and or optimisation models and so it is easy to implement, with this advantage being more important when, as in this case, data available for parameter estimation is limited.

In practice, naïve diversification usually results in reasonably diversified portfolios that are surprisingly close to some point on the efficient frontier (Fisher and Statman, 1997), while DeMiguel et al. (2005) show that "the 1/N allocation rule… is not very inefficient" when compared to more sophisticated optimisation methods, especially out-of-sample. Additionally, despite the development of sophisticated investment models and the advances in methods for estimating the parameters for optimisation models, investors continue to use simple allocation rules for dividing their wealth across assets. For instance, Benartzi and Thaler (2001) and Liang and Weisbenner (2002) note that investors allocate their wealth across assets using the naive 1/N allocation rule. This is especially the case when investors allocate their funds across mutual funds (Elton et al., 2004). As such, an investigation of the benefits of naïve diversification across real estate funds should provide results that are reasonably close to actual investor experience.

Equally weighted portfolios of increasing size (N = 1, 2, … , 19) are created by randomly selecting property funds from our data set using Monte Carlo simulation techniques. It is of course necessary to sample a sufficient number of times to obtain statistically acceptable output distributions and statistics. For each portfolio size, this process is repeated 10,000 times to obtain 10,000 observations of each statistic. This is necessary to estimate the "typical" behaviour of a portfolio of size N, but also to build confidence intervals for our results. Consequently, each of the risk measures outlined above is reported as an average of the number of funds in the portfolio.

Measuring the Benefits from Increased Portfolio Size

According to modern portfolio theory (MPT) the expected return of a portfolio is the average of the individual expected returns. Indeed, results, not reported here, show that the average portfolio return hardly changes with increased portfolio size. We therefore concentrate on evaluating the benefit of increased property fund portfolio size has on risk. However, which measure of risk to use is unclear in the real estate market (Investment Property Forum, 2002) we use a number of risk metrics to evaluate the benefits of increasing portfolio size and to try and answer the question how much diversification is enough? To facilitate comparison across the different risk measures, the results are standardised by dividing the performance measure by the result obtained for the one fund case.

The Traditional Measures of Risk

Given the pre-eminence of mean-variance analysis in investment theory the first risk measure uses the standard deviation of return to evaluate the benefits of increasing portfolio size on portfolio performance by calculating the standard deviation (SD) of portfolios of size N and showing that large size portfolios are less risky than portfolios of a smaller size. The reduction in standard deviation of a given increase in portfolio size may not, however, indicate the desirability of such an increase. Investors are also interested in the marginal reduction in portfolio risk, which previous studies show diminishes with increased size. It is therefore essential to show the percentage reduction in risk achieved from increasing portfolio size to see if there is a cut-off point beyond which the marginal increase is not worthwhile.

It can be argued, however, that investors are more interested in the consequences of diversification on their portfolio rather than the average risk level. In other words, the average risk (standard deviation) disguises the variability around the average, which could be large (Newbould and Poon, 1993). Thus, we also evaluate the impact of increased portfolio size on the standard deviation of the standard deviation (SDSD) to asses the confidence that investors can have in the performance of their portfolio instead of the average risk from increased portfolio size.

We also assess the gains from increasing portfolio size on risk (SD) to that of a well diversified portfolio to see how much additional risk investors are incurring from holding relatively small portfolios. This can be done in a number of ways. We can compare the ratio of average risk of portfolio size N to a market benchmark, which can be assumed to be fully diversified. As an alternative we can compare the risk of portfolios of size N to the minimum risk from holding all assets in the data set. This definition does not, however, seem appropriate for this study, where the number of available property funds is only 19, which is a relatively low portfolio size. In other words, there may be still be gains from diversification beyond that of the small number of property funds considered and so we need to compare the risk level of increased portfolio size to portfolios that are more diversified than that achievable by the 19 funds used here to measure of complete diversification. Recall from equation 2 that the lowest potential risk considered here corresponds to the square root of the average covariance, which, as was mentioned before, measures the portfolio risk for a portfolio that is infinitely large. This suggests that the average covariance seems to be a more appropriate measure of minimum risk for evaluating the relative risk of naive portfolios for small data sets. Therefore, in order to evaluate the risk level of portfolios of size N to a well diversified portfolio we compare their risks to the lowest potential risk level as measured by the average covariance of all property funds in our data set.

Non-Traditional Measures of Risk

When evaluating a portfolio manager's performance, investors typically compare the return on the portfolio to the return of a specified benchmark. Additionally, the risk of the portfolio is measured by comparing the volatility of the portfolio's returns to the volatility of returns on the benchmark. This suggests that portfolio risk reduction from increasing portfolio size needs to be evaluated to the risk of an appropriate benchmark of performance. Such risk is referred to as tracking error risk (TER) since it quantifies the extent to which a portfolio can be expected to obtain a differential return from the benchmark. To evaluate the benefits of increased portfolio size on TER and to keep the measure comparable with the traditional measure of risk (standard deviation) we calculate the difference between the returns of the naively constructed property fund portfolios and those of the benchmark ($R_i - R_b$) and measure TER by the standard deviation of these excess returns. Two benchmarks are used as comparators: the IPD Monthly Index (IPDMI) and the Pooled Property Fund Index (PPFI). The IPDMI was used as it is the de facto measure of performance of unitised funds in the UK (Society of Property Researchers, 1994). The IPDMI, however, is constituted from the performance of 55 investment vehicles, which are not necessarily legally the same as the 19 property funds analysed here. As an alternative we use the PPFI, as this index is made up of similar property funds as the property funds analysed.

