Journal of Property Research, December 2006, **23**(4) 323–345

Residential Property as an Institutional Asset: The Swiss and Dutch Cases

JOAQUIM MONTEZUMA[1] and KENNETH GIBB[2]
[1]*ImoEconometrics, Lisbon, Portugal*
[2]*Department of Urban Studies, University of Glasgow, Glasgow, UK*

Received December 2003
Revised September 2004; May 2006
Accepted October 2006

Summary

This study evaluates residential property as an institutional asset group in two European countries (Switzerland and the Netherlands). These are countries where housing is the main institutional property asset group, with institutional property portfolio allocations of over 52% and 50% respectively. Two criteria were used to evaluate residential property as an institutional asset group. First, the size of the private rented stock potentially available for institutional investors must be sufficiently large in order to provide significant diversification benefits. Second, in terms of risk and return, housing must offer good mean-variance performance. Direct residential property is compared with other asset groups: shares (domestic and European indices), government bonds and indirect non-residential property. A bootstrap analysis (Efron, 1979; Liang *et al.*, 1996; Ziobrowski *el al.*, 1997) is employed to estimate confidence intervals for the optimum level of residential property in mixed-asset portfolios. The paper concludes, on balance, that there is a case for a residential property component within portfolios in these two countries.

Keywords: Residential property, rental housing markets, portfolio performance, bootstrap analysis, institutional investing

1. Introduction

This study evaluates residential property as an institutional asset group in two European countries (Switzerland and the Netherlands). Housing is the most important institutional property asset type in those two countries, comprising over 52% and 50% of the Swiss and Dutch institutional property portfolios respectively (Wuest & Partner, 2003; Association of Institutional Property Investors in the Netherlands, 2003). In countries such as Sweden and the US, residential property plays an important but not dominant role in the domestic institutional property portfolios, representing about 21% and 25% of the institutional property holdings respectively (Brzeski *et al.*, 1993). At the other extreme are countries such as the UK, where the institutional allocation to residential property is virtually nonexistent (Jones Lang LaSalle, 2000).

Author to whom Correspondence should be addressed: Joaquim Montezuma, ImoEconometrics, Rua Lúcio de Azevedo, N.12, 11°B, 1600-148 Lisbon, Portugal. E-mail: jmontezuma@imoeconometrics.pt

Journal of Property Research
ISSN 0959–9916 print/ISSN 1466–4453 online © 2006 Taylor & Francis
http://www.tandf.co.uk/journals
DOI: 10.1080/09599910601095324

The comparative analysis of the Swiss and Dutch housing systems shows that they have a large rental sector, which appears to be related to historical government intervention in the form of subsidies and allowances to both the social and private rented sectors and restrained encouragement of owner-occupation tenure. The mixed provision within the rental sectors is, however, significantly different in those two countries. On the one hand there is the Netherlands with predominance of social renting (40% of the Dutch housing stock) and on the other hand Switzerland with a clear preponderance of private renting (60% of the Swiss housing stock) (see: Balchin, 1996; Kleinman *et al.*, 1998).

Two criteria were used to evaluate residential property as an institutional asset group. First, the size of the private rented stock potentially available for institutional investors must be sufficiently large in order to provide significant diversification benefits (Muralidhar, 2001). Second, in terms of risk and return, housing must offer good mean-variance performance (Muralidhar, 2001). Direct residential property is compared with other asset groups: shares (domestic and European indices), government bonds and indirect non-residential property. A bootstrap analysis (Efron, 1979; Liang *et al.* 1996; Ziobrowski *el al.*, 1997) is employed to estimate confidence intervals for the optimum level of residential property in the mixed-asset portfolios over the period 1986–2001.

The structure of the paper is as follows. Section 2 links the current study to the main messages of the existing literature. Section 3 is contextual, describing the private rented housing in the two case study countries. Section 4 looks at the size of rented market potentially available for institutional investment. Section 5 is concerned with methodology and data requirements required for the bootstrap simulation. Section 6 is the main results section. Section 7 summarizes and concludes.

2. Previous Studies

Over the past three decades numerous empirical studies have been devoted to understanding the risk–return characteristics of housing property and its contribution to risk diversification within a mixed-asset portfolio according to the Modern Portfolio Theory (Markowitz, 1952).

One of the earliest studies on the relative ability of housing to diversify institutional portfolio investment is that of Ibbotson and Siegel (1984). The study compares the US property returns (commercial, farm and residential) with those of shares, corporate and government bonds, short-term bills and inflation over the 1947–1982 period. Following studies such as Hartzell *et al.* (1986) and Goetzmann and Ibbotson (1990) for the US, Hoesli and Hamelink (1997) for Switzerland, and Hutchison (1994) and Ben-Shahar (2001) for Israel confirm earlier evidence that returns on direct residential property have been between those of shares and bonds, and that residential returns are lowly correlated with the returns on financial assets. Furthermore, most of the aforementioned empirical studies indicate that direct residential property offers attractive diversification opportunities for share and bond portfolios.

Empirical studies (e.g. Hartzell *et al.*, 1986; Gatzlaff, 2000) report that residential property is weakly correlated with non-residential property. Thus, housing investment should provide property diversification opportunity. That is to say that housing investment could play a potential role within portfolios of different property types. However, since other property segments can offer diversification benefits to financial assets, and since diversification across property segments involves high cost and the administrative burden of selecting and managing the investment, the former conclusion is not certain.

Liang *el al.* (1996) investigate the performance of indirect residential property in the context of optimal mixed-asset portfolios, using US housing real estate investment trusts (REITs). Their empirical study shows evidence that securitized housing allocation has potential benefits on optimal mixed-asset portfolios. This approach carries two problems. First, the percentage of US REITs that invest exclusively in housing is low; this is in spite of the US having one of the worlds' most developed REIT industry. Second, the behaviour of securitized and unsecuritized property does not always exhibit the same pattern.

One must be conscious that there is a variety of factors, other than those considered in the reviewed empirical studies, that drive the strategic asset allocation decisions of institutional investors. First, most of the empirical studies reviewed did not take into account important variables such as illiquidity and divisibility issues, high management portfolio costs, the lack of reliable market information. Of course the relative importance of those variables is not uniform across countries. For instance, the high management costs and lack of market information seems to be more important in countries where there is a historically low residential institutional ownership (e.g. the UK) than in countries where the institutional investors are more familiar with the sector (e.g. Switzerland, the Netherlands or the US).

