# Serial Persistence in Individual Real Estate Returns in the UK

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*Abstract:* Persistence of property returns is a topic of perennial interest to fund managers as it suggests that choosing those properties that will perform well in the future is as simple as looking at those that performed well in the past. Consequently, much effort has been expended to determine if such a rule exists in the real estate market. This paper extends earlier studies in US, Australian, and UK markets in two ways. First, this study applies the same methodology originally used in Young and Graff (1996) making the results directly comparable with those in the US and Australian property markets. Second, this study uses a much longer and larger database covering all commercial property data available from the Investment Property Databank (IPD), for the years 1981 to 2002 for as many as 216,758 individual property returns. While the performance results of this study mimic the US and Australian results of greater persistence in the extreme first and fourth quartiles, they also evidence persistence in the moderate second and third quartiles, a notable departure from previous studies. Likewise patterns across property type, location, time, and holding period are remarkably similar leading to the conjecture that behaviors in the practice of commercial real estate investment management are themselves deeply rooted and persistent and perhaps influenced for good or ill by agency effects.

## Introduction

The persistence of property returns is a topic of particular interest to real estate fund managers as it suggests that choosing those properties that will perform well in the future is as simple as looking at those that performed well in the past. Consequently, much effort has been expended to determine if such a rule exists in the real estate market. Serial persistence in real estate returns has been examined in the private markets in the US (Young and Graff, 1996, 1997), Australia (Graff, Harrington and Young, 1999) and the UK (Lee and Ward, 2001). Studies have also examined the serial persistence of publicly-traded real estate (REIT) market, Graff and Young (1998). The approach adopted for testing for persistence is much the same in each case. For each time period the total returns of each property, or REIT, was calculated and the cross-sectional returns ranked into quartiles. If the performance of real estate returns through time is independent, the use of quartile ranks implies that there is a only a 25% probability of a property remaining in the same quartile return rank from one period to the next. A significant departure from the 25% theoretical probability can therefore be considered an indicator of serial dependence in performance.

This paper extends prior studies in two ways. First, this study applies the same methodology as originally used in Young and Graff (1996) making the results directly comparable with those in the US and Australian property markets. Second, this study uses a much longer and larger

database than in previous studies. The data cover commercial property returns available from the Investment Property Databank (IPD) for the years 1981 to 2002 for as many as 30,000 individual property time-series returns and so should provide a strong statement on the issue of persistence in individual real estate returns.

## Previous Studies

The analysis for the US private real estate market (Young and Graff, 1996, 1997) used annual returns from the NCREIF database, over the period 1978 to 1994. The study was based on the return performance of fifty Metropolitan Statistical Areas (MSA) that had at least one occurrence of two consecutive years of data, the total number of MSAs ranging from eight in 1978 to forty-four in 1991. The data was also decomposed into the five property types; Office, Retail, Warehouse, R&D and Apartments. The results for the five property types indicated that for the two extreme quartiles, the highest and lowest ranks, serial persistence was demonstrated with almost complete certainty from one year to the next. However, the persistence tended to fade beyond this, except for Apartments where serial persistence was extended to runs of two and three years. For the combined data serial persistence was exhibited for one, two, three, four and five years, indicating that private real estate returns exhibit persistence for some considerable time. In contrast, little or no significant serial persistence was found for the second and third quartiles, except for Warehouses over one year and the combined data for one- and two- years runs. In other words, persistence is exhibited at the extremes of performance, the best and the worst properties, in any one year but not by properties around the median.

Graff, et al (1999) applied the same approach to the Australian direct property market using annual data over the period from 1985 to 1997 from the Property Council of Australia database. The data decomposed into three property types: Office, Retail and Industrial. The results of the analysis showed that serial persistence was exhibited by Office and Retail property at the extreme quartiles (the first and fourth) and for the median quartiles (second and third combined), but that Industrial properties exhibited serial independence in all categories. In addition there was a qualitative difference in the Office data between CBD and non-CBD properties. In particular, the Office data in the CBD locations exhibited serial persistence in all quartiles, but no serial persistence was found for the non-CBD data, while the combined data exhibited statistical significance in all quartiles. In other words, superior performance is generally followed by continued superior performance and inferior performance by continued inferior performance.

Lee and Ward (2001) tested the persistence in performance of private real estate returns in the UK between 1981 and 1996 using the same quartile ranking method used in previous studies. However, the authors used a Markov Chain approach that allows the estimation of several parameters of interest not readily available from the binomial approach of Young and Graff (1996,1997). The sample data consisted of the total returns on properties in three types, Retail, Office, and Industrial, in various local authority districts, essentially towns, in the UK, to give a total of 392 asset possibilities. The authors found that the observed persistence in performance of real estate returns in other countries was confirmed and appeared to be fairly stable between 1981 and 1996. Second, the persistence did not appear to be driven by volatility, and was robust across sectors, regions, and unaffected by size variations.

The authors also tested a number of trading strategies and concluded that real estate investors would be better off, in terms of higher returns coupled with a lower turnover rate, by purchasing

properties identified as the best in one period and only selling those that fall below the median in the next, rather than concentrating investment in properties from the first quartile. Such a strategy outperformed a random approach and one that assumed absolute persistence in returns, even after transaction costs. The evidence suggested two important rules-of-thumb for property fund managers who wish to maximize performance: (1) avoid properties with below average performance and (2) invest in properties in the upper quartile of performance in one year as they have a higher-than-average chance of achieving above average returns next year. In other words, a fund manager would be advised to stay with the best and avoid the worst.

Finally, using monthly, quarterly, and annual data over the ten-year period from January 1987 to December 1996, Graff and Young (1997) find that the results for REITs are somewhat different. In particular, the data showed a variety of conclusions depending on the sample frequency. For the annual data, like the results for the private real estate market, persistence was observed at the two extremes (i.e., combined first and fourth quartiles) while the two moderate quartiles (i.e., combined second and third quartiles) were statistically insignificant from the theoretical 25% probability. In contrast, the quarterly data showed a lack of serial persistence in the extreme and the moderate quartiles. The monthly returns displayed yet different results, with the extreme quartiles showing negative persistence. That is, a REIT in the fourth and especially the first quartile have less than a 25% chance of being in that quartile in the subsequent period. The negative persistence was more pronounced for large-capitalization REITs than for small-capitalization REITs.

## Data

Data on private real estate assets in the UK are collected by Investment Property Databank (IPD), a commercial organization that provides independent performance measurement and benchmarking services to property investors. Their databases are comprised of individual property data provided by contributing investors that include insurance companies, pension funds, and publicly-listed property companies. There were 232 funds contributing to the UK database at the end of 2002, giving information on over 11,400 properties with an aggregate value of £102 billion. It is estimated that this is equivalent to 75% of the total property investments held by UK institutions and listed property companies (IPD, 2003).

The data used in this study are annual total returns for individual properties over the period 1981 to 2002. Data on both historic and currently-held properties were made available, so as many as 30,000 property records were used in the analysis. Returns for a property were only used for those years where it was a standing investment, i.e., held in an investor portfolio and not traded or subject to development or significant improvement expenditure. Furthermore, a property needed at least two consecutive periods as a standing investment for the persistence test to be performed. Returns for transaction periods are therefore not included and where a transaction is made between two funds in the database; the returns under the new fund's ownership are recorded as a separate observation.

As in previous studies, disaggregation into property types was performed. Properties that did not belong to one of the three main property types (Office, Retail, or Industrial) were excluded from the analysis. It is worth noting that, unlike in the US, Residential / Apartment properties do not form a significant part of most institutional portfolios. The data were also disaggregated into three super-geographical regions (London, the Rest of the Southeast, and the Rest of the UK).

Exhibit 1 shows the number of samples for all properties and disaggregations by property type and region. The total number of return observations over the twenty-two-year period was 216,758. By quartile rank over the entire period, 54,206 sample returns fell into the first quartile, 54,188 into the second quartile, 54,188 into the third quartile, and 54,176 into the fourth quartile.

## Methodology and Confidence Interval Estimation

The methodology in this study is as follows: for each annual sample period, we group individual property returns into quartiles and record the quartile rank. Successful persistence is then defined as a property staying in the same quartile rank in the subsequent annual period, and unsuccessful persistence as the property appearing in a different quartile rank in the subsequent annual period. Because the returns are grouped into quartiles, the theoretical probability of repetitive quartile rankings is 25%, if consecutive quartile rankings for each property are serially independent, the typical assumption made by researchers. Accordingly, statistically significant departures from 25% among sample persistence statistics are deemed evidence that asset returns are not serially independent.

Within each quartile group we examine the incidence of serial runs of uniform quartile rank. Our test statistic is the sample incidence of successful persistence (i.e., the observed rate at which a repetitive quartile rank occurs in the period immediately subsequent to a run of identical quartile rankings over one, two, three, or four sample periods). The persistence counting procedure is identical to that used in previous studies in the US and Australia noted above and the actual counting technique is described more fully in the Appendix of Graff, Harrington, and Young (1999).

To determine whether quartile performance is serially dependent, we calculate confidence intervals for the binomial distribution under the assumption that the probability of repeating quartile performance is 25%. As with the counting procedure, a complete explanation of confidence interval estimation is available in prior publications. See Young and Graff (1996) for example.

## Tests and Results

Exhibit 1 shows the number of samples arranged by year, by three property types, and by three distinct regions. The performance persistence results are shown in tabular and graphical form on the next seven exhibits, described more fully as follows.

As shown in Exhibit 2, Panel A, performance persistence is statistically significant in the cross-sectional distribution of the full set of IPD property returns for the years 1981 to 2002. Statistically significant performance persistence is found in each quartile following runs of 1 year; in the first, second, and fourth quartiles following runs of 2 years; in the first, second, and fourth quartiles following runs of 3 years; and in the first and fourth quartile following runs of 4 years. Combining the first and fourth quartiles into an extreme-quartile group and combining the second and third quartiles into a moderate-quartile group, we find that there is statistically significant persistence in the extreme-quartile group following runs of 1 through 4 years, and that there is somewhat lesser statistically significant persistence in the moderate-quartile group following runs of 2 and 3 years while statistically significant persistence following a run of 1 year is the same as in the extreme-quartile group.

When we disaggregate properties by type, patterns of return persistence are nearly identical to the aggregate. Panels B, C, and D of Exhibit 2 show persistence results of Office, Retail, and Industrial property groupings, respectively. Comparing these results to the aggregate resultss in Panel A, we find that the quartile serial persistence across runs of 1 to 4 years is statistically similar to those of Panel A. The relatively minor although notable difference is evident in the extreme- versus moderate-quartile groupings where strong serial persistence is evident across runs of 1 to 4 years for all three property types for the extreme-quartile groupings, but only a run of 1 year for the moderate-quartile grouping.

Panels E, F, and G of Exhibit 2 show persistence results of London, South East, and the Rest of the United Kingdom regional groupings. Once again, the patterns irrespective of region mimic the patterns observed in the all property aggregates and the property type groupings. The same quantitative and qualitative differences between the extreme-quartile and moderate-quartile groupings are virtually indistinguishable from the results shown in Panels A through D. We do not have available data to determine whether the property types distributions across the regional groupings are identical, but suspect that they are not, especially with regard to the Rest of the UK grouping. If our conjecture is correct, the similarities of patterns across property type and region appears to be a fundamental or intrinsic characteristic of the commercial real estate market rather than a function of its property type or regional distinction.