Radcliffe (1994) suggests that investors regard *ex post* variability around the mean as inconsequential and are only interested in total periodic returns, i.e. the cumulative change in initial investment over their particular holding period or the Terminal Wealth (TW) of their portfolio; since it is from the TW that they will derive their benefits. Nawrocki (1991) goes further and notes unambiguously that for an investor with a long term investment horizon TW is the appropriate measure of investment performance. Of cause, an increase in expected TW is not guaranteed. In other words, TW will show variability around its expected value. With this idea in mind Radcliffe (1994) proposed that the terminal wealth standard deviation (TWSD) rather than the more conventional time-series standard deviation (TSSD) should be used as the 'true' measure of portfolio risk to long-term institutional investors. Nonetheless, only one study has used TWSD to evaluate the impact from increases in portfolio size in mutual fund portfolios (O'Neal, 1997). O'Neal (1997) showed that the difference in the amount of wealth you will accumulate over 5- to 19-year holding periods, compared with the risk of how much you will end up with at the end of that time (TWSD) reduces substantially by holding a larger number of funds. By holding 20 growth funds over 19 years, an investor could reduce TWSD by 83 percent over that from owning one fund. Indeed, the risk-reduction value of owning only eight funds over one fund is substantial.

Mean-variance analysis rests on two assumptions: either that investors have a quadratic utility function, or that returns are normally distributed. The quadratic utility function however has been shown to be an unacceptable as a measure in describing the actual behaviour of investors (Levy and Sarnat, 1994 and Alexander and Francis, 1986), which means that the application of MPT rests on the assumption of normality of returns. Yet, studies in the UK document the non-normality of UK property returns (see Brown, 1991; Brown and Matysiak, 2000; Lizieri and Ward, 2000; and Young et al., 2006 among others). In general, the studies show that at the individual, sector level, and index level property data exhibits non-normality, as a result of significant skewness and excess kurtosis in the data. We therefore examine the skewness and kurtosis of portfolios of size N to see if increasing portfolio size leads to an increase or decrease in the undesirable higher moment characteristics.

Finally, a holding in property is often advocated to investors as real estate offers risk reduction benefits and return enhancement capabilities to the mixed-asset portfolio (see Seiler et al, 1999 and Hoesli et al, 2001 for comprehensive reviews). However, if an investor tries to minimise within property risk by holding a large number of property funds such benefits maybe diminished or even eradicated. Consequently, we evaluate the benefits of increasing portfolio size by examining the correlation between the property fund portfolios of size N and with that of the other major asset classes; shares and bonds. The performance of share and bonds represented by the returns on the FT All Share Index and the 5-15 year Gilt Index.

Data

The property fund data used in the study consisted of the quarterly returns for 19 tax-exempt open-ended real estate funds in the UK over the 9 years from 1994 Q4 to 2003 Q3. The data collected from the quarterly surveys produced by the Investment Property Databank (IPD) on behalf of the Hong Kong and Shanghai Bank (HSBC) and the Association of Property Unit Trusts (APUT). The summary statistics of the 19 property funds are shown in Table 1.

Table 1: Individual Summary Statistics: 1994 Q4 to 2003 Q3

Statistic	Return	Risk	Correlation	Skewness	Kurtosis
Average	2.402	1.810	0.380	-0.140	3.620
SD	0.317	0.570	0.170	1.522	6.694
Max	3.110	3.146	0.761	1.794	22.894
Min	1.781	0.910	-0.151	-4.199	-0.759

Table 1 indicates that there is very little variation in average individual risk (standard deviation) and return across the 19 property funds. In addition, Table 1 shows that the difference between the average variance and covariance is small so the benefits of increasing portfolio size on risk (Standard Deviation) between a fund of all property funds and that of a single fund will also be small. Recall from equation (2) that the diversification effect depends on the difference between the average variance and average covariance (correlation). When correlation is close to one, the average variance and covariance are close, and the potential benefits from naïve diversification are small.

Investment theory argues that investors prefer positive skewness and are averse to excess kurtosis, Table 1 shows that on average the property fund data is slightly negatively skewed and displays excess positive kurtosis, i.e. the property fund data shows a greater probability of achieving negative return than would be predicted if the data were normal distribution and that the returns are leptokurtic and so displays evidence of “fat tails.” These results are in line with previous studies in the UK (see Young et al, 2006 for a review).