Second, the reviewed empirical studies ignore the presence of liabilities in the decision-making process. This is not completely realistic since one of the major institutional investment policy objectives is to ensure sufficient assets to meet liabilities. In other words, the institutional investors must also tailor their asset holdings to hedge their liabilities. Accordingly, Chun *et al.* (2000), following Sharpe (1990) argue that the maximization of risk-adjusted future surplus value (equal to assets minus liabilities) can imply that pension fund allocations are different to those suggested by the simplistic mean-variance framework. Thus, the institutional allocation can be best seen in an asset–liability context, where the net wealth portfolio (present value of future liability obligations minus present value of asset holdings) is optimized, rather than in an asset-only context.

Third, the overall market for an investment opportunity must be sufficiently large in order to provide significant diversification benefits (Muralidhar, 2001). Since the size of the private rented sector in most of the developed countries represents a small percentage of total housing stock and the vast majority of privately rented houses are let by individual landlords, the proportion of the stock available for the institutional investors' allocation is usually minor. It appears that this fact may contribute in explaining the low institutional investment towards the private rented sector in several countries (e.g. the UK, Portugal and Ireland). For instance, FPD Savills (2000) estimated that the British private rented sector available in the open market is just 5% of the total housing stock. Again, one can argue that the small size of the private sector is actually a consequence of the historical lack of institutional interest in the rented housing than a cause of that disinterest.

Finally, the empirical studies reviewed do not include international shares (and international property) as an asset class, despite the fact that foreign-based equities are usually considered eligible assets by institutional investors. Some studies (e.g. Gordon *et al.*, 1998) have shown evidence that when international shares are included in the portfolio optimization, the allocation towards property becomes less important.

Mean-Variance Portfolio Theory, although it has been the mainstream and standard set of ideas in the area of investment management, has well-known limitations.

The empirical analysis of the level of residential property in a mixed-asset portfolio carried in this study took advantage of bootstrapping non-parametric methodology. This approach is especially useful when the distribution of the returns series is not normally distributed and when the sample size is small. This empirical strategy could help to resolve some of those limitations. Unfortunately, there is not one methodology able to resolve all the mean-variance framework problems.

The rest of this paper analyses institutional investment in the two European countries with relatively large institutional residential ownership. Section 3 contextualizes the study by examining the rental housing in Switzerland and the Netherlands.

3. Background to the Case Study Countries

3.1. Housing Policy and Private Rented Sector

European private rental markets tend to have experienced secular decline in size both in absolute and relative terms (Balchin, 1996). European rented markets have, in most cases, relied heavily on various forms of rent controls in the belief that such measures protect tenants and redistribute income. Despite evidence to the contrary, such regulation remains widely in place (although not in the UK).

Key questions for rental market policy concern, on the supply side, the composition and objectives of private landlords, as well as the fiscal and other forms of financial support that may be open to investors. Regulatory measures are also important through the monitoring of landlord behaviour and the achievement and enforcement of minimum standards. On the demand side, policies are concerned typically with the affordability of rental housing and the use of housing allowances, rent controls and such measures to achieve reasonable housing costs. Many countries also impose anti-discrimination regulation to enable access for minority groups seeking rented housing.

Traditionally, analysis of the rental market in different national housing systems has identified a number of tensions that undermine the coherence of rental housing policy.

First, policy often failed to distinguish between the different motivations of the main types of supply actors in rental markets. Individual landlords with small portfolios of property, relatively unresponsive to economic signals, often constitute the largest landlord interest group by size of stock. Their stock is typically older than the average. Institutional investment in private renting, on the other hand, consisting of pension funds, banks and insurance companies tend to be economically rational and focused on diversifying risk. Housing policy (not just fiscal policy) has to reconcile these wholly different interests.

Second, policies aimed at the owner-occupied sector at one extreme and at social housing on the other, may not take sufficient account of their consequent impact on private renting. This is despite the fact that rental markets play a key role as housing of the last resort or easy access housing (in relation to social housing) and as a means to assist would-be home owners set up home and save towards a downpayment. From a housing system point of view, changes in one part of the market directed at the other sectors can all too easily spill over into the rental market. Rental markets are often therefore the pressure point of the entire housing system.

Third, policies aimed at protecting tenants continue to be based around rent controls despite the extensive international evidence (e.g. Maclennan, 1982) about their negative effects, albeit that one has to examine the design of individual policies before assessing the impact of controls on non-controlled tenants, on investment and housing quality disincentives and on housing shortages.

It is in this challenging environment that one needs to consider residential investment within a mixed asset portfolio. To make things more concrete, we now look at housing policies and the market environment for private rented housing in each of the two countries studied.

3.1.1. The Netherlands. About one in ten households rent privately (Ball, 2003). The sector was the majority tenure after the war but has been in decline ever since. There have been particularly large declines in urban centres in recent years. In 1993, about 40% of the sector was made up of institutionally owned rental housing, predominantly apartments and consequently smaller properties than the Dutch average. New investment is institutionally sourced, good quality housing, and is targeted at higher income groups and the elderly. Institutions received subsidies to promote such investment but these were reduced in the 1990s (Boelhouwer *et al.*, 1996). The evidence suggests that small-scale landlords are selling up to other tenures when the opportunities arise and that growth or the re-composition of the tenure is occurring through institutional growth and a gradual quality improvement in the sector overall, albeit at a smaller scale. Examples of Dutch institutional investors who have residential property in their portfolios include Vesteda, AZL, Vermogensbeheer BV, Fortis Vastgoed, Delta Lloyd Vastgoed, Altera Vastgoed, Amvest, ING Real Estate, among others.

3.1.2. Switzerland. More than three in five Swiss households are private tenants, setting the country's housing system apart from the rest of Europe. Ball (2003) attributes this comparatively anomalous position to (political and contextual) institutional inertia. The small size of the home ownership sector also means that the housing market is less liquid so it is harder for the sector to grow and this process is cumulatively causative. Although market dominated, this does not mean that Swiss housing is unregulated. It has, in fact, operated within a host of price, quantity and quality restrictions, and with political reversals over policy to move, respectively, closer to or further away from the market over time (Lawrence, 1996). Ball (2003) reports that half of the rental stock is owned by individuals and around 30% by institutions (1996, p. 105). Examples of Swiss institutional investors who have residential property in their portfolios include Warteck Invest AG, Prevista Anlagestiftung, Swiss Life, Bassellandschaftliche, Teachers Pension Fund of Beune, CIA, Caisee de Prevoyance, Allreal Holding AG, Baloise Insurance Company, Swiss Re, Zurich Insurance Company, IntegralStiftung, BAV Pensionskasse, Pensionskasse Post, Personalvorsorgekasse, among others.