Exhibit 3 depicts the results of Exhibit 2 for runs of 1 year graphically. Horizontal bars on the graphs indicate the percent of successes and the vertical bars indicate the 95% confidence intervals. Additionally, the data for all properties and property type and regional groupings have been split into three time periods: the full 1981 to 2002 period, the more recent 1992 to 2002 period, and the earlier 1981 to 1991 period. The vertical axes of the graphs within a single grouping are identical to facilitate comparisons over different time periods.

Exhibit 3 shows quite clearly the degree to which persistence in the extreme quartiles differs from persistence in the moderate quartiles in nearly all groupings. Across quartiles, there is a tendency for somewhat greater persistence in the fourth quartile, the quartile with poorest relative performance, for all properties, Office, Retail (except in the 1981 to 1991 period), South East, and Rest of UK (except in the 1981 to 1991 period). Industrial properties across the entire 1981 to 2002 and especially across the 1992 to 2002 periods exhibit the greatest departure from the patterns observed for other groupings. Particularly notable is the 1992 to 2002 pattern for Industrial properties where the performance persistence declines progressively from the first to the fourth quartile.

In the aggregate and in all groupings except Industrial, performance persistence in the moderate quartiles is less pronounced in the 1992 to 2002 period than in the earlier 1981 to 1991 period.

Exhibit 4 shows results for four different groups of holding periods: 2 to 5 years, 6 to 10 years, 11 to 15 years, and 16 to 20 years. As in Exhibit 2, these results are computed for persistence runs from 1 to 4 years duration. The results for all four holding period clusters are similar to those reported in Exhibit 2, namely more persistence in the extreme quartiles than in the moderate quartiles extending to runs of 1 to 4 years. While persistence does not appear to vary across holding, the pronounced fourth quartile persistence across all four holding period groupings is a notable departure from performance persistence in the other three quartiles.

It seems odd that investors or their managers would hold on to properties that exhibited repeatedly poor relative performance for upwards of twenty years of ownership. Graphical

depictions of the Exhibit 4 tables for runs of 1 year are shown in Exhibit 5, which makes the exceptional fourth quartile performance most evident.

It could be argued that there should be a difference in persistence in "Up" and "Down" markets. Up markets are characterized by all sectors and regions showing good, but divergent performance. In other words, although all sectors are achieving good capital gains, some are showing dramatic performance while others are only doing reasonably well. In contrast, in a downturn, there tends to be a convergence in performance, all of it bad, so all sectors show equally poor returns. This suggests that in an Up market there is likely to be even stronger levels of persistence in the first and fourth quartiles than in the Down market. We therefore classified the data into Up and Down markets to test this proposition. An Up market is defined as those years showing a positive deviation from the long-term trend in the IPD Annual Index while Down markets are those years with a negative deviation. Up markets include the calendar years 1986 to 1989 and 1996 to 2002, while Down markets include the 1981 to 1985 and 1990 to 1995 periods. Given the relatively short periods for these cycles, the persistence data for runs of more than 1 or 2 years diminish in explanatory power and as such they were excluded from the analysis.

Exhibit 6 shows the serial persistence results for all properties, Panels A and B, and for Office properties, Panels C and D, in Up and Down markets. The patterns that by now are becoming familiar hold, namely that the extreme-quartiles are more persistent than the moderate quartiles in the aggregate and in the Office group during Up markets. Furthermore, there is little to distinguish Up and Down market persistence patterns for the aggregate of all properties and even the magnitudes of the quartile persistence figures are nearly identical in the first and fourth quartiles. The Up and Down market persistence pattern of Office properties differ a bit, most notably in the first quartile in Down markets that are quite low, relatively speaking, and in the fourth quartile in Down markets that are quite high. Exhibit 7, which shows graphically the 1-year persistence results from Exhibit 6, makes these contrasting patterns most evident.

Exhibit 8 combines persistence results from Young and Graff (1996) involving US NCREIF data, from Graff, Harrington, and Young (1999) involving Australian Property Council of Australia (PCA) data, and the present study, all for runs of 1 year in the aggregate and by the three property types. Although time periods differ and the sample sizes produce substantially different confidence intervals, similarities among commercial property persistence results are evident from these graphs. In particular, the greater persistence in the first and fourth quartiles versus the second and third quartiles is similar across all three national data sets. Office properties have a similar cross-national pattern, although somewhat more muted in the first quartile persistence and generally more pronounced in the fourth quartile results.

US results for Retail properties and Australian results for Industrial properties are more dissimilar than for like-property results for the other countries. In particular, the US Retail property results have especially high first quartile persistence while especially low fourth quartile persistence. Australian Industrial property results are especially low for first quartile persistence and notably low for fourth quartile persistence as well. These exceptions are discussed in the prior research and need not be elaborated upon here except to say that there are or can be trends or circumstances of attention paid to particular property types in particular time periods that can lead to possibly atypical patterns or performance behavior. The "fads" discussed in the next section are likely contributors to these seemingly anomalous results.

## Possible Sources of Persistence

A number of reasons can be advanced to explain the greater persistence in the UK compared with that in the US and Australia. First, that more individual property valuations in the UK are conducted internally rather externally. In other words, the organization produces valuations that portray the performance of the properties in the best light and tries to maintain this as long as possible, leading to serial persistence in individual property returns.

A second but related argument might be that even where valuations are conducted by an external valuer, undue pressure is brought to bear to produce figures that benefit the organization, again leading to serial persistence.

Even if the external valuation firms do not come under pressure to produce a favourable report, the use of comparable evidence in arriving at a valuation itself induces serial persistence in property returns. The argument is that the comparables used to arrive at a current estimate of price are themselves based on previous valuations from similar properties and that this tendency to recycle valuations has the effect of incorporating previous prices in the current return, leading to serial persistence.

Grossman and Stiglitz (1976) assert that, due to the paucity of data from market prices, a thin market will display uniformity of investor beliefs about asset prices, which leads to fads for a particular property type or region. This uniformity of belief may itself lead to persistence in real estate returns, especially if the number of firms undertaking the external valuations is so few that the market evidence is averaged out and so constrains the variability in valuation (Graff and Webb, 1997).

Finally, lease term variations across property types may also account for differences in persistence. As terms lengthen, for example, property economics may take on a more bond-like character where annual valuations and the returns derived from them become synchronized with interest rates or capitalization rates, in real estate parlance. We look at each of these arguments in turn.

### *Agency Effects, Internal and External*

The valuations used by IPD in the annual index are based on valuations of the individual properties of the organization by external rather than internal valuers. An External Valuer is defined in the RICS Red Book as "…a valuer who…has no significant financial linkages with the client either as a director or employee," RICS (2004). These External Valuers, therefore, should produce valuations that are less likely to put the organization in the most favourable light than if the valuations were undertaken internally. This would imply that the first argument cannot account for the greater serial persistence observed in UK property return.

However, the Carsberg Report (RICS, 2002) notes that the fee-earning relationship that exists between the valuer and client may threaten an External Valuers objectivity. The objectivity of valuers in carrying out their work is governed by Regulation 1 of the RICS Code of Conduct. More specifically, Practice Statement 7.1.5 of the Red Book requires objectively by its members in carrying out valuations and that any lack of objectively on the part of a member would breach RICS rules and could result in disciplinary action. Nonetheless, the Carsberg Report reports that "close personal relationships…could lead to insufficient questioning of factors affecting the valuation…and that…any relationship involving payment of a fee, particularly where repeat business is possible, the objectivity and independence of the service provider may be at risk."

In particular, the study by the Investment Property Forum (IPF) (2000) on the valuation process in the UK raised concerns about what are known a "draft valuation meetings" at which the valuer produces preliminary figures for discussion with the client prior to producing the final valuation. The Carsberg Report and IPF both appreciate that such meetings could provide the client with an opportunity to influence the outcome of the valuations to the benefit of the organization. The IPF (2000) found evidence that client influence "…does occur and valuations can be influenced by clients." However, they note that such influence is short-lived and could be counter productive. Indeed, the IPF (2000) study finds that any short-term pressure to push valuation upwards was not evident over the long term "as valuations would be forced to recover the position over future periods."

It would seem, therefore, that any influence on external valuers is unlikely to account for the greater persistence found in annual returns to real estate in the UK compared with the US and Australia, despite the issues noted above.

### *Anchoring*

The argument that the valuation procedures used to derive price can account for the large amount of persistence in real estate returns is well known. Valuers in the UK typically use comparable evidence to estimate price (Crosby, 1990). Quan and Quigley (1989, 1991) argue that if valuers use comparable evidence to derive price, the optimum strategy is to use a weighted average of the previous value and the most recent market evidence. The smooth nature of real estate returns, therefore, arises from the relative uncertainly of the variability of movements in the market in general and that of the property being valued, Brown and Matysiak (2000). In addition, since 1990, there has been a significant increase in the incidence of valuers being sued for negligence (Crosby et al, 1998), the only defense of which is that the valuer followed 'correct' procedures and hierarchies of evidence in arriving at their valuation. The greater the uncertainly in current market sentiment, the less likely it is to be used, all of which leads valuers to see the previous valuation as the only hard evidence. Consequently, it is rational for valuers to put more weight on the previous valuation and less weight on more nebulous current market sentiment that cannot be proved, Quan and Quigley (1989, 1991).

Diaz (1990a, 1990b, and 1997) and Diaz and Wolverton (1998) have shown that valuers inadequately adjust from their previous appraisal in performing current valuations, a process known as 'anchoring.' Thus, the estimate of the current price of the property is biased towards the initial starting figure of the previous valuation and so will give rise to serial persistence in returns. However, there is no evidence to suggest that valuers in the UK anchored more to previous valuations than their counterparts in the US or Australia. In other words, anchoring alone is unlikely to account for the greater persistence in real estate returns in the UK relative to that in the US and Australia.

Even if anchoring is found to be an important source of persistence, there are relatively simple and inexpensive solutions that managers could take to alleviate the problem. In particular, Graff and Young (1999) recommend switching or rotating valuers on a more frequent basis.

### *Number and Dispersion of Independent Valuers*

When using current market evidence within the valuation process a noticeable difference can be seen between the US and UK. In the US market, Graff and Webb (1997) observe that knowledge

is locally-based and under the control of a small handful of local firms. Thus, the market sentiment of one locality is likely to be ironed out among this small number of firms leading to a uniformity of belief as to the prospects for properties in that locality. This has the effect of clients with property in that area updating their portfolios based on the same market data that constrains variation in values, leading to persistence in returns. In particular, this may explain why the properties in the fourth quartile show greatest level of persistence as it may be these properties that require the strongest amount of market evidence to shift the valuer away from the previous valuation.