Results

Tables 2 and 3 present the results of the Monte Carlo simulations for each portfolio size N. Table 2 displays the results for the traditional measure of risk (TSSD) and Table 3 presents the results using the non-traditional measures of portfolio risk: TER, TWSD; skewness; kurtosis; and the correlation of the property portfolios with Shares (FT All Share Index) and Bonds (5-15 years Gilts Index).

Figure 1 presents the relationship between the portfolio average TSSD and the number of property funds in the portfolio. The purpose of presenting Figure 1 is to show how the portfolio TSSD declines with increased portfolio size. Figure 1 demonstrates that TSSD decreases as a function of the number of funds in the portfolio, but at a decreasing rate. The relationship observed is comparable for portfolios of directly held stocks (Evans and Archer (1968), Elton and Gruber (1977) and Statman (1987)) property Byrne and Lee (2003) as well as in Fund of Funds studies (O’Neal, 1997; Newell et al (2000); Lhabitant and Learned, 2000; Amin and Kat, 2002; and Brands and Gallagher, 2005).

Column 2 of Tables 2 presents the average TSSD of the 10,000 simulations for the naïve property fund portfolios versus the number of funds. The first standard deviation value is the expected standard deviation of a portfolio of one fund. This corresponds to the case where an investor selects, at random, one fund among the 19 and invests all his money in that fund. The expected standard deviation for one property funds portfolios is 1.81. This expected portfolio standard deviation values equal the average standard deviation among all property funds (Table 1). Note that this is easy to check in equation (2), since if N = 1 the second term of the equation cancels out.

The portfolio TSSDs presented in Column 2 of Table 2, show that when the number of property funds in the portfolio increases the portfolio TSSD decreases. The portfolio of all 19 property funds has the lowest risk level among the naïve portfolios selected from this set of 19 property funds. The expected TSSD value for 19 property funds portfolios is 1.16%. However, the difference in TSSD between 1 and 19 property funds is only 36%. In addition, Table 2 demonstrates that the majority of diversification gains are achieved with a portfolio comprising four or five property funds. After this point, a marginal increase in the number of funds held in the portfolio does not give rise to a significant reduction in average TSSD. For example, when a second property fund is added to the TSSD decreases by 16.1%, when a third property fund is added by 22.6%, a fourth property fund 26.2%. The decrease in TSSD by adding a property funds is lower for larger size portfolios, and after several property funds have been added to the portfolio, adding another one has only a very small risk reduction effect. For instance, the difference in TSSD between portfolios of 16 and 17 property funds is only 0.4%.

These results are consistent with the findings reported in Byrne and Lee (2000a) in the direct market and Newell et al (2000) in the fund of funds market and can be explained by a diminishing increase in the number of unique property funds added to the property fund portfolio as the number of the funds in the portfolio rises. For instance, Newell et al (2000) find that the risk reduction was relatively small and that the bulk of the portfolio risk reduction is readily achievable with portfolios of 8-10 property trusts. For example, the risk a two property trust portfolio was only 15% less than that of a one fund trust portfolio, portfolio sizes 5 and 10 were only 25% and 28% less. While, holding all 23 property trusts eliminated only 31% of diversifiable risk.

The reduction in the SDSD shown in columns 5 of Table 2 present a different picture and show that a portfolio of all 19 funds shows a reduction in risk of 88% compared with a one fund portfolio. Furthermore, the results indicate that there are substantial reductions in SDSD even beyond the four or five fund level. For instance, whereas there is 44% reduction in SDSD moving from a one to a two fund portfolio increasing the portfolio from 9 to 10 funds still reduces SDSD by 7%. This suggests that investors need to hold a much large number of property funds than that suggested by TSSD in order to have a greater confidence that the risk (standard deviation) level they expected to have is the one they would actually achieve.

The last three columns of Table 2 present the ratio between the average standard deviation of a portfolio of size N and three measures of complete diversification. The first, is the lowest potential risk level the average covariance of all property funds in our data set ($\overline{\sigma}_{i,j}$) and the last two are the risk levels of the two market benchmarks, PPFI and the IPDMI. All three columns show that a one fund strategy is sub-optimal as the risk of such an investment is between 63% and 85% greater than a well-diversified portfolio. Even holding all 19 funds still incurs an additional risk of between 5% and 18% over a well-diversified portfolio, as indicated in Figure 1. The property fund portfolios showing the closet risk level to the PPFI and least to the IPDMI, which suggest that benchmark choice is an important consideration when evaluating fund performance.

The impact on TER compared with the two market benchmarks, the PPFI and the IPDMI, from increased portfolio size is shown in Columns 1 to 4 of Table 3. The results show a much greater reduction in risk compared with TSSD but also indicate that even holding all 19 funds an investor still does not exactly track the market, results in line with the findings Byrne and Lee (2000b). There are also differences in TER depending on the benchmark portfolio. Specifically, the results show that that the naïve property fund portfolios are closer in performance to the PPFI, which is composed of similarly constituted funds, than the IPDMI, which is much broader in constitution. This again suggests that the choice of benchmark is important in measuring the relative risk a property fund portfolio.