4. The Magnitude of the Private Rented Housing

Knowing the magnitude of residential assets available to institutional investors is crucial for any analysis of the role of residential property in a mixed asset portfolio. This is true, because to hold anything other than a 'market' portfolio is to expose an investor to a different set of risks than those of the market (Hartzell *at al.*, 1994). Additionally, is important because the overall private rented sector market value must be sufficiently large if it is to provide sufficient diversification benefits (Muralidhar, 2001).

Due to data availability problems, the present study adopted the straightforward Malpezzi *et al.* (2001) approach to estimate the total value of housing stock in the Netherlands. This approach assumes that total residential wealth could be estimated multiplying the total number of house units by the mean home price. A drawback with the use of this admittedly crude approach is that rental properties are likely to be smaller than for the housing stock as a whole (and specifically the owner-occupied sector). It is thus probable that the use of average house prices will overstate the size of the rental market. The value of private rented housing stock was computed multiplying the estimated total residential wealth by the proportion of the private rented sector in each country as portrayed in the Table 1. For Switzerland we used the estimated market values of rented apartments, owner-occupied apartments and detached houses by Wüest & Partner.

In Switzerland, due to its comparatively large size of the private rented sector, the total value of private rented housing stock is substantial relatively to institutional investors wealth (see Table 1). The extraordinary size of the Swiss private rented sector could in fact be one of the reasons for the important role that Swiss residential property has in the institutional portfolios.

Table 1 shows that in the two countries the value of the potential institutional private rented market satisfies the minimum requirements usually considered by institutional investors. According to Muralidhar (2001), allocations less than 5% do not provide significant diversification benefits. In spite of the fact that the two countries have a sufficient potential institutional private rented market to satisfy the earlier criteria, only Switzerland presents empirical allocations to residential property above 5%. The institutional investment in residential property tends to be concentrated in a small number of organizations as suggested by Montezuma (2006). For example, the author

Table 1. Size and value of private rented housing in the Netherlands and Switzerland (values in billions of euros 2000)

	Netherlands	Switzerland
Total number of dwellings	6 649 000	3 574 988
% of private rented sector	11	60
Total value of housing stock	1.150	914
Total value of private rented housing stock	127	389
Actual residential institutional investment	17	33
Total institutional investment	861	591
Private rented sector as per cent of total institutional investment	15%	66%
Actual residential institutional investment As per cent of total institutional Investment	2%	6%

Sources: Swiss Federal Statistical Office, CBS Statistics Netherlands, OECD.

reports that, in 2003, 30 institutional investors controlled approximately 90% of the total Dutch institutional property capital. Thus, one can expect that the number of institutions that allocate funds to residential relatively is small and are actually able to satisfy the 5% criteria.

The paper now moves to the second of the key criteria: that residential property in these countries constitutes an acceptable portfolio diversifier.

5. Methodology and Data

5.1. Methodology

An analysis of the level of residential property in a mixed-asset portfolio combined with the bootstrap approach was carried out assuming that investors care only about the mean and variance of portfolio returns.

Giving the property data limitations in terms of quality and availability, the use of bootstrap methods in a mean-variance framework could be particularly useful to analyse efficient property allocation within mixed asset portfolios instead of the traditional mean-variance optimization techniques. The bootstrap approach is free from any specific distributional assumption and incorporates uncertainty explicitly back into the allocation process, estimating both the shape and impact of uncertainty. The traditional mean-variance framework gives limited investment decision guidance since it prescribes point estimates of asset allocations without describing the weights of each asset class in statistical terms. Incorporating uncertainty into mean-variance analysis seems particularly important when the framework is used to define the optimal allocations to property in mixed asset portfolios because of the property returns measurement problems.

Bootstrap is a statistical nonparametric approach used to estimate the sampling distribution of a statistic, $\hat{\theta}$, to make inferences about a population characteristic, θ. The main difference between the bootstrap approach and the classical parametric inference is how they obtain the sampling distribution. While the traditional parametric statistical inference uses *a priori* assumptions about the shape of $\hat{\theta}$'s distribution, bootstrap estimates the entire sampling distribution of $\hat{\theta}$, applying the analogy principle between the sample and the population (Davison and Hinkley, 1997). The central idea of the bootstrap approach, introduced by Efron's (1979) pioneering paper, is that it may, in some situations, be better to make inferences about population characteristics strictly from the sample available, rather than consider implausible assumptions about the population.

Although bootstrap is potentially useful to analyse efficient property allocation within mixed asset portfolios, the statistical technique assumptions and limitations cannot be ignored. Efron's (1979) original bootstrap algorithm required resampling from data which are in the population and independent. If these assumptions do not hold, the sampling distribution of $\hat{\theta}$ will not be accurate and bootstrap will fail to give valid standard error estimates. Thus, in our empirical application it is crucial that the time series contains at least one entire economic cycle in order that the possibility of lack of congruence between population distribution function and empirical distribution function is minimized. Furthermore, bootstrap sampling imposes mutual independence on the sample values. If the data set displays serial correlation, the bootstrap technique cannot be applied directly to the data set because the statistics calculated from the resample data will be inconsistent. The Box–Ljung statistical procedure results (see Table 4) appears to suggest that our return series are not serially correlated. In fact, this result seems to confirm the commonly held belief that smoothing problems of property returns based on valuations are more important than those based on transactions.

Following the procedure described by Efron (1979), Liang *et al.* (1996) and Ziobrowski *et al.* (1997), random samples of 17 observations were taken directly (here named as pseudosamples) with replacement, from the original sample of 17 observations. Since each observation has the same probability, 1/17, of being chosen, the pseudosample could contain the same holding period several times over. The original sample was used to generate 3000 pseudosamples. For each pseudosample the optimum portfolio return, risk and portfolio composition were then computed using the Markowitz quadratic-programming algorithm. Distribution medians and several sets of confidence intervals were calculated by the percentile-t method to describe the optimum portfolio risk and optimum allocation at nine returns levels on the efficient frontier.