Furthermore, according to Grossman and Stiglitz (1976), in a thin market such as real estate that lacks strong market price data, institutions may develop fads for certain property types and locations, a process that will continue for a long time until the evidence is so overwhelming that the particular property type or location loses its charm. In other words, the persistence in real estate returns can be explained by the faddish behavior on the part of investors and the control of market data in the hands of only a few firms. However, these phenomena will be limited across the US because appraisal firms in the US are more disperse than in the UK. Thus, although there may be a "house view" of certain property types and regions by firms, this is likely to be limited to that individual firm. Any uniformity of belief about a particular region is therefore unlikely to permeate across all investor portfolios without property in that region, thereby reducing the amount of cross serial correlation in returns across the US and mitigating the level of serial persistence in real estate returns.

In contrast, in the UK the number of firms undertaking the vast majority of external valuations in the UK is very small and they are national in size. For instance, the Carsberg Report (RICS, 2002) observed that, as of December 2000, 64.7% by capital value of the properties in the IPD Annual Index were valued by five firms, and 37.7% by three firms. For the smaller IPD Monthly Index, the corresponding figures (as of November 2001) were 79.6% by the top five valuation firms and 62.4% by the top three firms. Anecdotal evidence also suggests that the top firms also meet informally on a regular basis to 'pool' their market knowledge. Thus, the 'house view' of one firm, which itself is a distillation of market sentiment from its own valuers for each property type and region, is further refined across all valuation firms, leading to a uniform market view displaying little variation. In the UK, therefore, current market evidence is likely to be even more uniform across the country and has an even greater chance to pervade all institutional investor portfolios than across the US. This uniform market view will then filter down the chain for use in the valuation of individual properties for all clients by all firms.

Thus, when undertaking an external valuation for one client the valuation firm not only incorporates the previous valuation of the individual property but it will also use the market view for all properties of a similar type from across the UK. Such a process is likely to lead to serial persistence in the returns of individual properties for one client and induce cross serial correlation in similar properties for all clients, inadvertently leading to even greater persistence across individual properties in the UK compared with the US. However, the extent to which this explains the greater serial persistence found in UK properties is not known and deserving of future research.

*Lease Terms*

Lease term variations across property types may also account for differences in persistence. As terms lengthen, for example, property economics may take on a more bond-like character where annual valuations and the returns derived from them become synchronized with interest rates or capitalization rates, in real estate parlance.

Although the data shown in Exhibit 9 should be viewed as preliminary, unrefined and perhaps incomplete, they are nonetheless indicative of the differences in lease terms by property type between the UK and the US. For example, taking the simple averages of the lease terms by property type in Panel A, the IPD data, and contrasting them with the 2000 to 2004 averages in Panel B, the RREEF data, we find that in the UK (IPD) average Office lease terms are about 7.9 years versus the US (RREEF) average Office lease terms of about 4.6 years. Similarly, UK average Retail lease terms are about 11.1 years versus a US average of about 5.7 years, and the UK average Industrial lease terms are about 7.9 years versus a US average of about 3.4 years.

If these relative differences in average lease terms are found to be valid, then it is reasonable to believe that considerably more of the total value estimate of UK properties is comprised of current rather than future leases compared to the composition of the total value estimate of US properties. This difference may account for the greater observed persistence of UK properties relative to US properties across the board.

## Conclusions

This study has examined persistence in relative investment return performance for UK commercial property during the twenty-two-year interval 1981 through 2002. Annual returns data divided into three property type subgroups: Office, Retail, and Industrial, and by three regions; London, the South East, and the Rest of the UK were used.

The empirical persistence results in this study demonstrate conclusively that total returns from properties within the IPD database between 1981 and 2002 exhibit serial dependence across all four quartiles of relative returns for all properties aggregated, as well as across each of three property types and regions. These results contrast markedly from results of similar studies of commercial property returns in the US and Australia where persistence tended to be statistically significant in the extreme first and fourth quartiles, but statistically independent in the moderate second and third quartiles.

While the statistical differences among UK, US, and Australian property return quartiles exist, the UK pattern of generally more persistence in the extreme quartiles than in the middle quartiles is qualitatively similar to both the US and Australia. This leads to suspicion that the general commercial real estate risk profile among the three countries is of the same general character and that the differences, notably evident in the middle quartiles, result from agency or behavioral aspects of the management of the real estate investment management business.

These conclusions are at odds with the prevailing finance theory-based assumption about real estate risk, and appear to invalidate current beliefs about statistically-derived risk proxies and Modern Portfolio Theory-based portfolio construction applications. In particular, if MPT or the Efficient Markets Hypothesis are valid models for equity real estate, our findings of performance persistence in extreme returns and qualitative differences in performance persistence across property types and geographical regions or countries should not be observed. In general, the results of this and prior similar studies leads to the inevitable conclusion that research based upon

models that presume serial independence within real estate returns cannot be reliable or suitable for real estate investors. A new paradigm consistent with the empirical results must be developed.

That persistence in extreme or moderate quartiles is qualitatively different depending upon property type, location, or time period argues strongly against the existence of linear multifactor market models of UK commercial real estate. Unless researchers can demonstrate the existence of a class of linear multifactor models based on financial and real economic input variables that generate persistence in the variety of ways as this study has shown, we must conclude that linear multifactor models are as inapplicable in the case of UK commercial real estate as they are in the US and Australia.

To identify the economic forces and mechanisms that produce the results observed in this study, we suggest that agency-related concepts and behavioral finance models will provide fertile fields for future research. Additionally, extensions of this research and a better understanding of the forces that give rise to the patterns observed may likely lead to rewarding operational prescriptions such as programs of systematically identifying and culling underperforming assets from portfolios in order to improve overall portfolio performance.

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**Exhibit 1**
**Number of Return Observations by Year, Property Type, and Region in the IPD Database for Properties with at Least Two Observations, 1981 to 2002**

| Year | All | Retail | Office | Industrial | London | SooouthEast | RestofUK |
|---|---|---|---|---|---|---|---|
| 1981 | 8,990 | 4,572 | 2,746 | 1,672 | 2,930 | 2,247 | 3,813 |
| 1982 | 9,953 | 4,993 | 3,047 | 1,913 | 3,199 | 2,531 | 4,223 |
| 1983 | 9,958 | 4,909 | 3,102 | 1,947 | 3,119 | 2,581 | 4,258 |
| 1984 | 10,173 | 5,036 | 3,167 | 1,970 | 3,087 | 2,697 | 4,389 |
| 1985 | 10,307 | 5,168 | 3,221 | 1,918 | 3,029 | 2,811 | 4,467 |
| 1986 | 10,529 | 5,337 | 3,303 | 1,889 | 2,990 | 2,980 | 4,559 |
| 1987 | 10,130 | 5,319 | 3,117 | 1,694 | 2,794 | 2,901 | 4,435 |
| 1988 | 9,837 | 5,339 | 2,949 | 1,549 | 2,661 | 2,952 | 4,224 |
| 1989 | 9,967 | 5,465 | 2,971 | 1,531 | 2,643 | 3,106 | 4,218 |
| 1990 | 10,328 | 5,591 | 3,108 | 1,629 | 2,641 | 3,286 | 4,401 |
| 1991 | 10,652 | 5,680 | 3,268 | 1,704 | 2,627 | 3,482 | 4,543 |
| 1992 | 10,955 | 5,777 | 3,318 | 1,860 | 2,641 | 3,640 | 4,674 |
| 1993 | 10,623 | 5,578 | 3,218 | 1,827 | 2,539 | 3,513 | 4,571 |
| 1994 | 10,383 | 5,503 | 3,099 | 1,781 | 2,469 | 3,353 | 4,561 |
| 1995 | 11,393 | 6,093 | 3,337 | 1,963 | 2,515 | 3,697 | 5,181 |
| 1996 | 10,960 | 5,938 | 3,148 | 1,874 | 2,363 | 3,537 | 5,060 |
| 1997 | 10,100 | 5,539 | 2,796 | 1,765 | 2,175 | 3,190 | 4,735 |
| 1998 | 9,905 | 5,459 | 2,618 | 1,828 | 2,135 | 3,067 | 4,703 |
| 1999 | 9,163 | 4,996 | 2,407 | 1,760 | 2,077 | 2,771 | 4,315 |
| 2000 | 8,421 | 4,523 | 2,197 | 1,701 | 1,937 | 2,540 | 3,944 |
| 2001 | 7,546 | 3,665 | 2,107 | 1,774 | 1,771 | 2,329 | 3,446 |
| 2002 | 6,485 | 3,047 | 1,839 | 1,599 | 1,589 | 1,998 | 2,898 |
| Totals | 216,758 | 113,527 | 64,083 | 39,148 | 55,931 | 65,209 | 95,618 |

**Exhibit 2**
**Annual Return Persistence, 1981 to 2002**

Panel A: **All Properties**

| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 46,871 | 16,118 | 34.4 *** | (24.6,25.4) | 1 | 47,388 | 13,619 | 28.2 *** | (24.6,25.4) |
| 2 | 16,118 | 5,430 | 33.7 *** | (24.3,25.7) | 2 | 13,619 | 3,617 | 30.8 ** | (24.3,25.7) |
| 3 | 5,430 | 1,974 | 36.4 *** | (23.9,26.2) | 3 | 3,617 | 980 | 33.3 * | (23.6,26.4) |
| 4 | 1,974 | 713 | 36.1 *** | (23.1,26.9) | 4 | 980 | 261 | 31.8 | (22.3,27.8) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 45,261 | 16,819 | 37.2 *** | (24.6,25.4) | 1 | 47,238 | 13,222 | 28.0 *** | (24.6,25.4) |
| 2 | 16,819 | 5,359 | 31.9 *** | (24.3,25.7) | 2 | 13,222 | 3,296 | 24.9 | (24.3,25.7) |
| 3 | 5,359 | 1,682 | 31.4 *** | (23.9,26.2) | 3 | 3,296 | 854 | 25.9 | (23.5,26.5) |
| 4 | 1,682 | 500 | 29.7 ** | (23.0,27.1) | 4 | 854 | 224 | 26.2 | (22.2,28.0) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 92,132 | 32,937 | 35.7 *** | (24.2,26.7) | 1 | 94,626 | 26,841 | 28.4 *** | (24.7,25.3) |
| 2 | 32,937 | 10,789 | 32.8 *** | (24.5,25.5) | 2 | 26,841 | 6,913 | 25.8 * | (24.5,25.5) |
| 3 | 10,789 | 3,656 | 33.9 *** | (24.2,25.8) | 3 | 6,913 | 1,834 | 26.5 * | (24.0,26.0) |
| 4 | 3,656 | 1,213 | 33.2 *** | (23.6,26.4) | 4 | 1,834 | 485 | 26.4 | (23.0,27.0) |