TWSD is an alternative risk measure which enables investors to understand the ability of their investments to actually meet future monetary obligations. This measure exhibits greater diversification potential compared to that of TSSD, as can be clearly seen from the TSSD figures in columns 2 and 3 in Table 2 with the TWSD results in columns 6 and 7 in Table 3. For instance, increasing a property fund portfolio from one to 5 property funds reduces TWSD to 56% of the initial level, whereas TSSD only reduces 28%. A 10 fund property portfolio leads to a 69% reduction in TWSD, compared with only a 33% reduction for TSSD. A portfolio of all 19 property funds offering a 77% reduction in TWSD while the comparable figure is 36% for TSSD. These results therefore complement the findings of Byrne and Lee (2002).

Figure 2 and Column 8 of Table 3 shows that skewness becomes increasingly more negative as a function of the number of funds, and then stabilises as the number of funds equals between 8 and 9. Similar findings are documented in the other investment markets by Cormwell et al (2000); Amin and Kat (2002); Lhabitant and Learned (2002) and Brands and Gallagher (2005). Investment theory argues that investors prefer positive skewness unfortunately the results here suggest that while an increasing portfolio size offers decreases in TSSD the evidence shows that adding more funds to a real estate fund portfolio leads to an increase in negative skewness. In other words, investors can only reduce property fund portfolio volatility at the expense of increases in negative skewness.

Figure 3 and Column 9 of Table 3 shows that the kurtosis of property fund portfolio returns becomes less positive and insignificantly different from zero with increasing portfolio size. This is consistent with the results of Lhabitant and Learned (2002) for hedge funds, but is in contrast to the results of Brands and Gallagher (2005) for Australian equity mutual funds where kurtosis became increasing more positive with increased portfolio size.

Finally, investors are concerned about the contribution a property portfolio makes to the mixed-asset portfolio. Property displays the attractive mixed-asset portfolio characterises of a low correlation with the alternative asset classes; shares and bonds. However, if an investor tries to reduce within property fund risk by increasing portfolio size he may at the same time also increase the correlation of the property fund portfolio with the mixed-asset portfolio. Columns 10 and 11 of Table 3 show that increasing portfolio size has no impact on properties correlation with shares or bonds. Specifically, although the correlation of the property fund portfolio with shares increases with portfolio size, the correlation of the property fund portfolios with bonds becomes more negative with increased portfolio size. In other words, the increase in correlation with shares was offset by the increase in negative relationship with bonds, at least over this period. In addition, none the changes are significant and the correlation coefficients of property with both asset classes are insignificantly different from zero at all portfolio size levels. Consequently increasing portfolio size has no effect on properties attractive mixed-asset portfolio characteristics.

What do our results imply for the number of property funds to hold? Increasing the number of funds within a portfolio will tend to reduce TSSD, but at a decreasing rate, so that holding more than 10 funds offers very marginal benefits, i.e. the most relevant range of choice lies between 1 and 10 funds. In contrast, if an investor wanted more certainty as to his actual portfolio risk level (SDSD) or an acceptable level of risk relative to market benchmarks and a reduction in TER and TWSD, he should diversify beyond the 10 fund level. However, this also means accepting an increase in negative skewness.

Summary and Conclusions

This study examines the benefits of increasing portfolio size on risk using a sample of open-ended tax-exempt property funds in the UK. Results show that increasing the number of property funds reduces TSSD, but the marginal decrease in risk from adding a new property funds decreases rapidly with portfolio size. Hence, for investors who consider TSSD as their measures of risk it is possible to gain most of the risk reduction from diversification across a small number of property funds, say between 5 and 10. In contrast, if an investor considers the variability around the standard deviation (SDSD) is important the results suggest holding a large number of property funds is desirable. Furthermore, if an investor held only a few property funds, say four, in a portfolio, the results in Table 2 indicate that such a portfolio would display a level of risk (TSSD) between 17% and 31% higher than that of a well diversified portfolio, depending on the benchmark chosen, whereas if an investor held 15 funds these values fall to 6% and 19%, respectively, which suggest that an investors needs to hold almost all 19 funds to have a low level of risk relative to the market benchmarks. A conclusion that is reinforced if the investors considers TER and TWSD as the results indicate risk reduction benefits are still available beyond the 10 fund level. However, while increasing the number of funds in a property portfolio provides investors with improvements in risk reduction it does so with increases in negative skewness.

Additionally, there is a trade-off between the difficulty of following a large number of property funds and the risk reduction benefits from greater diversification. In other words, beyond a small portfolio size the disadvantages of managing a more complicated portfolio may exceed the risk reduction benefits. Furthermore, the number of property funds in a portfolio is not the sole determinant of the degree of diversification and randomly picking property funds is not the most intelligent way to diversify. An investor could significantly reduce risk in his portfolio with fewer property funds if he chooses them wisely across different property sectors, so they do not move up and down in lockstep. Thus, property fund portfolio construction should include more research - not just into the performance of individual funds, but into the effects of a given property fund allocation upon an entire portfolio structure. This echo's Corgel and Olphitant's (1991) view that fund "performance seems to depend less on "good management" than on other factors related to the real estate", and that investors "should always evaluate the real estate first." All of which suggests holding only a few property funds in the portfolio and monitoring their performance extremely closely may be the preferred option.