5.2. Data

We used annual data pertaining to shares (both domestic and European indices), government bonds, indirect non-residential property and direct residential property for the Netherlands and Switzerland for the period between 1986 and 2002. All returns are total returns, and include both capital appreciation and income return components. The total returns from investing in the private rented sector comprise two components: the rate of capital appreciation of the housing price index and the rental value of the service flow generated by the housing unit (net of operating costs). We used indirect instead of direct non-residential property because of data availability problems. In fact, the time period during which the direct non-residential property returns are available in these two countries is hopelessly short.

The share and governmental bond data were obtained from DataStream. The share indices are market capitalization-weighted and represent at least 80% of the share's market value traded in each country's exchanges. The European composite share return index is also market capitalization-weighted and comprises at least 80% of the share's market value traded in Europe.

In order to determine the returns of representative portfolios of non-residential property companies we used the indirect non-residential property indices published by GPR (Global Property Research). The GPR indices are constructed on a total return basis with immediate reinvestment of all dividends, and include office, retail, industrial, health care and diversified property companies. Furthermore, the indices track the performance of listed property companies with market capitalization in excess of 50 million US dollars for two consecutive months. Companies are included for which at least 75% of operational turnover is derived from investment activities (property investment companies) or investment and development activities combined. Pure property development companies are excluded from the GPR indices.

To estimate the total housing returns for the Swiss market we used a performance index published by the Swiss Centre D'Information et Formation Immobilieres (CIFI). The CIFI performance indices are only available for investment grade properties and they cover roughly 5900 professionally managed properties. The CIFI indices are in the process of evaluation to serve as underlying for property index derivatives. The CIFI price indices are computed by Laspeyres' Chain index method and are based on transactions. The income component is based on the average net cash flow return from the Swiss Property Benchmark. This performance index has the advantages of controlling for the heterogeneity in housing attributes and measuring the return's income component.

Unfortunately, we were not able to secure a time series of residential rental indices for the Netherlands. Instead, and following Englund *et al.* (2002) we estimated the rental component using the one-in-one-hundred rule, which stipulates that the annual rate of net rent revenues is equal to 1% of the asset value. Thus, the continuously compounded total housing returns series for the Netherlands was determined as follows:

$$r_t^H = \ln\left(\frac{P_t + D_t}{P_{t-1}}\right) = \ln\left(\frac{P_t + 0.01 \cdot P_t}{P_{t-1}}\right) = \ln(P_t \cdot 1.01) - \ln(P_{t-1}) = \ln(P_t) + 0.00995 - \ln(P_{t-1})$$

Where:
P_t is the value of the housing price index value at the beginning of the year t
P_{t-1} is value of the housing price index value at the end of the year t
D_t is the housing net rent revenue during the year t
ln is the natural logarithm function.

The price index for the Netherlands is based on the median transaction price of houses from the Dutch owner-occupied sector reported by the Dutch Association of Property Brokers (NVM). The NVM is the association representing the Dutch property brokerage industry, which actively monitors and safeguards quality levels within the sector. The association has now been in existence for more than 100 years (it was founded in 1898) and has more than 3800 members, 3000 of whom are residential real estate brokers.

The procedure adopted to estimate the Dutch total housing returns has some drawbacks. First, the housing price indices used are based on fundamentally different methods. In fact, the diverse methodologies utilized to construct the house price indices depart from different assumptions. Second, the use of the rent series estimated using the one-in-one-hundred rule could be problematic since some rented segments in the Netherlands have been regulated (Boelhouwer *et al.*, 1996). In fact, the variations in rents are likely smaller than variations in the housing prices. Therefore, the rent series estimated for the Netherlands could lead to an overestimation of 'true' rent volatility. Although there are the discussed drawbacks, the Dutch estimated total housing returns appear to be reasonable similar to the corresponding IPD indices during the 1995–2002 time period (see appendix A).

Table 2 shows that the total return volatility values estimated for the Netherlands are consistent with those estimated for Switzerland. Furthermore and as Pollakowski (1995) pointed out, the requirements for quality control are less important when the objective is to value a large portfolio of houses over time. One can add that the procedures adopted to estimate the total housing returns will not influence greatly the critical optimization inputs (i.e. volatilities and correlations) and therefore it is not crucial for the conclusions about the role of residential property in a multi-asset portfolio.

Table 2. Distributional features of return time series for Switzerland and the Netherlands

Switzerland from 1987–2002	Mean %	Std Dev. %	Skewness	Kurtosis	JB statistic	KS statistic
Direct residential property	1.64	5.52	0.3856	2.2357	0.786	0.472
Domestic share	9.62	22.88	−0.4138	1.98684	1.141	0.385
Governmental bond	5.12	4.06	0.1388	2.208	0.470	0.494
Indirect non-residential property	4.99	13.77	0.0501	3.5711	0.224	0.402
European share composite	7.71	22.96	−0.2994	1.6588	1.438	0.371
Netherlands 1986–2002						
Direct residential property	7.35	5.09	0.3107	2.4851	0.461	0.496
Domestic share	10.32	21.02	−0.6234	2.4697	1.300	0.368
Government bond	6.72	4.35	−0.3345	3.2539	0.363	0.491
Indirect non-residential property	3.95	15.46	−0.4212	3.3644	0.597	0.381
European share composite	8.65	20.55	−0.3073	1.9868	0.995	0.377

These data problems are, of course, familiar to researchers undertaking comparative property market research. Nonetheless, we do not think, on balance, that they undermine the validity of the overall approach or our tentative conclusions.

5.3. Descriptive Statistics for the Returns Times Series

Before going further with the empirical stage of this study, we must test the robustness of the key assumptions of the Modern Portfolio Theory. Namely, that returns series are normally distributed stationary. The mean-variance framework assumes (and we test) that returns are jointly normally distributed and that the distribution of returns is stationary, i.e. the rates of return are independent over time and have a constant variance.

To test for the normality of our annual continuously compounded return series, we use the Jarque–Bera (JB) test and the Kolmogorov–Smirnov (KS) test. The JB test, following a chi-squared distribution, evaluates the null hypothesis that the data have a normal distribution with unspecified mean and standard deviation, against the alternative that the distribution is not normal. The $\chi^2_{critical}$ value at the 2% level is 0.0404 (JB test at the 5% level revealed evidence about return series normality, which was inconsistent with the visual inspection of return series' histograms). The null hypothesis is rejected if the JB statistic is higher than the $\chi^2_{critical}$, otherwise one must accept the hypothesis that the returns are normally distributed.