Panel B: **Office Properties**

| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 12,907 | 4,307 | 33.4 *** | (24.3,25.8) | 1 | 13,198 | 3,643 | 27.6 *** | (24.3,25.7) |
| 2 | 4,307 | 1,364 | 31.7 *** | (23.7,26.3) | 2 | 3,643 | 915 | 25.1 | (23.6,26.4) |
| 3 | 1,364 | 473 | 34.7 *** | (22.7,27.3) | 3 | 915 | 244 | 26.7 | (22.2,27.9) |
| 4 | 473 | 172 | 36.4 *** | (21.2,29.0) | 4 | 244 | 56 | 23.0 | (19.8,30.6) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 15,146 | 6,342 | 41.9 *** | (24.3,25.7) | 1 | 13,909 | 3,886 | 27.9 *** | (24.3,25.7) |
| 2 | 6,342 | 2,232 | 35.2 *** | (23.9,26.1) | 2 | 3,886 | 1,003 | 25.8 | (23.7,26.4) |
| 3 | 2,232 | 759 | 34.0 *** | (23.2,26.8) | 3 | 1,003 | 253 | 25.2 | (22.4,27.7) |
| 4 | 759 | 244 | 32.1 ** | (22.0,28.1) | 4 | 253 | 63 | 24.9 | (19.9,30.5) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 28,053 | 10,649 | 38.0 *** | (24.5,25.5) | 1 | 27,107 | 7,529 | 27.8 *** | (24.5,25.5) |
| 2 | 10,649 | 3,596 | 33.8 *** | (24.2,25.8) | 2 | 7,529 | 1,918 | 25.5 | (24.0,26.0) |
| 3 | 3,596 | 1,232 | 34.3 *** | (22.2,27.9) | 3 | 1,918 | 497 | 25.9 | (23.1,27.0) |
| 4 | 1,232 | 416 | 33.8 *** | (22.6,27.5) | 4 | 497 | 117 | 23.9 | (21.3,28.9) |

**Exhibit 2 (continued)**
**Annual Return Persistence, 1981 to 2002**

Panel C: **Retail Properties**

| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 24,828 | 8,359 | 33.7 *** | (24.5,25.5) | 1 | 24,754 | 6,972 | 28.2 *** | (24.5,25.5) |
| 2 | 8,359 | 2,826 | 33.8 *** | (24.1,25.9) | 2 | 6,972 | 1,879 | 27.0 ** | (24.0,26.0) |
| 3 | 2,826 | 1,058 | 37.4 *** | (23.4,26.6) | 3 | 1,879 | 512 | 27.2 * | (23.1,27.0) |
| 4 | 1,058 | 386 | 36.5 *** | (22.4,27.7) | 4 | 512 | 192 | 26.0 | (21.3,28.8) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 23,172 | 8,016 | 34.6 *** | (24.4,25.6) | 1 | 25,496 | 7,224 | 28.3 *** | (24.5,25.5) |
| 2 | 8,016 | 2,301 | 28.7 *** | (24.1,26.0) | 2 | 7,224 | 1,815 | 25.1 | (24.0,26.0) |
| 3 | 2,301 | 660 | 28.7 ** | (23.3,26.8) | 3 | 1,815 | 487 | 26.8 | (23.0,27.0) |
| 4 | 660 | 192 | 29.1 * | (21.8,28.4) | 4 | 487 | 135 | 27.7 | (21.3,28.9) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 48,000 | 16,375 | 34.1 *** | (24.6,25.4) | 1 | 50,250 | 14,196 | 28.3 *** | (24.6,25.4) |
| 2 | 16,375 | 5,127 | 31.3 *** | (24.3,25.7) | 2 | 14,196 | 3,694 | 26.0 * | (24.3,25.7) |
| 3 | 5,127 | 1,718 | 33.5 *** | (23.8,26.2) | 3 | 3,694 | 999 | 27.0 * | (23.6,26.4) |
| 4 | 1,718 | 578 | 33.6 *** | (23.0,27.1) | 4 | 999 | 268 | 26.8 | (22.4,27.7) |

Panel D: **Industrial Properties**

| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 9,136 | 3,452 | 37.8 *** | (24.1,25.9) | 1 | 9,436 | 3,004 | 31.8 *** | (24.1,25.9) |
| 2 | 3,452 | 1,240 | 35.9 *** | (23.6,26.5) | 2 | 3,004 | 823 | 27.4 * | (23.5,26.2) |
| 3 | 1,240 | 443 | 35.7 *** | (22.6,27.5) | 3 | 823 | 224 | 27.2 | (22.1,28.0) |
| 4 | 443 | 155 | 35.0 ** | (21.1,29.1) | 4 | 224 | 72 | 32.1 * | (19.6,30.9) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 6,943 | 2,461 | 35.4 *** | (24.0,26.0) | 1 | 7,833 | 2,112 | 27.0 ** | (24.0,26.0) |
| 2 | 2,461 | 826 | 33.6 *** | (23.3,26.7) | 2 | 2,112 | 478 | 22.6 * | (23.2,26.9) |
| 3 | 826 | 263 | 31.8 ** | (22.1,28.0) | 3 | 478 | 114 | 23.8 | (21.2,29.0) |
| 4 | 263 | 64 | 24.3 | (20.0,30.4) | 4 | 114 | 26 | 22.8 | (17.5,33.4) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 16,079 | 5,913 | 36.8 *** | (21.1,29.0) | 1 | 17,269 | 5,116 | 29.6 *** | (24.4,25.6) |
| 2 | 5,913 | 2,066 | 34.9 *** | (17.2,32.2) | 2 | 5,116 | 1,301 | 25.4 | (23.8,26.2) |
| 3 | 2,066 | 706 | 34.2 *** | (8.1,43.5) | 3 | 1,301 | 338 | 26.0 | (22.7,27.4) |
| 4 | 706 | 219 | 31.0 ** | [0.0,55.0) | 4 | 338 | 98 | 29.0 | (20.5,29.8) |

**Exhibit 2 (continued)**
**Annual Return Persistence, 1981 to 2002**

Panel E: **London**

| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 13,426 | 5,097 | 38.0 *** | (24.3,25.7) | 1 | 11,825 | 3,341 | 28.3 *** | (24.5,25.5) |
| 2 | 5,097 | 1,811 | 35.5 *** | (23.8,26.2) | 2 | 3,341 | 869 | 26.0 | (24.1,25.9) |
| 3 | 1,811 | 681 | 37.6 *** | (23.0,27.0) | 3 | 869 | 233 | 26.8 | (23.6,26.5) |
| 4 | 681 | 259 | 38.0 *** | (21.8,28.3) | 4 | 233 | 61 | 26.2 | (19.7,30.8) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 11,788 | 4,620 | 39.2 *** | (24.2,25.8) | 1 | 11,273 | 2,995 | 26.6 ** | (24.2,25.8) |
| 2 | 4,620 | 1,589 | 34.4 *** | (23.8,26.3) | 2 | 2,995 | 744 | 24.8 | (23.5,26.6) |
| 3 | 1,589 | 528 | 33.2 *** | (22.9,27.2) | 3 | 744 | 215 | 28.9 * | (22.0,28.2) |
| 4 | 528 | 154 | 29.2 * | (21.4,28.8) | 4 | 215 | 56 | 26.0 | (19.4,31.0) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 25,214 | 9,717 | 38.5 *** | (24.5,25.5) | 1 | 23,098 | 6,336 | 27.4 *** | (24.4,25.6) |
| 2 | 9,717 | 3,400 | 35.0 *** | (24.1,25.9) | 2 | 6,336 | 1,613 | 25.5 | (23.9,26.1) |
| 3 | 3,400 | 1,209 | 35.6 *** | (23.6,26.5) | 3 | 1,613 | 448 | 27.8 * | (22.9,27.1) |
| 4 | 1,209 | 413 | 34.2 *** | (22.6,27.5) | 4 | 448 | 117 | 26.1 | (21.1,29.1) |

Panel F: **South East**

| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 12,847 | 3,998 | 31.1 *** | (24.3,25.8) | 1 | 14,517 | 4,138 | 28.5 *** | (24.3,25.7) |
| 2 | 3,998 | 1,268 | 31.7 *** | (23.7,26.4) | 2 | 4,138 | 1,097 | 26.5 * | (23.7,26.3) |
| 3 | 1,268 | 433 | 34.1 *** | (22.7,27.4) | 3 | 1,097 | 292 | 26.6 | (22.5,27.6) |
| 4 | 433 | 144 | 33.3 ** | (21.0,29.2) | 4 | 292 | 82 | 28.1 | (20.2,30.1) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 13,945 | 5,130 | 36.8 *** | (24.3,25.7) | 1 | 14,887 | 4,285 | 28.8 *** | (24.3,25.7) |
| 2 | 5,130 | 1,550 | 30.2 *** | (23.8,26.2) | 2 | 4,285 | 1,082 | 25.3 | (23.7,26.3) |
| 3 | 1,550 | 454 | 29.3 ** | (22.9,27.2) | 3 | 1,082 | 267 | 24.7 | (22.5,27.6) |
| 4 | 454 | 129 | 28.4 | (21.2,29.1) | 4 | 267 | 66 | 24.7 | (20.0,30.4) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 26,792 | 9,128 | 34.1 *** | (24.5,25.5) | 1 | 29,404 | 8,423 | 28.6 *** | (24.5,25.5) |
| 2 | 9,128 | 2,818 | 30.9 *** | (24.1,25.9) | 2 | 8,423 | 2,179 | 25.9 | (24.1,25.9) |
| 3 | 2,818 | 887 | 31.5 *** | (23.4,26.6) | 3 | 2,179 | 559 | 25.7 | (23.2,26.8) |
| 4 | 887 | 273 | 30.8 ** | (22.2,27.9) | 4 | 559 | 148 | 26.5 | (21.5,28.7) |