All of which suggests that there is no definitive answer to the question 'how many funds should be enough' it all depends on the investors attitude to risk; their research capabilities and the costs of monitoring the performance of the properties in the portfolio.

References

Alexander, G.J. and Francis, J.C. (1986) *Portfolio Analysis*, Englewood Cliffs; NJ; Prentice Hall, pp. 254-59.

Amin G. and Kat H.M. (2002), *Portfolios of Hedge funds: What Iinvestors Really Inves In*, ISMA discussion paper no 07

Benartzi S. and Thaler R.H. (2001), Naive diversification strategies in retirement saving plans, *American Economic Review*, **91**, 79-98

Billingsley, R.S. and Chance, D.M. (1996) Benefits and Limitations of Diversification Among Commodity Trading Advisors, *Journal of Portfolio Management*, **23**, 65-80.

Brands, S. and Gallagher, D.R. (2005) A Note on Portfolio Selection, Diversification and Fund-of-Funds, *Accounting and Finance*, **45**, 2, 185-197

Brennan J.M. and Torous W.N. (1999), Individual Decision-Making and Investor Welfare, *Economic Notes*, **28**, 2, July

Brown, G.R. (1991) *Property Investment and the Capital Markets,* E and FN Spon

Brown, G.R. and Matysiak, G.A. (2000) *Real Estate Investment A Capital Market Approach*, Financial Times Prentice Hall

Byrne, P.J. and Lee, S.L., (2000a) Risk Reduction in the United Kingdom Property Market, *Journal of Property Research*, **17**, 1, 23-46.

Byrne, P.J. and Lee, S.L., (2000b) The Impact of Market Risk on Property Portfolio Risk Reduction, *Journal of Property Investment and Finance*, **18**, 6, 613-626

Byrne, P.J. and Lee, S.L., (2002) The Impact of Portfolio Size on the Variability of the Terminal Wealth of Real Estate Funds, *Briefings in Real Estate Finance*, **1**,4, 319-330

Chopra, V.K. and Ziemba, W.T. (1993) The Effect of Errors in Means, Variances and Covariances on Optimal Portfolio Choice, *Journal of Portfolio Management*, Winter, 6-11.

Corgel, J.B. and Oliphant, M.L. (1991) One or More Commingled Real Estate Funds? *Journal of Portfolio Management*, Summer, 69-72

Cormwell, N.O., Taylor, W.R.L. and Yoder, J.A. (2000), Diversification Across Mutual Funds in a Three-moment World, *Applied Economic Letters*, **7**, 243-245

DeMiguel, A., Garlappi, L. and Raman Uppal, R. (2005) *How Inefficient are Simple Asset-allocation Strategies*? Presented at the Inquire Conference, Manchester, September

Elton, E.J. and Gruber, M.J. (1977) Risk Reduction and Portfolio Size: An Analytical Solution, *Journal of Business*, **50**, 415-437.

Elton, E., Gruber, M., and Blake, C. (2004) *The Adequacy of Investment Choices Offered by 401K Plans*, Working Paper, New York University, Stern School of Business

Fisher, K., Statman, M. (1997), Investment Advice from Mutual Fund Companies, *Journal of Portfolio Management*, **24**, 9-25

Henker, T. (1998) Naïve Diversification for Property funds, *Journal of Alternative Investments*, **1**, 33-38.

Henker, T. and Martin, G.A. (1998) Naïve and Optimal Diversification for Managed Mutual Funds, *Journal of Alternative Investments*, **1**, 25-39.

Hoesli, M., MacGregor, B., Adair, A. and McGreal, S. (2001) *The Role of Property in Mixed Asset Portfolios (MAPs),* RICS Foundation, RS0201

Hope, K. (2003) Safe as Houses? *Pension Management*, March

Investment Property Forum (2000) *The Assessment and Management of Risk in the Property Investment Industry, A Survey by IPD for the Investment Property Forum*, Risk Working Party, March.

Kalberg, J.G. and Ziemba, W.T. (1984) Mis-Specification in Portfolio Selection Problems, in Bamberg, G. and Spremann, A. (eds.) *Risk and Capital*, Springer-Verlag: New York.

Lee, S.L. (1997) The Components of Property Fund Performance*, The Journal of Real Estate Portfolio Management*, **3**, 2, 97-106.

Lee, S.L. (2002) *Property Fund Flows and Returns*, Working Papers in Land Management and Development 02/00 pp.17

Lee, S.L. and P.J. Byrne, (2002) The Impact of Portfolio Size on the Variability of the Terminal Wealth of Real Estate Funds, *Briefings in Real Estate Finance*, **1**, 4, 319-30.