The KS test is a goodness-of-fit (GoF) procedure particularly recommended for small samples. The KS test is based on a cumulative distribution function and evaluates the null hypothesis that the data have a normal distribution (that is, a normal distribution having mean 0 and variance 1), against the alternative hypothesis that the data do not have that distribution. For each potential value $\times$, the KS test compares the proportion of values less than $\times$ with the expected number predicted by the standard normal distribution. If the maximum distance between the assumed and empirical cumulative distributions is small, then the assumed distribution will likely be correct. Otherwise, the assumed distribution will likely be incorrect. We can reject the null hypothesis if the KS statistic is higher than the critical value (which for Swiss case, at 2% level, would be 0.366).

The historical statistics presented in Table 2 appear to indicate that the risk dimension of investment in direct residential property tends to be closer to that of government bonds and considerably lower than that of shares and indirect non-residential property. The latter statistical evidence is supported by Key *et al.* (2002). According to those authors, housing demand is driven by total household income rather than more volatile components of economy that drive shares and non-residential property (e.g. office and industrial). Additionally, housing markets are frequently characterized by rent controls and supply restrictions. Taken together, these facts result in a property investment with low vacancy rate, stable if low income, high long-term security and low volatility. One can add that the rent control could in fact promote the long-term residential property investment performance only if it consents that rents are competitive, in the long run, with those obtained in the financial market for the same level of risk. Alternatively, the residential investor could accept lower rent levels when he/she is able to take advantage of capital appreciation, buying housing stock in downswing and selling in upswing. According to Montezuma (2006) surveys the majority of Dutch and Swiss institutional investors that are able to take advantage of the housing cycle.

The estimated values for skewness suggest that the share returns, for both the domestic and European composite markets, are slightly skewed to the left. This evidence is consistent with other empirical studies (e.g. Maurer and Reiner, 2001). One possible explanation for this is that share prices fall in value faster than they increase (see: Brown and Matysiak, 2000). The empirical skewness for the other assets is uneven and moderate. The skewness results for the residential property show a rightward tail for the two countries.

The empirical kurtosis shows significant positive values for indirect property in the Netherlands and Switzerland, implying that the distribution is more peaked than normal, which implies a greater probability of obtaining market extremes, both for jumps in value and for crashes (Brown and Matysiak, 2000). The same arguments are equally valid for residential property in all markets.

Following the JB and KS statistical results, one can reject at the 2% level the possibility that the distributions of the various returns series are normally distributed for the two countries.

Following the Ljung–Box statistical results (see Table 3) one cannot reject the null hypothesis (that all p_k are zero, at least some of them must be non zero) because LB statistic is not higher than the critical value of chi-square distribution at the 5% level. Thus the Box–Ljung test indicates that, at the 95% confidence level, the times series for the two countries are not significantly serial correlated.

The limitations and uncertainty of residential property returns, the presence of non-normal distributions and the scarcity of historical time-series available make the application of the traditional Markowitz mean-variance framework problematic. In this context, the combination of mean-variance framework with the bootstrap approach seems particularly appropriate. Since the dependence problem appears not to be crucial for the time series used one can expect that the asset weight vectors generated by

Table 3. LB statistic and critical value (at a significance level 5%)

	P value	LB stat	Critical value
Switzerland			
Housing	0.2376	18.4946	24.9958
Share	0.3880	15.9107	24.9958
Bond	0.4487	15.0373	24.9958
Indirect non-housing	0.7277	11.3459	24.9958
Share composite	0.5982	13.0528	24.9958
Netherlands			
Housing	0.1038	23.3860	26.2962
Share	0.7838	11.4057	26.2962
Bond	0.7211	12.3283	26.2962
Indirect non-housing	0.9895	5.8672	26.2962
Share composite	0.9074	9.1425	26.2962

Table 4. Asset groups: descriptive statistics

Switzerland (1987–002)	Residential	Share	Bond	Non-residential	Composite
Mean (%)	1.64	9.62	5.12	4.99	7.71
Standard dev. (%)	5.51	22.88	4.07	13.77	22.96
Coefficient of variation	3.35	2.38	0.79	2.76	2.98
Correlations					
Residential	1.00				
Domestic share	0.12	1.00			
Bond	−0.51*	0.10	1.00		
Non-residential	−0.19	0.52*	0.54*	1.00	
Composite	0.10	0.85**	−0.18	0.36	1.00
Netherlands (1986–2002)	Residential	Share	Bond	Non-residential	Composite
Mean (%)	7.35	10.32	6.72	3.95	8.65
Standard dev. (%)	5.09	21.02	4.35	15.46	20.55
Coefficient of Variation	0.69	2.04	0.65	3.92	2.38
Correlations					
Residential	1.00				
Domestic share	0.47	1.00			
Bond	−0.35	−0.17	1.00		
Non-residential	0.39	0.47*	−0.33	1.00	
Composite	0.51*	0.97*	−0.27	0.53*	1.00

*Correlation is statistically different from zero at the 5% level.
**Correlation is statistically different from zero at the 1% level.

residual-based bootstrap will not be significantly different from those generated by direct bootstrap.

6. Empirical Results

The mean, standard deviation, coefficient of variation and Pearson's correlation matrices for the various assets are presented in Table 4.

The returns adjusted for risk (according to the coefficient of variation) on housing investment outperformed share (domestic and European indices) and indirect property investment and underperformed relative to Dutch government bonds. Surprisingly, the Swiss returns adjusted for risk on housing investment underperform those on all other assets.

Residential property shows a slightly negative correlation with long-term government bonds both countries. This suggests that institutional investors may obtain significant diversification benefits from investing in residential property besides investing in bonds. The residential prices exhibit a moderate positive correlation in Switzerland and the Netherlands. This would seem to indicate a relative higher degree of interdependence between residential and share markets in the latter two countries.