**Exhibit 2 (continued)**
**Annual Return Persistence, 1981 to 2002**

Panel G: **Rest of United Kingdom**

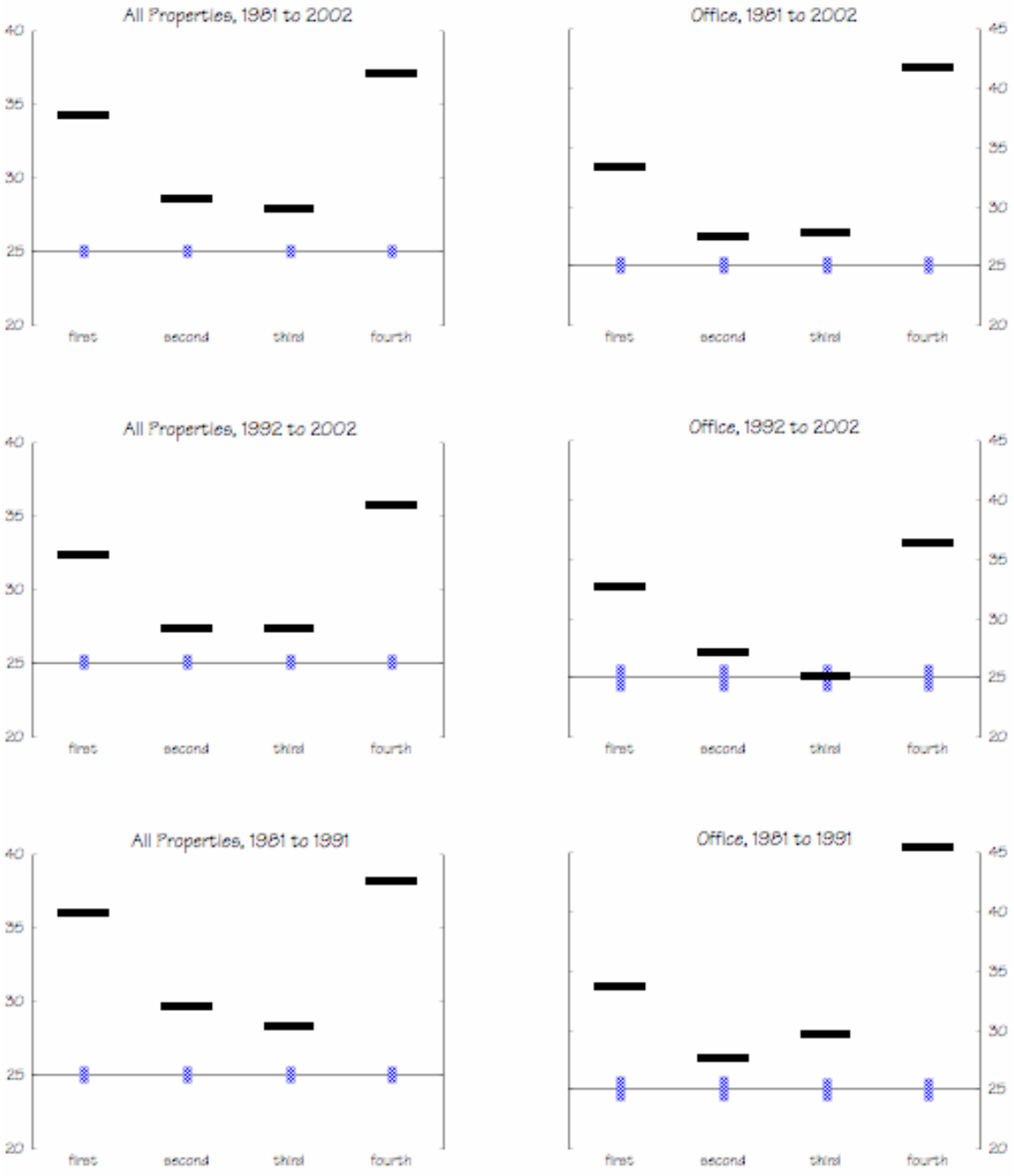
| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 20,598 | 7,023 | 34.1 *** | (24.4,25.6) | 1 | 21,046 | 6,140 | 29.2 *** | (24.4,25.6) |
| 2 | 7,023 | 2,351 | 33.5 *** | (24.0,26.0) | 2 | 6,140 | 1,651 | 26.9 ** | (23.9,26.1) |
| 3 | 2,351 | 860 | 36.6 *** | (23.3,26.8) | 3 | 1,651 | 455 | 27.6 * | (22.9,27.1) |
| 4 | 860 | 310 | 36.0 *** | (22.2,28.0) | 4 | 455 | 118 | 25.9 | (21.1,29.1) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 19,528 | 7,069 | 36.2 *** | (24.4,25.6) | 1 | 21,078 | 5,942 | 28.2 *** | (24.4,25.6) |
| 2 | 7,069 | 2,220 | 31.4 *** | (24.0,26.0) | 2 | 5,942 | 1,470 | 24.7 | (23.9,26.1) |
| 3 | 2,220 | 700 | 31.5 *** | (23.2,26.8) | 3 | 1,470 | 372 | 25.3 | (22.8,27.2) |
| 4 | 700 | 217 | 31.0 * | (21.9,28.3) | 4 | 372 | 102 | 27.4 | (20.7,29.5) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 40,126 | 14,092 | 35.1 *** | (24.6,25.4) | 1 | 42,124 | 12,082 | 28.7 *** | (24.6,25.4) |
| 2 | 14,092 | 4,571 | 32.4 *** | (24.3,25.7) | 2 | 12,082 | 3,121 | 25.8 * | (24.2,25.8) |
| 3 | 4,571 | 1,560 | 34.1 *** | (23.8,26.3) | 3 | 3,121 | 827 | 26.5 | (23.5,26.5) |
| 4 | 1,560 | 527 | 33.8 *** | (22.9,27.2) | 4 | 827 | 220 | 26.6 | (21.1,28.0) |

* Null hypothesis rejected at the 5% level of significance
* * Null hypothesis rejected at the 0.01% level of significance
* * * Null hypothesis rejected at the 0.00001% level of significance

Exhibit 3

Quartile Performance Persistence in the IPD Database

All Properties & Office Properties

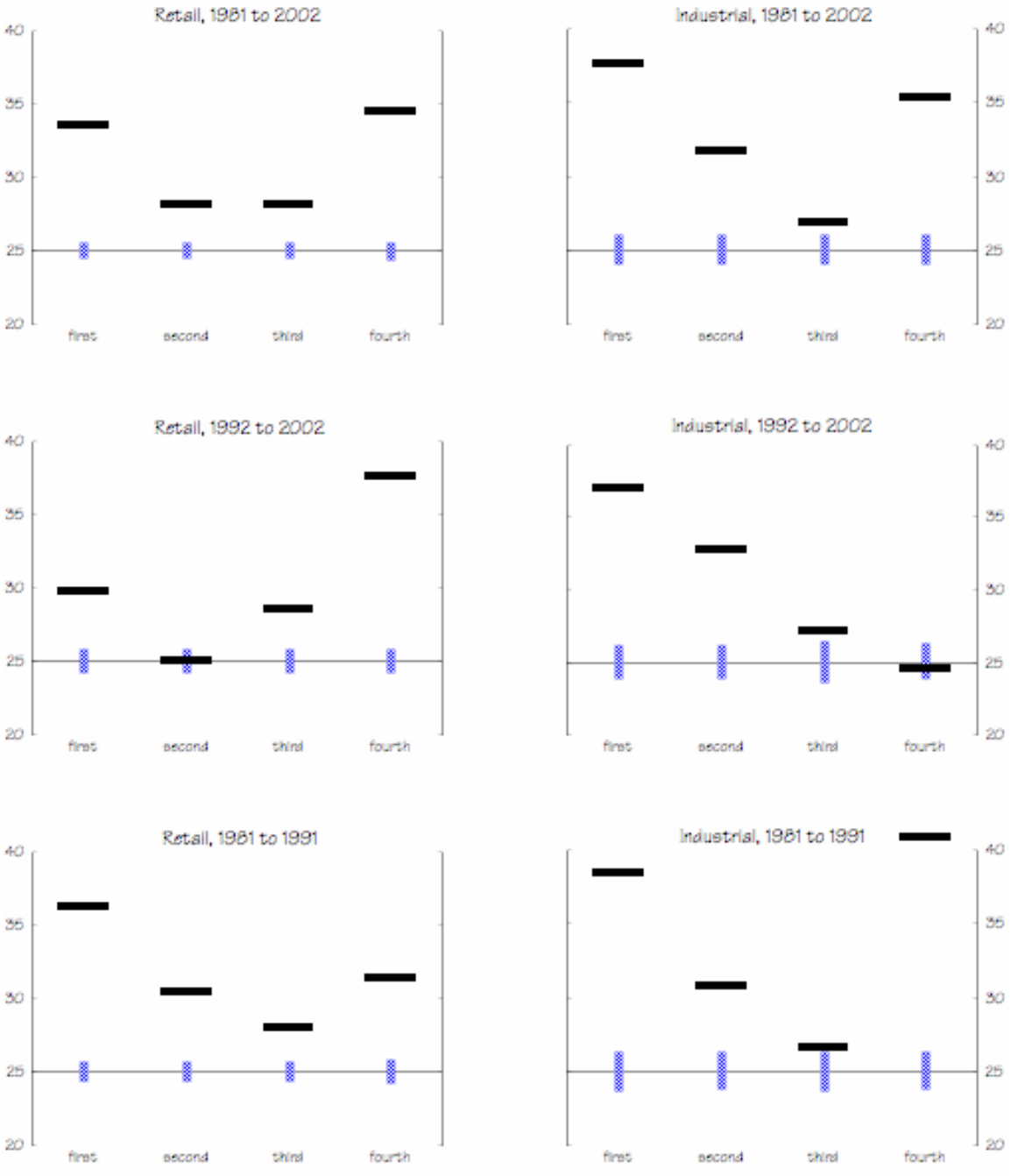



Note: Vertical bars represent the 95% confidence intervals while horizontal bars represent the persistence results.

Exhibit 3 (continued)

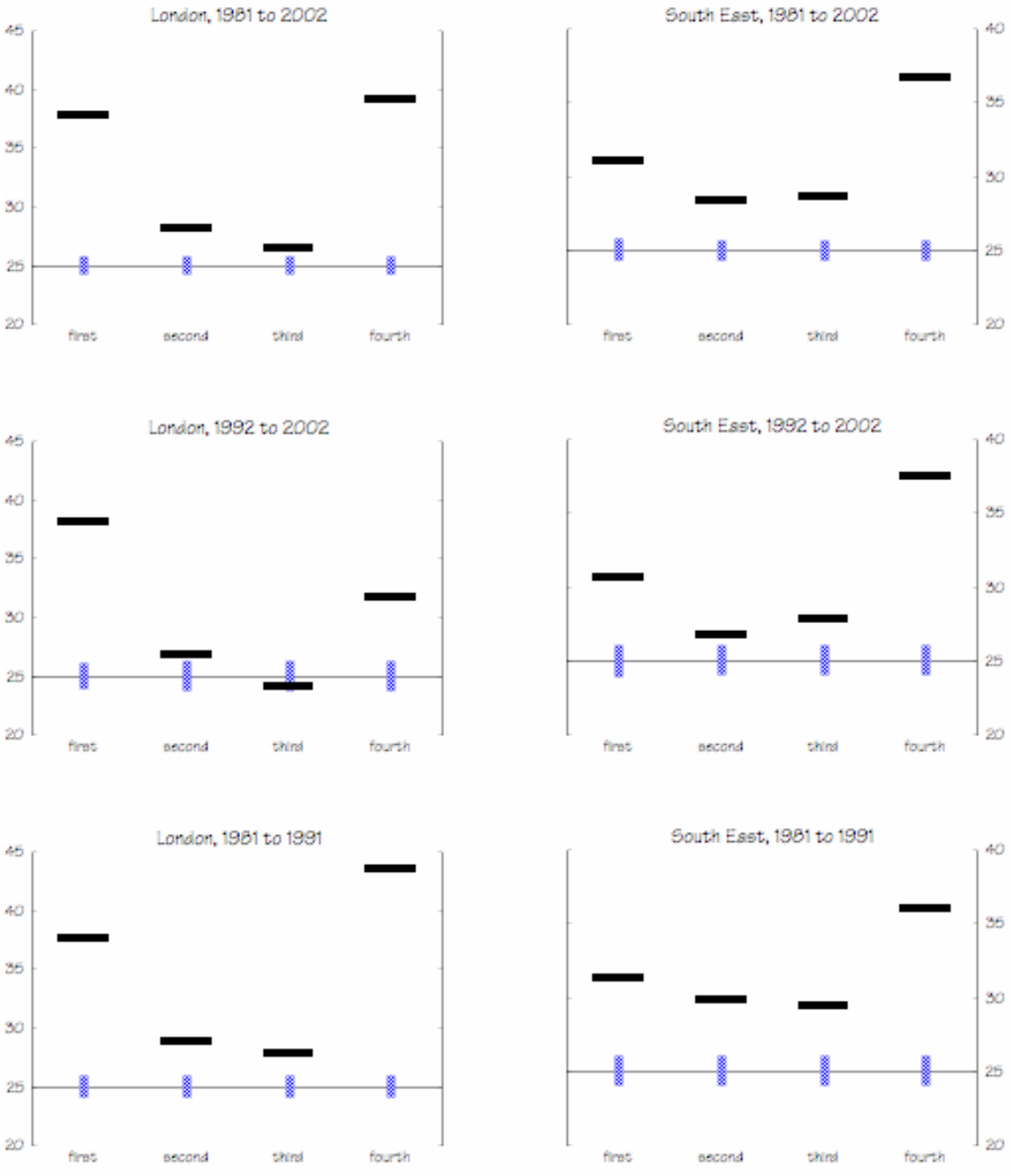
Quartile Performance Persistence in the IPD Database

Retail and Industrial Properties




Note: Vertical bars represent the 95% confidence intervals while horizontal bars represent the persistence results.