Lee, S.L., and Stevenson, S. (2003) Empirical Evidence on the Micro and Macro Forecasting Ability of Real Estate Funds, *Journal of Property Research*, **20**, 3,

Levy, H. and Sarnat, M. (1994), *Portfolio and Investment Selection: Theory and Practice. 5th Ed.* New York: Prentice Hall.

Lhabitant, F.S. and Learned, M. (2002) Hedge Fund Diversification: How Much is Enough? Journal of Alternative Investments, 5, 23-49.

Liang, N., and Weisbenner, S. (2002), *Investor Behavior and the Purchase of Company Stock in 401(K) Plans – The Importance of Plan Design*, NBER working paper 9131.

Lizirei, C and Ward, C.W.R. (2000) Commercial Real Estate Return Distributions: A Review of the Literature and Empirical Evidence, in Knight, J. and Satchell, S. (eds.) *Return Distributions in Finance*, Butterworth Heinemann.

Markowitz, H. (1952) Portfolio Selection, *Journal of Finance*, **7**, 77-91.

Newell, G., Acheampong, P., Padan, M. and Kishore, R. (2000) *Diversification Issues in Property Fund Securities*, A paper presented at the Annual Pacific Rim Real Estate Society (PRRES) Conference, Sydney, January 23-27.

O'Neal E.D. (1997) How Many Mutual Funds Constitute a Diversified Mutual Fund Portfolio? *Financial Analysts Journal*, 53, 2, 37-46.

Radcliffe, R.C. (1994) *Investment: Concepts, Analysis, Strategy*, New York, Harper Collins.

Ruddick S. (2002), *Diversification Overkill*, working paper, Albourne Partners, January.

Scott, R. and Horvath, P. (1980) On the Direction of Preference for Moments of Higher Order than the Variance, *Journal of Finance*, **35**, 4,

Seiler, M.J., Webb, J.R. and Myer, F.C.N. (1999) Diversification Issues in Real Estate Investment, *Journal of Real Estate Literature*, **7**, 2, 163-179

Society of Property Researches (1994) *Property Indices Research Report*, Technical Paper No. 1, SPR, London

Wagner, J (2006) Spreading the Risk, *Investments and Pensions Europe*

Waldy, E.B.D. (1989) *Risk Perception and Evaluation in the UK Property Investment Market*, Unpublished MPhil, University of Cambridge

Young, M.S. and Graff, R.A. (1995), Real Estate is not Normal: A Fresh Look at Real Estate Return Distributions. *Journal of Real Estate Finance and Economics*, **10**, 3, 225-259.

Young, M.S., Lee, S.L., and Devaney, S.P. (2006) *Non-Normal Returns Distributions by Property-types in the UK*, *Journal of Property Research*, forthcoming

Table 2: The Impact of Size on Traditional Measure of Risk (Standard Deviation): TSSD; SDSD; and Portfolio SD compared to Complete Diversification

1	2	3	4	5	6	7	8
Num of Funds	TSSD Aver	TSSD %	SDSD Aver	SDSD %	Ratio Av Cov	Ratio PPF	Ratio IPD
1	1.811		0.559		1.75	1.63	1.83
2	1.521	-16.1	0.309	-44.7	1.47	1.37	1.54
3	1.402	-22.6	0.224	-59.9	1.35	1.26	1.42
4	1.336	-26.2	0.183	-67.2	1.29	1.20	1.35
5	1.296	-28.4	0.158	-71.8	1.25	1.17	1.31
6	1.268	-30.0	0.140	-75.0	1.22	1.14	1.28
7	1.247	-31.2	0.125	-77.7	1.20	1.12	1.26
8	1.231	-32.0	0.114	-79.6	1.19	1.11	1.25
9	1.219	-32.7	0.105	-81.2	1.18	1.10	1.23
10	1.209	-33.3	0.098	-82.5	1.17	1.09	1.22
11	1.200	-33.7	0.092	-83.5	1.16	1.08	1.22
12	1.193	-34.2	0.087	-84.5	1.15	1.07	1.21
13	1.187	-34.5	0.083	-85.2	1.14	1.07	1.20
14	1.182	-34.8	0.079	-85.9	1.14	1.06	1.20
15	1.177	-35.0	0.075	-86.5	1.14	1.06	1.19
16	1.173	-35.2	0.072	-87.0	1.13	1.06	1.19
17	1.170	-35.4	0.070	-87.5	1.13	1.05	1.18
18	1.167	-35.6	0.067	-88.0	1.12	1.05	1.18
19	1.164	-35.8	0.065	-88.4	1.12	1.05	1.18

Figure 1: Mean Standard Deviation versus the Number of Funds and Three Well-diversified Portfolios