The residential returns are moderately correlated with those on indirect non-residential property for the Netherlands and negatively correlated for Switzerland. The Swiss result could be due to a 'true' weak correlation between housing and non-housing property as reported by Hartzell *et al.* (1986) and Goetzmann and Ibbotson (1990) among other authors. Alternatively or additionally, the Swiss empirical evidence is related to the fact that indirect and direct property do not always behave in the same manner (see Geltner and Miller, 2001). In fact, several authors have found empirical evidence that indirect property performs as a hybrid asset with characteristics of shares and direct property (see Liu *et al.*, 1997; Hoesli and MacGregor, 2002). This explanation appears to be supported by the positive correlations between the indirect property returns and those of shares for all two countries shown in Table 4.

Efficient frontiers without short sales were estimated using the traditional point estimation approach and the bootstrap simulation. Table 5 presents the point estimates of portfolio returns and risk along the efficient frontier. The table also shows the statistical properties of the simulated risk generated by the 3000 direct bootstrap simulations.

Table 5 shows that if the investors are willing to tolerate a lower degree of precision (i.e. a smaller confidence band) the bootstrap is able to provide a relative guidance to the optimum portfolio composition. For instance, at a Swiss portfolio return of 4.55%, using bootstrap, with a 50% confidence band, the risks ranges from 2.17% ($P(0.25)$) to 2.75% ($P(0.75)$).

At every level of expected return, the point estimates of risk are upwardly biased in comparison to the estimates produced by bootstrap simulations. These results hold for the two countries and are somewhat different from those reported by Liang *et al.* (1996) and Ziobrowski *et al.* (1997). Those authors found that, at lower levels of return, point estimates of risk were downwardly biased and upwardly biased elsewhere. Since risk estimates produced by our bootstrap simulations tend to be lower than those of point estimates, one can expect that bootstrap residential simulated weights will tend to be

Table 5. Point estimates and bootstrap efficient frontiers for the mixed-asset portfolios consisting of direct residential property, indirect non residential property and financial assets

Switzerland	Return (%)	Risk (%)	Bootstrap simulation estimate of portfolio risk (%)						
			Mean	STD	P(0.03)	P(0.25)	P(.50)	P(.75)	P(.97)
1	3.92	2.12	1.98	0.39	1.18	1.74	1.98	2.25	2.64
2	4.55	2.46	2.45	0.44	1.62	2.17	2.46	2.75	3.27
3	5.18	3.27	3.33	0.97	1.83	2.52	3.25	4.10	5.15
4	5.81	4.68	4.51	1.70	1.98	2.82	4.61	6.01	7.29
5	6.45	7.02	6.00	2.55	2.19	3.19	6.57	8.16	9.87
6	7.08	9.84	7.94	3.38	2.34	4.26	9.17	10.65	12.42
7	7.71	12.84	10.04	4.34	2.57	5.98	11.72	13.39	15.46
8	8.34	15.91	12.38	5.22	2.71	8.70	14.44	16.33	18.51
9	8.97	19.02	14.97	6.19	3.02	11.84	17.43	19.43	22.18
Netherlands	Return (%)	Risk (%)	Mean	STD	P(0.03)	P(0.25)	P(.50)	P(.75)	P(.97)
1	6.87	2.53	2.31	0.38	1.54	2.07	2.33	2.57	2.96
2	7.25	2.95	2.65	0.47	1.69	2.34	2.68	2.99	3.47
3	7.63	4.57	3.42	1.03	1.79	2.55	3.36	4.26	5.26
4	8.02	6.64	4.45	1.77	1.91	2.73	4.48	5.93	7.54
5	8.40	8.86	5.65	2.57	1.96	2.91	5.95	7.85	9.85
6	8.78	11.13	6.98	3.45	2.12	3.10	7.77	9.99	12.22
7	9.17	13.42	8.69	4.29	2.23	3.59	9.86	12.25	14.95
8	9.55	15.74	10.56	5.20	2.42	4.18	12.42	14.73	17.62
9	9.93	18.06	12.79	6.17	2.57	4.95	15.05	17.62	20.75

higher than those of point estimates. This is because the residential property tends to perform better at the low end of the efficient spectrum. This assertion appears to be validated from our empirical results (see Tables 6, 7 and 7).

The mean of simulated standard deviations tends to be larger than its 50th percentile, which implies that the risk estimates produced by bootstrap simulation show a higher frequency to smaller values. The difference between the mean and the 50th percentile increases as the expected return increases. Consistent with the previous studies, the higher the expected return the higher the dispersion of bootstrap risk estimates and therefore the optimum portfolio composition becomes less certain.

The point and direct bootstrap estimates of the asset weight vectors are provided in Tables 6 and 7 for Switzerland and the Netherlands respectively. In accordance with Liang *et al.* (1996) two conclusions could be drawn from Tables 6 and 7. First, the means of point estimates are close to bootstrap simulations at the low end of the efficient risk/return spectrum. While the point estimates and the bootstrap means tend to move away over higher return levels. Second, the confidence band for various asset weights is somewhat broader and again the confidence band becomes wider with the increase of return level. Ziobrowski *et al.* (1997) found empirical evidence that is possible to reduce the confidence band by including short-term government bonds. According to the latter authors, the optimum amount allocated to short-term bonds is substantial. The same