Exhibit 3 (continued)
Quartile Performance Persistence in the IPD Database
London and South East

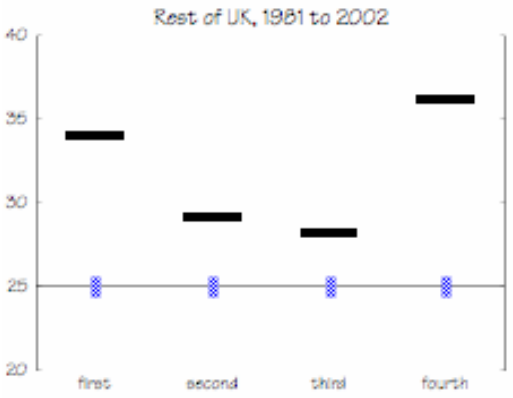


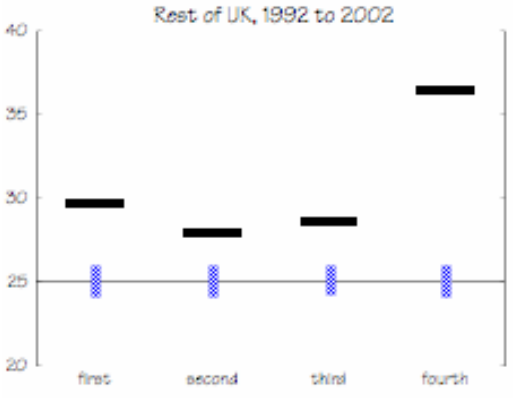

Note: Vertical bars represent the 95% confidence intervals while horizontal bars represent the persistence results.

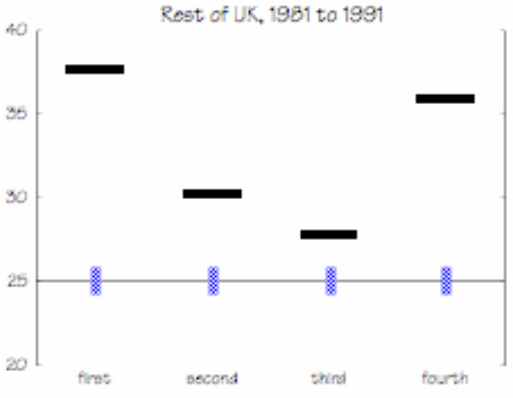
Exhibit 3 (continued)

Quartile Performance Persistence in the IPD Database

Rest of United Kingdom




Note: Vertical bars represent the 95% confidence intervals while horizontal bars represent the persistence results.

**Exhibit 4**
**Annual Return Persistence for Various Holding Periods**

Panel A: **2- to 5-year Holding Period**

| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 3,865 | 1,158 | 30.0 *** | (23.6,26.4) | 1 | 4,450 | 1,190 | 26.7 * | (23.7,26.3) |
| 2 | 1,158 | 217 | 18.7 ** | (22.5,27.5) | 2 | 1,190 | 192 | 16.1 *** | (22.6,27.5) |
| 3 | 217 | 31 | 14.3 ** | (19.5,31.0) | 3 | 192 | 24 | 12.5 ** | (19.1,31.4) |
| 4 | 31 | 4 | 12.9 | (11.4,41.9) | 4 | 24 | 2 | 8.3 * | (9.8,44.4) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 4,804 | 2,041 | 42.5 *** | (23.8,26.2) | 1 | 4,755 | 1,437 | 30.2 *** | (23.8,26.2) |
| 2 | 2,041 | 483 | 23.7 | (23.1,26.9) | 2 | 1,437 | 251 | 17.5 *** | (22.8,27.3) |
| 3 | 483 | 81 | 16.8 ** | (21.3,29.0) | 3 | 251 | 50 | 19.9 | (19.8,30.6) |
| 4 | 81 | 10 | 12.3 * | (16.2,35.0) | 4 | 50 | 9 | 18.0 | (14.0,38.0) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 8,669 | 3,399 | 36.9 *** | (24.1,25.9) | 1 | 9,205 | 2,627 | 28.5 *** | (24.1,25.9) |
| 2 | 3,199 | 700 | 21.9 ** | (23.5,26.5) | 2 | 2,627 | 443 | 16.9 *** | (23.4,26.7) |
| 3 | 700 | 112 | 16.0 *** | (21.9,28.3) | 3 | 443 | 74 | 16.7 ** | (21.1,29.1) |
| 4 | 112 | 14 | 12.5 * | (17.4,33.5) | 4 | 74 | 11 | 14.9 * | (15.8,35.5) |

Panel B: **6- to 10-year Holding Period**

| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 7,109 | 2,137 | 30.1 *** | (24.0,26.0) | 1 | 8,164 | 2,325 | 28.5 *** | (24.1,25.9) |
| 2 | 2,137 | 650 | 30.4 *** | (23.2,26.9) | 2 | 2,325 | 637 | 27.4 * | (23.3,26.8) |
| 3 | 650 | 206 | 31.7 ** | (21.7,28.4) | 3 | 637 | 166 | 26.1 | (21.7,28.4) |
| 4 | 206 | 67 | 32.5 * | (19.3,31.2) | 4 | 166 | 37 | 22.3 | (18.7,31.9) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 8,154 | 3,145 | 38.6 *** | (24.1,25.9) | 1 | 8,694 | 2,515 | 28.9 *** | (24.1,25.9) |
| 2 | 3,145 | 1,057 | 33.6 *** | (23.5,26.5) | 2 | 2,515 | 666 | 26.5 | (23.3,26.7) |
| 3 | 1,057 | 356 | 33.7 *** | (22.4,27.7) | 3 | 666 | 172 | 25.8 | (21.8,28.4) |
| 4 | 356 | 109 | 30.6 * | (20.6,29.6) | 4 | 172 | 45 | 26.2 | (18.8,31.8) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 15,263 | 5,282 | 34.6 *** | (24.3,25.7) | 1 | 16,858 | 4,840 | 28.7 *** | (24.3,25.7) |
| 2 | 5,282 | 1,707 | 32.3 *** | (23.8,26.2) | 2 | 4,840 | 1,303 | 26.9 * | (23.8,26.2) |
| 3 | 1,707 | 562 | 32.9 *** | (23.0,27.1) | 3 | 1,303 | 338 | 25.9 | (22.7,27.4) |
| 4 | 562 | 176 | 31.3 ** | (21.5,28.7) | 4 | 338 | 82 | 24.3 | (20.5,29.8) |

**Exhibit 4 (continued)**
**Annual Return Persistence for Various Holding Periods**

Panel C: **11-- to 15-year Holding Period**

| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 5,032 | 1,477 | 29.4 *** | (23.8,26.2) | 1 | 5,656 | 1,562 | 27.6 ** | (23.9,26.1) |
| 2 | 1,477 | 461 | 31.2 *** | (22.8,27.2) | 2 | 1,562 | 398 | 25.5 | (22.9,27.2) |
| 3 | 461 | 158 | 34.3 ** | (21.2,29.1) | 3 | 398 | 95 | 23.9 | (20.9,29.4) |
| 4 | 158 | 46 | 29.1 | (18.6,32.1) | 4 | 95 | 23 | 24.2 | (16.8,34.2) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 5,885 | 2,117 | 36.0 *** | (23.9,26.1) | 1 | 6,147 | 1738 | 28.3 *** | (23.9,26.1) |
| 2 | 2,117 | 665 | 31.4 *** | (23.2,26.9) | 2 | 1,738 | 482 | 27.7 * | (23.0,27.1) |
| 3 | 665 | 183 | 27.5 | (21.8,28.4) | 3 | 482 | 142 | 29.5 * | (21.2,29.0) |
| 4 | 183 | 50 | 27.3 | (19.0,31.5) | 4 | 142 | 44 | 31.0 | (18.2,32.5) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 10,917 | 3,594 | 32.9 *** | (24.2,25.8) | 1 | 11,803 | 3,300 | 28.0 *** | (24.2,25.8) |
| 2 | 3,594 | 1,126 | 31.3 *** | (23.6,26.4) | 2 | 3,300 | 880 | 26.7 * | (23.5,26.5) |
| 3 | 1,126 | 341 | 30.3 ** | (22.5,27.6) | 3 | 880 | 237 | 26.9 | (22.2,27.9) |
| 4 | 341 | 96 | 28.2 | (20.6,29.7) | 4 | 237 | 67 | 28.3 | (19.7,30.7) |