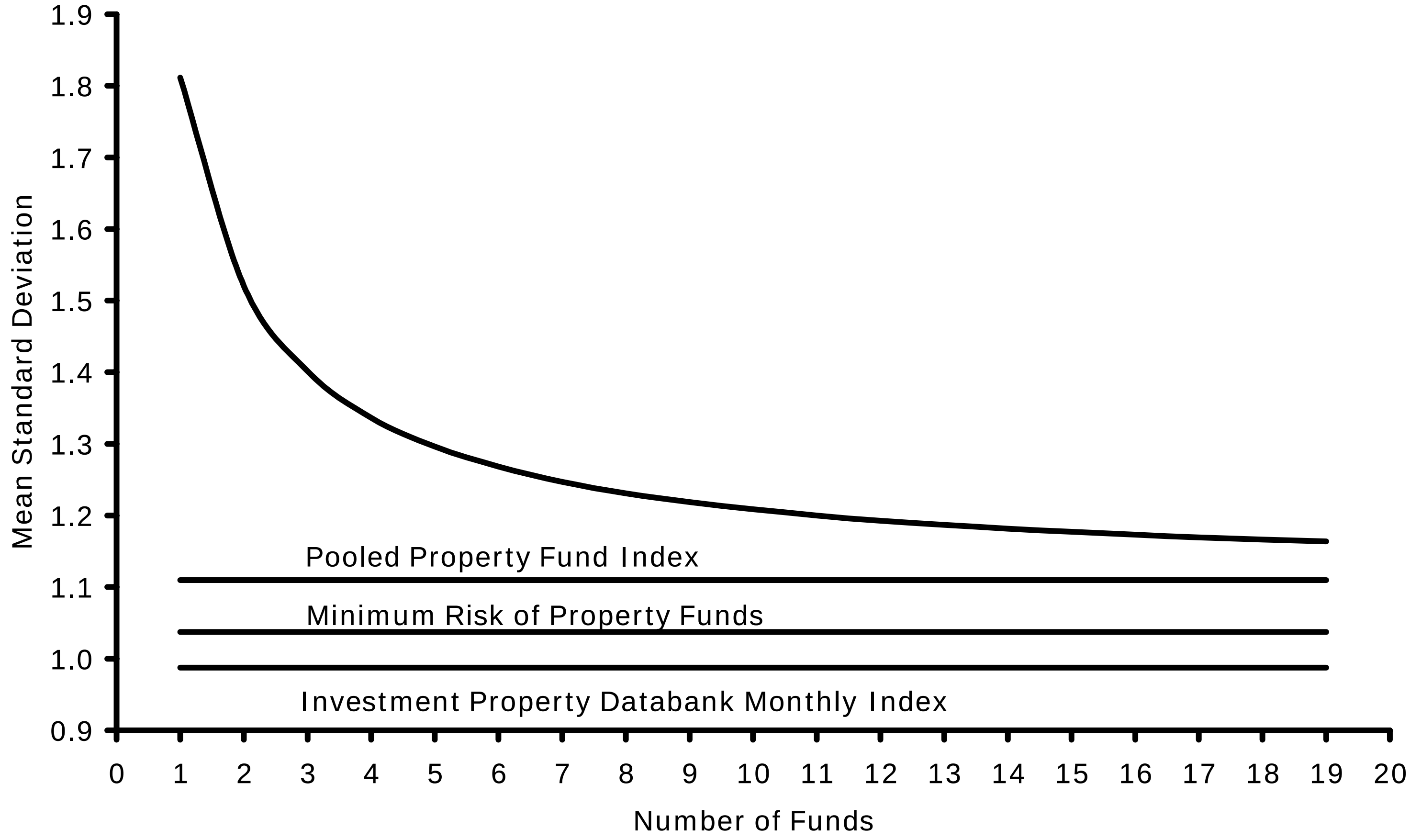

Table 3: The Impact of Size on Non-Traditional Measures of Risk: TER; TWSD; Skewness; Kurtosis; and The Property Portfolios Correlation with Shares and Bonds

1	2	3	4	5	6	7	8	9	10	11
Num of Funds	TER PPFI	TER %	TER IPDMI	TER %	TWSD Aver	TWSD %	Skewness Aver	Kurtosis Aver	Cor FTA Aver	Cor Bonds Aver
1	1.457		1.490		0.26		-0.119	3.359	0.065	-0.075
2	1.072	-26.4	1.128	-24.3	0.18	-29.2	-0.219	2.223	0.074	-0.088
3	0.892	-38.8	0.964	-35.3	0.15	-43.2	-0.247	1.625	0.078	-0.095
4	0.784	-46.2	0.867	-41.8	0.13	-51.1	-0.250	1.279	0.082	-0.100
5	0.711	-51.2	0.803	-46.1	0.11	-56.3	-0.260	1.064	0.084	-0.104
6	0.658	-54.8	0.757	-49.2	0.11	-59.6	-0.256	0.884	0.086	-0.106
7	0.616	-57.7	0.722	-51.6	0.10	-62.8	-0.256	0.765	0.087	-0.108
8	0.583	-60.0	0.695	-53.4	0.09	-65.1	-0.253	0.666	0.088	-0.109
9	0.556	-61.8	0.673	-54.9	0.09	-67.1	-0.253	0.595	0.088	-0.110
10	0.534	-63.3	0.655	-56.1	0.08	-68.7	-0.249	0.525	0.088	-0.111
11	0.515	-64.7	0.639	-57.1	0.08	-70.0	-0.248	0.469	0.089	-0.112
12	0.498	-65.8	0.625	-58.0	0.07	-71.3	-0.245	0.420	0.089	-0.112
13	0.484	-66.8	0.614	-58.8	0.07	-72.4	-0.245	0.387	0.089	-0.113
14	0.471	-67.7	0.604	-59.4	0.07	-73.4	-0.244	0.347	0.090	-0.113
15	0.460	-68.4	0.596	-60.0	0.07	-74.4	-0.243	0.317	0.090	-0.114
16	0.449	-69.1	0.588	-60.5	0.06	-75.2	-0.240	0.286	0.090	-0.114
17	0.440	-69.8	0.581	-61.0	0.06	-75.9	-0.238	0.258	0.090	-0.115
18	0.432	-70.4	0.575	-61.4	0.06	-76.6	-0.239	0.243	0.091	-0.115
19	0.424	-70.9	0.569	-61.8	0.06	-77.1	-0.237	0.222	0.091	-0.115