Table 6. Point and bootstrap estimate of the weight vector for Switzerland

	Point estimate	Bootstrap simulated weights (%)						
		Mean	STD	P(0.03)	P(0.25)	P(0.50)	P(0.75)	P(0.97)
Expected return (%)	3.92							
Residential property	36.91	37.76	6.87	25.72	33.33	37.28	41.59	52.17
Domestic share	0.00	0.03	0.32	0.00	0.00	0.00	0.00	0.00
Gov. bonds	59.92	59.18	6.56	47.00	55.19	59.19	63.24	71.54
Non-residential property	0.00	0.14	1.01	0.00	0.00	0.00	0.00	0.96
European share	3.16	2.89	2.09	0.00	1.15	2.88	4.40	6.84
Expected return (%)	4.55							
Residential property	20.96	25.35	8.81	10.69	19.16	24.75	30.69	43.19
Domestic share	0.00	1.50	3.19	0.00	0.00	0.00	0.66	10.96
Gov. bonds	72.94	67.41	8.91	48.24	62.86	68.03	72.76	82.53
Non-residential property	0.00	0.32	1.85	0.00	0.00	0.00	0.00	3.76
European share	6.10	5.42	4.29	0.00	1.93	4.77	8.32	14.49
Expected return (%)	5.18							
Residential property	5.01	14.71	12.43	0.00	3.83	12.32	24.16	39.27
Domestic share	0.00	3.84	6.64	0.00	0.00	0.00	5.85	21.89
Gov. bonds	85.95	73.94	12.22	42.33	68.39	76.12	82.28	90.54
Non-residential property	0.00	0.68	3.18	0.00	0.00	0.00	0.00	8.35
European share	9.04	6.83	6.78	0.00	0.94	4.71	11.06	22.27
Expected return (%)	6.45							
Residential property	0.00	6.87	11.64	0.00	0.00	0.00	13.35	33.05
Domestic share	29.49	14.16	15.96	0.00	0.00	5.51	28.94	44.11
Gov. bonds	70.51	66.05	17.26	22.44	58.04	67.32	77.91	91.60
Non-residential property	0.00	3.47	9.67	0.00	0.00	0.00	0.00	33.40
European share	0.00	9.44	13.25	0.00	0.00	2.95	14.91	42.34
Expected return (%)	7.08							
Residential property	0.00	4.96	10.01	0.00	0.00	0.00	6.49	31.70
Domestic share	43.60	21.69	21.38	0.00	0.00	17.25	44.01	55.21
Gov. bonds	56.40	56.79	20.97	9.53	45.43	53.19	76.40	90.83
Non-residential property	0.00	5.78	14.33	0.00	0.00	0.00	0.00	48.92
European share	0.00	10.79	16.79	0.00	0.00	0.79	15.64	53.11
Expected return (%)	7.71							
Residential property	0.00	3.60	8.31	0.00	0.00	0.00	1.53	27.32
Domestic share	57.70	27.93	26.95	0.00	0.00	25.58	56.82	66.36
Gov. bonds	42.30	46.62	25.32	0.00	33.21	39.57	64.91	90.30
Non-residential property	0.00	8.68	19.35	0.00	0.00	0.00	0.00	63.57
European share	0.00	13.17	21.19	0.00	0.00	0.00	18.26	65.10

Table 6. Continued

	Point estimate	Bootstrap simulated weights (%)						
		Mean	STD	P(0.03)	P(0.25)	P(0.50)	P(0.75)	P(0.97)
Expected return (%)	8.34							
Residential property	0.00	2.02	5.95	0.00	0.00	0.00	0.00	17.13
Domestic share	71.80	36.61	32.63	0.00	0.00	41.58	71.08	77.59
Gov. bonds	28.20	36.22	28.47	0.00	21.80	26.03	41.67	92.85
Non-residential property	0.00	10.44	22.08	0.00	0.00	0.00	0.00	71.19
European share	0.00	14.72	24.73	0.00	0.00	0.00	18.81	76.32
Expected return (%)	8.97							
Residential property	0.00	0.86	3.50	0.00	0.00	0.00	0.00	7.72
Domestic share	85.90	45.19	38.79	0.00	0.00	56.55	85.39	88.80
Gov. bonds	14.10	26.56	32.34	0.00	10.21	13.06	21.86	96.31
Non-residential property	0.00	10.03	22.99	0.00	0.00	0.00	0.00	82.80
European share	0.00	17.36	30.10	0.00	0.00	0.00	20.84	88.26

authors argue that the 'inability' of the bootstrap to converge on a precise portfolio composition at the high end of the efficient spectrum is above all a result of the 'true' nature of risk. One can add, however, that that is not only due to the true nature of the risk but also to the measurement risk process itself. In fact, risk measurement is less accurate at higher levels of return.

Table 6 shows that at a Swiss portfolio return of 3.92%, using bootstrap, with a 94% confidence band, the allocation to residential property ranges from 25.72% to 52.17%. At the high end of the efficient spectrum (Swiss portfolio return of 8.97%), with 94% confidence interval, the allocation to domestic share ranges from 0.0% to 88.80%.

Table 6 also shows that at the low end of the Swiss efficient curve, independently of the confidence band, there may be benefits from including residential property in an investment portfolio. At the middle of the Swiss efficient spectrum, independently of the confidence band, the governmental bonds seem to have a dominant position. At the high end of the Swiss spectrum, the bonds' position is eroded by an increasing allocation to the domestic shares.

In addition, the Swiss efficient asset allocations to indirect non-residential property and European shares appear to be more difficult to justify within a reasonable confidence interval. This result is in accordance with the US evidence reported by Gatzlaff (2000), that when direct residential property is included in the analysis, efficient allocations to non-residential property decrease.

As with Switzerland, as we move up the frontier the weight vector confidence bands become wider. In fact, it is not possible to define weight vectors within a reasonable confidence interval (90% or 95%) along most of the efficient frontier (see Table 7). The results indicate that there may be potential asset allocation to residential property over *all* risk levels of the Dutch efficient curve. However, it is not possible to define a precise residential property allocation with a reasonable degree of confidence.