Panel D: 1**6- to 20-year Holding Period**

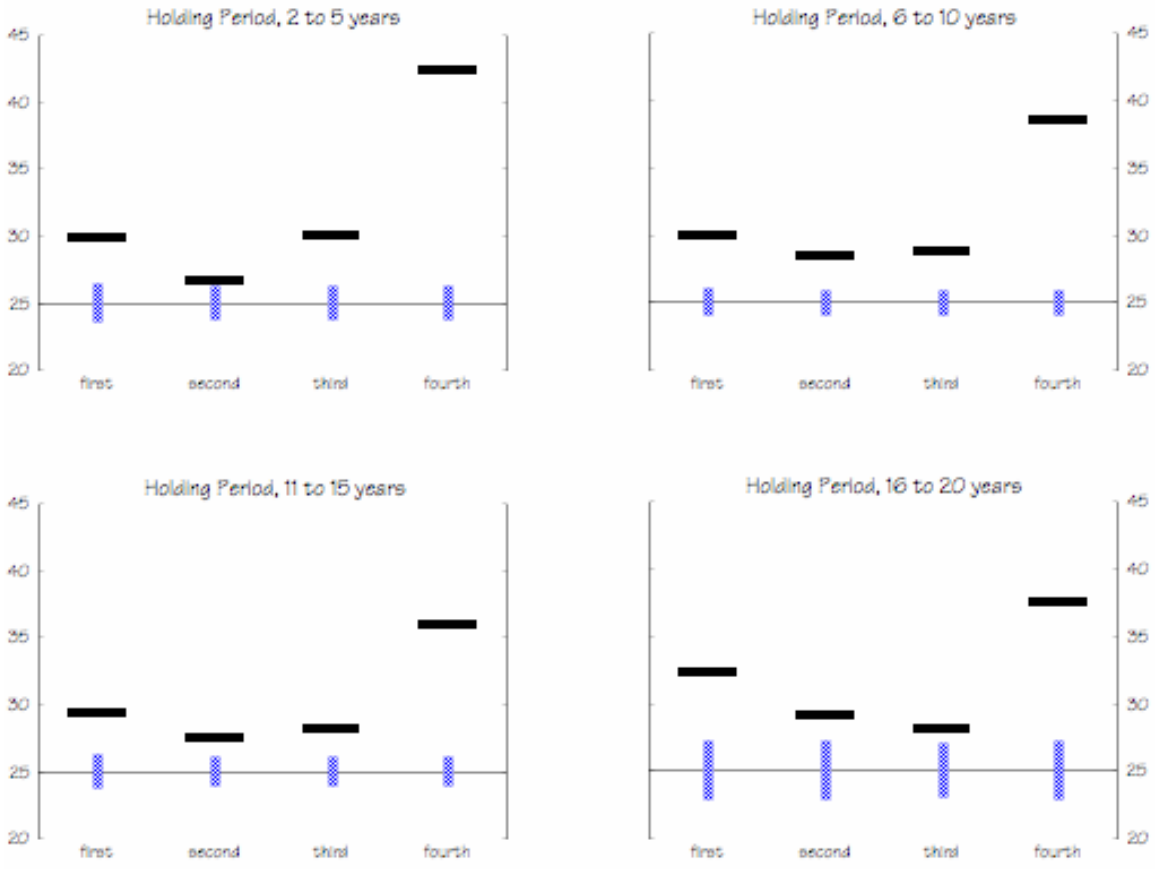
| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 1,401 | 455 | 32.5 *** | (22.8,27.3) | 1 | 1,540 | 449 | 29.2 ** | (22.9,27.2) |
| 2 | 455 | 150 | 33.0 ** | (21.1,29.1) | 2 | 449 | 126 | 28.1 | (21.1,29.1) |
| 3 | 150 | 54 | 36.0 * | (18.4,32.3) | 3 | 126 | 37 | 29.4 | (17.8,33.0) |
| 4 | 54 | 17 | 31.5 | (14.4,37.5) | 4 | 37 | 12 | 32.4 | (12.4,40.3) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 1,598 | 603 | 37.7 *** | (22.9,27.2) | 1 | 1,679 | 474 | 28.2 * | (23.0,27.1) |
| 2 | 603 | 221 | 36.7 *** | (21.6,28.5) | 2 | 474 | 122 | 25.7 | (21.2,29.0) |
| 3 | 221 | 74 | 33.5 * | (19.5,30.9) | 3 | 122 | 25 | 20.5 | (17.7,33.1) |
| 4 | 74 | 22 | 29.7 | (15.8,35.5) | 4 | 25 | 4 | 16.0 | (10.0,44.0) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 2,999 | 1,058 | 35.3 *** | (23.5,26.6) | 1 | 3,219 | 923 | 28.7 ** | (23.5,26.5) |
| 2 | 1,058 | 371 | 35.1 *** | (22.4,27.7) | 2 | 923 | 248 | 26.9 | (22.3,27.8) |
| 3 | 371 | 128 | 34.5 ** | (20.7,29.5) | 3 | 248 | 62 | 25.0 | (19.8,30.6) |
| 4 | 128 | 39 | 30.5 | (17.9,32.9) | 4 | 62 | 16 | 25.8 | (15.0,36.6) |

* Null hypothesis rejected at the 5% level of significance
* * Null hypothesis rejected at the 0.01% level of significance
* * * Null hypothesis rejected at the 0.00001% level of significance

Exhibit 5

Quartile Performance Persistence in the IPD Database

Various Holding Periods from 2 to 20 years




Note: Vertical bars represent the 95% confidence intervals while horizontal bars represent the persistence results.

**Exhibit 6**
**Annual Return Persistence in Up and Down Markets**

Panel A: **All Properties in Up Markets**
**1986 to 1989 and 1996 to 2002**

| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 20,701 | 7,108 | 34.3 *** | (24.4,25.6) | 1 | 20,911 | 5,690 | 27.2 *** | (23.9,26.1) |
| 2 | 7,108 | 1,760 | 24.8 | (24.0,26.0) | 2 | 5,690 | 1,140 | 20.0 *** | (22.9,27.2) |
| 3 | 1,760 | 462 | 26.3 | (23.0,27.1) | 3 | 1,140 | 190 | 16.7 *** | (20.9,29.4) |
| 4 | 462 | 121 | 26.2 | (21.2,29.1) | 4 | 190 | 24 | 12.6 ** | (16.8,34.2) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 19,592 | 7,168 | 36.6 *** | (24.4,25.6) | 1 | 13,238 | 3,763 | 28.4 *** | (24.3,25.7) |
| 2 | 7,168 | 1,613 | 22.5 ** | (24.0,26.0) | 2 | 3,763 | 877 | 20.9 *** | (23.6,26.4) |
| 3 | 1,613 | 337 | 20.9 ** | (22.9,27.1) | 3 | 787 | 149 | 18.9 ** | (22.0,28.1) |
| 4 | 337 | 61 | 18.1 | (20.5,29.8) | 4 | 149 | 23 | 15.4 * | (18.4,32.3) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 40,293 | 14,276 | 35.4 *** | (24.2,25.8) | 1 | 34,149 | 9,453 | 27.7 *** | (24.5,25.5) |
| 2 | 14,276 | 3,373 | 23.6 ** | (23.6,26.4) | 2 | 9,453 | 1,927 | 20.4 *** | (24.1,25.9) |
| 3 | 3,373 | 799 | 23.7 | (22.5,27.6) | 3 | 1,927 | 339 | 17.6 *** | (23.1,27.0) |
| 4 | 799 | 182 | 22.8 | (20.6,29.7) | 4 | 339 | 47 | 13.9 ** | (20.5,29.8) |

Panel B: **All Properties in Down Markets**
**1981 to 1985 and 1990 to 1995**

| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 26,170 | 9,010 | 34.4 *** | (24.5,25.5) | 1 | 26,477 | 7,929 | 29.9 *** | (24.5,25.5) |
| 2 | 9,010 | 2,827 | 31.4 *** | (24.1,25.9) | 2 | 7,929 | 2,004 | 25.3 | (24.1,26.0) |
| 3 | 2,827 | 952 | 33.7 *** | (23.4,26.6) | 3 | 2,004 | 528 | 26.3 | (23.1,26.9) |
| 4 | 952 | 320 | 33.6 *** | (22.3,27.8) | 4 | 528 | 130 | 24.6 | (21.4,28.8) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 25,669 | 9,651 | 37.6 *** | (24.5,25.5) | 1 | 26,484 | 26,484 | 28.6 *** | (24.5,25.5) |
| 2 | 9,651 | 3,080 | 31.9 *** | (24.1,25.9) | 2 | 7,566 | 7,566 | 23.0 ** | (24.0,26.0) |
| 3 | 3,080 | 964 | 31.3 *** | (23.5,26.5) | 3 | 1,738 | 1,738 | 23.3 | (23.0,27.1) |
| 4 | 964 | 263 | 27.3 | (22.3,27.8) | 4 | 405 | 95 | 23.5 | (20.9,29.3) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 51,839 | 18,661 | 36.0 *** | (24.6,25.4) | 1 | 52,961 | 15,495 | 29.3 *** | (24.6,25.4) |
| 2 | 18,661 | 5,907 | 31.7 *** | (24.4,25.6) | 2 | 15,495 | 3,742 | 24.1 * | (24.3,25.7) |
| 3 | 5,907 | 1,916 | 32.4 *** | (23.9,26.1) | 3 | 3,742 | 933 | 24.9 | (23.6,26.4) |
| 4 | 1,916 | 583 | 30.4 *** | (23.1,27.0) | 4 | 933 | 225 | 24.1 | (22.3,27.8) |

**Exhibit 6 (continued)**
**Annual Return Persistence in Up and Down Markets**

Panel C: **Office Properties in Up Markets**
**1986 to 1989 and 1996 to 2002**

| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 6,510 | 2,494 | 38.3 *** | (24.0,26.1) | 1 | 6,026 | 1,679 | 27.9 ** | (23.9,26.1) |
| 2 | 2,494 | 662 | 26.5 | (23.3,26.7) | 2 | 1,679 | 321 | 19.1*** | (22.9,27.2) |
| 3 | 662 | 175 | 26.4 | (21.8,28.4) | 3 | 321 | 52 | 16.2 ** | (20.9,29.4) |
| 4 | 175 | 44 | 25.1 | (18.9,31.7) | 4 | 52 | 6 | 11.5 * | (16.8,34.2) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 5,095 | 1,812 | 35.6 *** | (23.8,26.2) | 1 | 5,559 | 1,382 | 24.9 | (23.9,26.1) |
| 2 | 1,812 | 316 | 17.4 *** | (23.0,27.0) | 2 | 1,382 | 239 | 17.3 *** | (22.8,27.3) |
| 3 | 316 | 44 | 13.9 ** | (20.4,29.9) | 3 | 239 | 37 | 15.5 ** | (19.7,30.7) |
| 4 | 44 | 10 | 22.7 | (13.3,38.9) | 4 | 37 | 4 | 10.8 * | (12.4,40.3) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 11,605 | 4,306 | 37.1 *** | (24.2,25.8) | 1 | 11,585 | 3,061 | 26.4 ** | (24.2,25.8) |
| 2 | 4,306 | 978 | 22.7 ** | (23.7,26.3) | 2 | 3,061 | 560 | 18.3 *** | (23.5,26.6) |
| 3 | 978 | 219 | 22.4 | (22.3,27.8) | 3 | 560 | 89 | 15.9 ** | (21.5,28.7) |
| 4 | 219 | 54 | 24.7 | (19.5,31.0) | 4 | 89 | 10 | 11.2 * | (16.6,34.6) |