Figure 2: Mean Skewness versus the Number of Funds

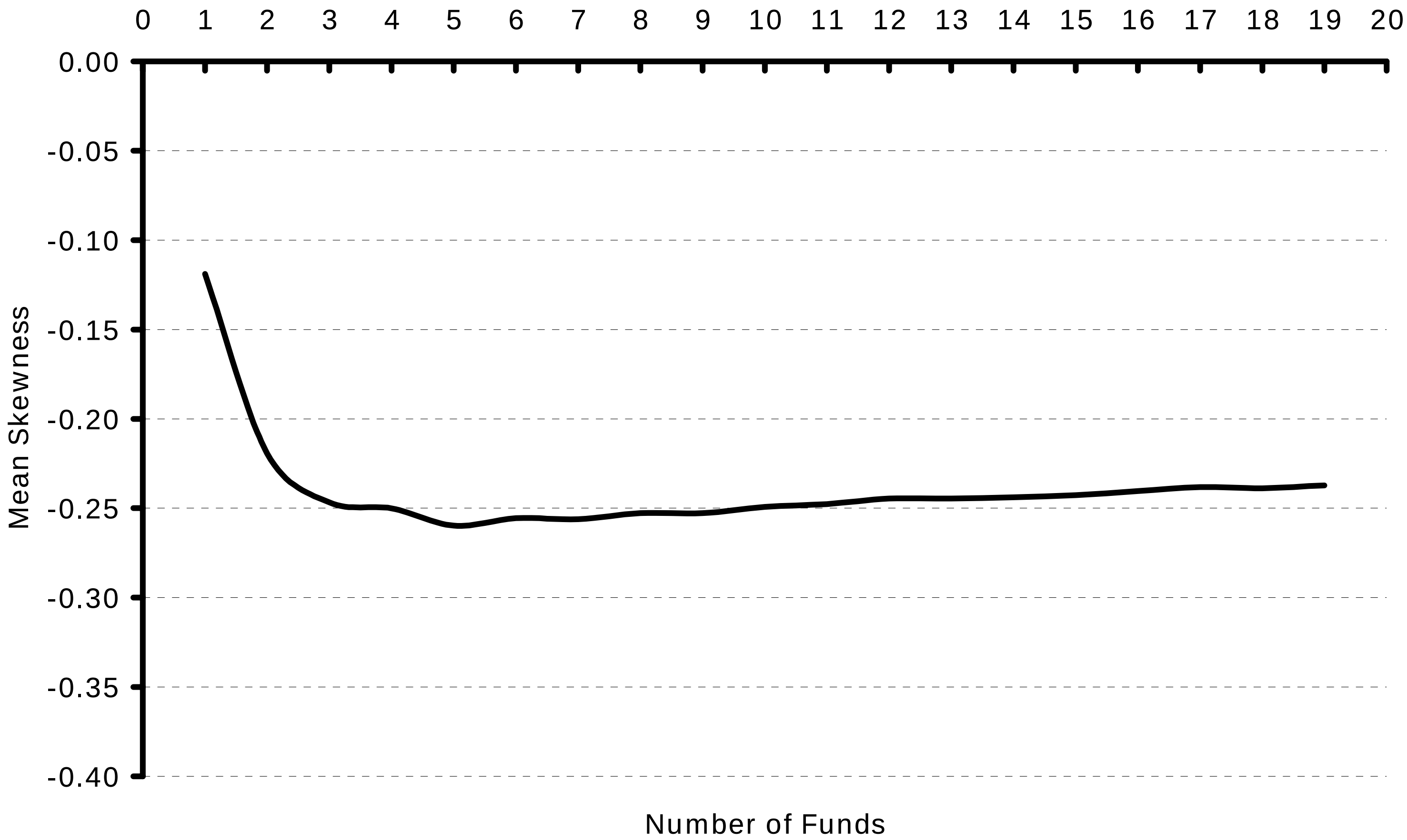

Figure 3: Mean Excess Kurtosis versus the Number of Funds