Panel D: **Office Properties in Down Markets**
**1981 to 1985 and 1990 to 1995**

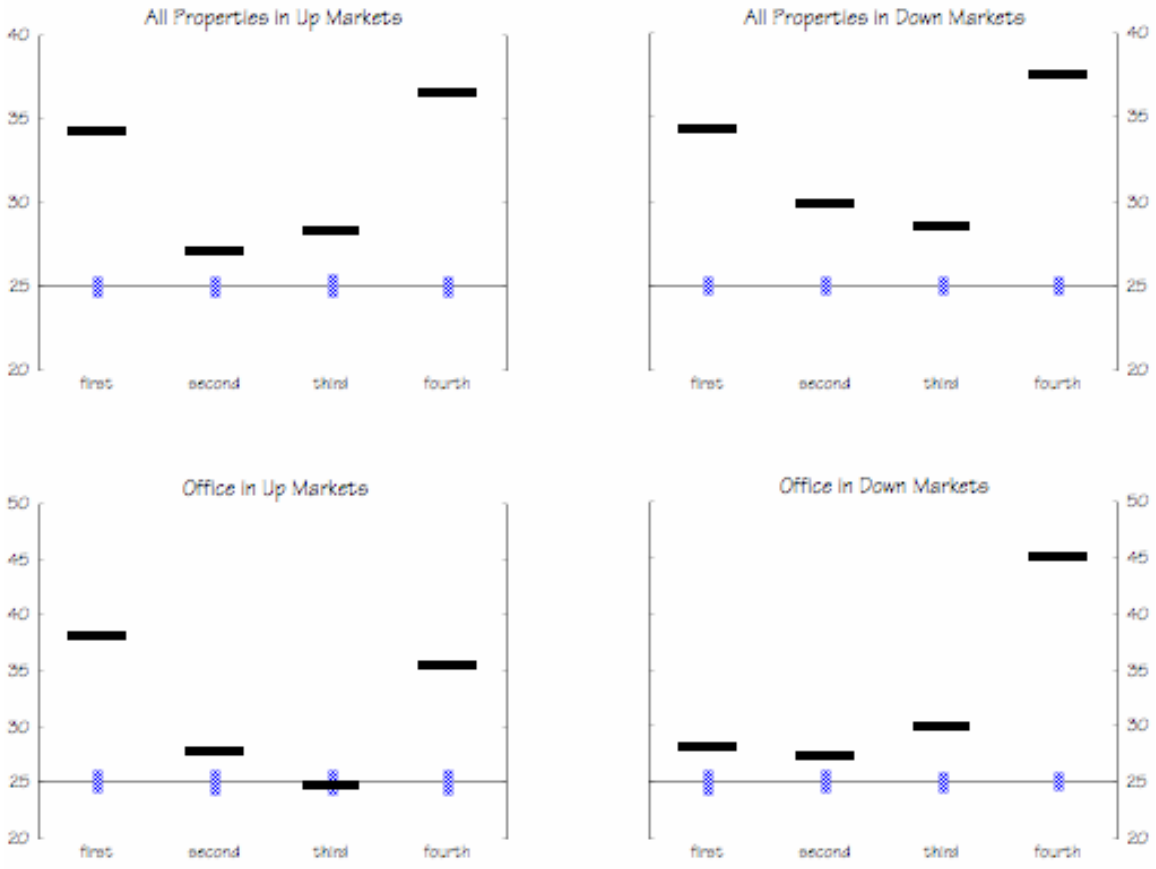
| Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval | Length of Run | No. of Samples | No. of Successes | % of Successes | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|---|
| 1st Quartile: | | | | | 2nd Quartile: | | | | |
| 1 | 6,397 | 1,813 | 28.3 *** | (23.9,26.1) | 1 | 7,172 | 1,964 | 27.4 ** | (24.0,26.0) |
| 2 | 1,813 | 465 | 25.6 | (23.0,27.0) | 2 | 1,964 | 488 | 24.8 | (23.1,26.9) |
| 3 | 465 | 141 | 30.3 * | (21.2,29.0) | 3 | 488 | 135 | 27.7 | (21.3,28.9) |
| 4 | 141 | 47 | 33.3 * | (18.2,32.5) | 4 | 135 | 30 | 22.2 | (18.1,32.7) |
| 4th Quartile: | | | | | 3rd Quartile: | | | | |
| 1 | 10,051 | 4,530 | 45.1 *** | (24.2,25.9) | 1 | 8,350 | 2,504 | 30.0 *** | (24.1,25.9) |
| 2 | 4,530 | 1,604 | 35.4 *** | (23.8,26.3) | 2 | 2,504 | 631 | 25.2 | (23.3,26.7) |
| 3 | 1,604 | 227 | 14.2 *** | (22.9,27.2) | 3 | 631 | 151 | 23.9 | (21.7,28.5) |
| 4 | 227 | 152 | 67.0 *** | (19.6,30.9) | 4 | 151 | 29 | 19.2 | (18.4,32.2) |
| 1st & 4th Combined Quartiles: | | | | | 2nd & 3rd Combined Quartiles: | | | | |
| 1 | 16,448 | 6,343 | 38.6 *** | (24.3,25.7) | 1 | 15,522 | 4,468 | 28.8 *** | (24.3,25.7) |
| 2 | 6,343 | 2,069 | 32.6 *** | (23.9,26.1) | 2 | 4,468 | 1,119 | 25.0 | (23.7,26.3) |
| 3 | 2,069 | 368 | 17.8 *** | (23.2,26.9) | 3 | 1,119 | 286 | 25.6 | (22.5,27.6) |
| 4 | 368 | 199 | 54.1 *** | (20.7,29.6) | 4 | 286 | 59 | 20.6 | (20.2,30.2) |

* Null hypothesis rejected at the 5% level of significance
* * Null hypothesis rejected at the 0.01% level of significance
* * * Null hypothesis rejected at the 0.00001% level of significance

Exhibit 7

Quartile Performance Persistence in the IPD Database

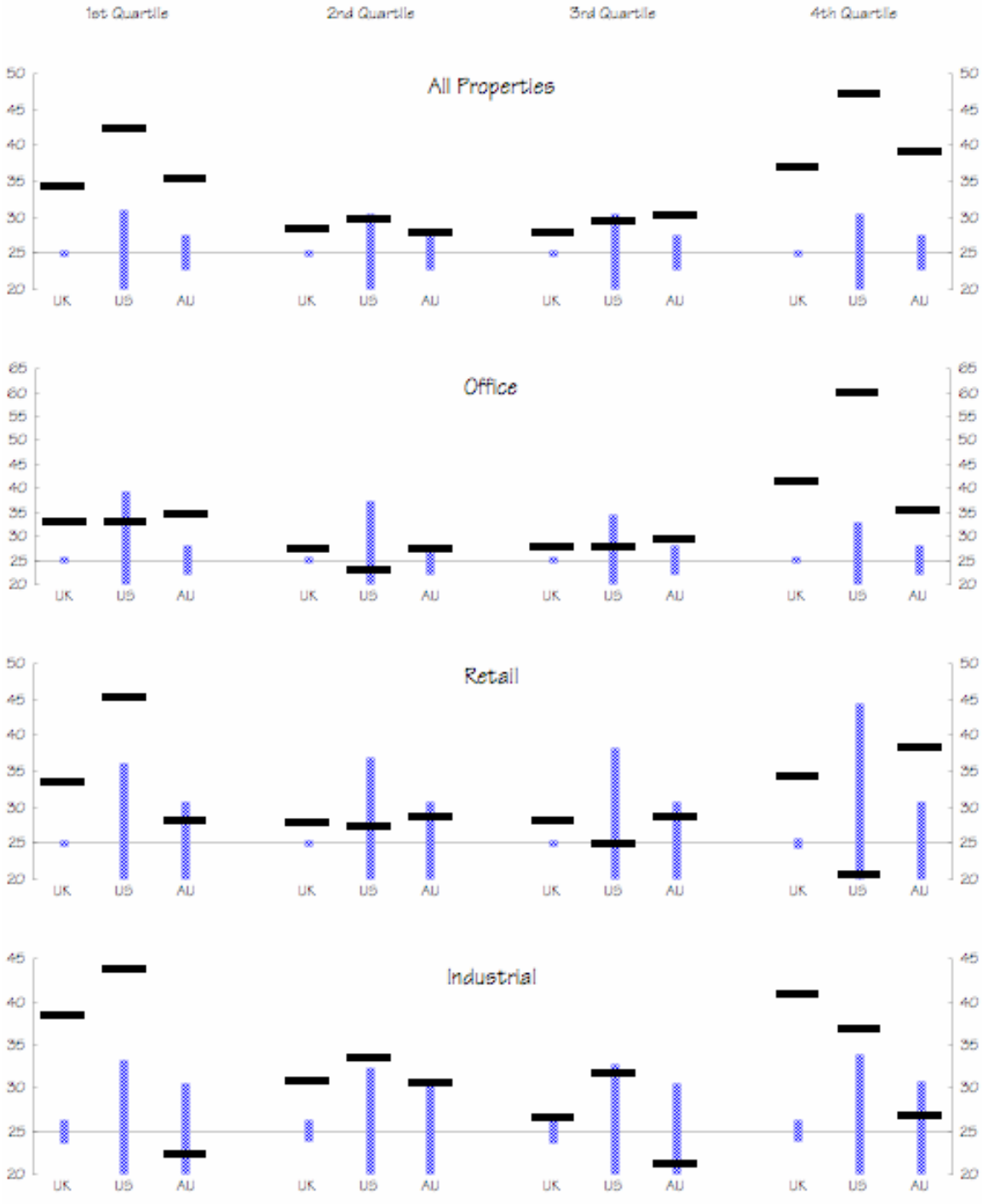
In Up (1986 to 1989 and 1996 to 2002) and Down Markets (1981 to 1985 and 1990 to 1995)




Note: Vertical bars represent the 95% confidence intervals while horizontal bars represent the persistence results.

Exhibit 8

Persistence by Quartile for All Properties, Office, Retail, and Industrial
in the United Kingdom, the United States, and Australia




Note: Vertical bars represent the 95% confidence intervals while horizontal bars represent the persistence results.

**Exhibit 9**

Panel A: **Lease Terms Equally Weighted within IPD Database by Starting Year**

| Property Type | Year | Average Term in Years | Median Term in Years | Number of Leases * |
|---|---|---|---|---|
| Office | 2002 | 6.9 | | 946 |
| | 2001 | 8.5 | | 3,786 |
| | 2000 | 8.5 | | 2,775 |
| | 1999 | 7.8 | | 1,565 |
| Retail | 2002 | 10.0 | | 2,052 |
| | 2001 | 11.1 | | 7,464 |
| | 2000 | 10.8 | | 6,604 |
| | 1999 | 12.3 | | 4,169 |
| Industrial | 2002 | 7.2 | | 714 |
| | 2001 | 8.5 | | 2,594 |
| | 2000 | 7.2 | | 1,887 |
| | 1999 | 8.6 | | 1,092 |

Panel B: **Lease Terms Equally Weighted within RREEF-Managed Portfolios by Starting Year**

| Property Type | Year | Average Term in Years | Median Term in Years | Number of Leases ** |
|---|---|---|---|---|
| Office | 2004 | 4.5 | 4.0 | 184 |
| | 2003 | 4.1 | 3.3 | 679 |
| | 2002 | 5.0 | 5.0 | 190 |
| | 2001 | 5.2 | 5.0 | 150 |
| | 2000 | 6.6 | 5.1 | 164 |
| | 2000-04 | 4.6 | 4.59 | 1,367 |
| Retail | 2004 | 4.6 | 5.0 | 84 |
| | 2003 | 5.8 | 5.0 | 224 |
| | 2002 | 5.8 | 5.0 | 83 |
| | 2001 | 6.0 | 5.1 | 41 |
| | 2000 | 6.4 | 5.0 | 56 |
| | 2000-04 | 5.7 | 5.0 | 488 |
| Industrial | 2004 | 3.0 | 3.0 | 723 |
| | 2003 | 3.0 | 3.0 | 2,201 |
| | 2002 | 3.6 | 3.0 | 723 |
| | 2001 | 4.5 | 4.4 | 449 |
| | 2000 | 5.4 | 5.0 | 395 |
| | 2000-04 | 3.4 | 3.0 | 4,491 |

* The number of leases in the IPD database are for groups of years as follows 2002-03, 1999-2001, 1996-98, and 1993-95. The median term column is intentionally left blank but included to be consistent with Panel B.

** The number of leases in the RREEF-managed portfolios reflect the leases written in the calendar years shown.