Table 7. Point and bootstrap estimate of the weight vector for the Netherlands

	Point estimate	Bootstrap simulated weights (%)						
		Mean	STD	P(0.03)	P(0.25)	P(0.50)	P(0.75)	P(0.97)
Expected return (%)	6.87							
Residential property	37.25	34.10	9.82	11.27	29.27	35.53	40.20	49.60
Domestic share	0	0.18	0.75	0.00	0.00	0.00	0.00	2.47
Gov. bonds	58.08	59.56	9.10	43.65	53.88	59.03	64.13	79.85
Non-residential property	3.81	4.83	5.00	0.00	0.08	3.66	7.65	16.25
European share	0.86	1.33	1.88	0.00	0.00	0.23	2.34	5.81
Expected return (%)	7.25							
Residential property	40.19	35.00	14.98	2.49	25.58	36.12	45.41	61.07
Domestic share	7.66	4.00	4.68	0.00	0.00	1.56	7.93	13.24
Gov. bonds	52.15	56.61	13.68	32.02	47.00	55.66	65.51	84.10
Non-residential property	0	3.05	4.61	0.00	0.00	0.17	4.93	14.66
European share	0	1.34	3.12	0.00	0.00	0.00	1.02	11.45
Expected return (%)	7.63							
Residential property	35.79	33.46	22.47	0.00	14.97	33.61	50.10	76.44
Domestic share	19.09	9.41	9.31	0.00	0.00	6.88	18.54	25.10
Gov. bonds	45.12	53.77	20.07	15.38	38.99	55.57	70.32	85.07
Non-residential property	0	2.54	5.24	0.00	0.00	0.00	2.96	17.61
European share	0	0.83	3.19	0.00	0.00	0.00	0.00	7.00
Expected return (%)	8.02							
Residential property	31.39	34.42	27.96	0.00	6.00	32.59	56.85	85.52
Domestic share	30.53	14.89	14.04	0.00	0.00	12.76	29.48	36.47
Gov. bonds	38.09	47.60	24.86	0.00	27.61	53.02	67.54	84.56
Non-residential property	0	2.58	6.95	0.00	0.00	0.00	1.22	25.29
European share	0	0.51	2.71	0.00	0.00	0.00	0.00	4.46
Expected return (%)	8.78							
Residential property	22.58	29.29	28.81	0.00	0.00	22.22	55.79	81.60
Domestic share	53.39	28.81	23.96	0.00	0.00	36.89	52.35	58.46
Gov. bonds	24.03	38.48	27.35	0.00	11.06	42.70	56.19	86.11
Non-residential property	0	2.91	10.66	0.00	0.00	0.00	0.00	42.76
European share	0	0.51	3.57	0.00	0.00	0.00	0.00	3.42
Expected return (%)	9.17							
Residential property	18.17	26.71	27.69	0.00	0.00	18.30	45.50	81.11
Domestic share	64.83	37.31	28.91	0.00	0.00	52.30	63.54	69.07
Gov. bonds	17	31.85	28.19	0.00	0.00	31.66	43.25	89.25
Non-residential property	0	3.27	12.42	0.00	0.00	0.00	0.00	51.48
European share	0	0.85	6.06	0.00	0.00	0.00	0.00	2.14

Table 7. Continued

	Point estimate	Bootstrap simulated weights (%)						
		Mean	STD	P(0.03)	P(0.25)	P(0.50)	P(0.75)	P(0.97)
Expected return (%)	9.55							
Residential property	13.77	22.01	27.11	0.00	0.00	11.91	31.21	86.21
Domestic share	76.26	46.82	34.32	0.00	0.00	68.63	75.94	79.47
Gov. bonds	9.97	26.65	29.28	0.00	0.00	21.21	28.52	92.75
Non-residential property	0	3.57	14.38	0.00	0.00	0.00	0.00	61.10
European share	0	0.96	7.36	0.00	0.00	0.00	0.00	0.00
Expected return (%)	9.93							
Residential property	9.37	15.55	26.51	0.00	0.00	4.14	15.39	92.86
Domestic share	87.69	57.60	39.48	0.00	0.90	84.56	88.03	89.77
Gov. bonds	2.94	21.77	32.41	0.00	0.00	10.62	14.26	96.02
Non-residential property	0	3.22	14.10	0.00	0.00	0.00	0.00	40.25
European share	0	1.87	11.68	0.00	0.00	0.00	0.00	1.75

The Dutch weight in residential property is higher, compared with the Swiss efficient frontier described earlier. This is mostly likely a consequence of the relatively weak risk/return performance of residential property in Switzerland.

The results also indicate that most of the Dutch efficient allocations contain a small proportion of wealth in indirect non-residential property. The non-residential allocations tend to be somewhat higher comparative to the European share index. The Dutch efficient asset allocation to European shares ranges from very small to nonexistent. This is likely to be a consequence of the high correlation between the Dutch and the European share markets.

The empirical institutional allocation to residential property in the Netherlands is about 2% (see Table 1). This value is lower than those we could expect from our bootstrap results at the middle of the efficient spectrum. The concentration of residential institutional investment in a relatively small number of organizations (Montezuma, 2006) could explain the apparent discrepancy between the empirical and bootstrap allocations. Those institutions are actually able to have allocations to housing equity large enough to provide significant diversification benefits.

In spite of using different index house prices and different procedures to estimate the total housing returns, the empirical results obtained for the two countries are coherent with each other. The two cases show that, at the low end of the efficient curve, there may be benefits from including residential property in an investment portfolio and residential allocation values in the region of 37%.

One should not forget that this study could suffer from the excluded assets problem. In fact, the portfolio under analyses does not include direct non-residential property, short-term government bonds and non-domestic investments other than euro-shares. The exclusion of direct non-residential property could be especially relevant for the institutional optimal portfolio composition because of the alleged high covariability of residential and non-residential property. However, several authors (e.g. Goetzmann and Ibbotson, 1990; Eichholtz and Koedij, 1996) report that residential property tends to exhibit relatively low correlations with other property types, which suggests that residential property offers risk diversification benefits even when held in a multi-asset portfolio that already includes direct non-residential property. Similarly, the empirical survey on institutional investors in Switzerland and the Netherlands (Montezuma, 2006) reports that residential property is perceived as being able to provide diversification benefits even when institutional portfolios already include non-residential property. The same survey reports that Swiss and Dutch institutional investors are looking mainly for capital appreciation returns in residential property, whereas in non-residential property they are looking for income return.

There are also theoretical arguments supporting the idea that residential property returns are low correlated with those of non-residential property. For instance, Key *et al.* (2002) argue that housing demand is driven by total household income rather than more volatile components of economy that drive non-residential property. Additionally, housing demand (owner-occupied and indirectly rented sector) depends on availability, cost and flexibility of mortgage financing as on demographic factors, which are less important in explaining non-housing property demand. Because of those arguments, one could expect relatively low correlations between residential and non-residential property returns.

Finally, the fact that housing represents an important share of the institutional property portfolios (52% in Swiss portfolios and 50% in Dutch portfolios) supports the idea that housing equity is able to provide diversification benefits even when institutional portfolios already include non-residential property. These high institutional residential property holdings are themselves a confirmation of the housing equity diversification benefits.

7. Summary and Conclusions

The purpose of this study was to evaluate direct residential property as an institutional asset group in two European countries (Switzerland and the Netherlands). For that purpose, two criteria were analysed: the magnitude of residential rental assets available relative to institutional investors' wealth and; the performance of housing as source of diversification in institutional investor' portfolios.

Regarding the first criteria, the study had shown that the value of the potential private rental market in the two countries satisfies the minimum requirements usually considered by the institutional investors (i.e. the allocations must be higher than 5% in order to provide significant diversification benefits).

Concerning the second criteria, the returns adjusted for risk (according to the coefficient value) on housing investment outperformed share (domestic and European indices) and indirect property investment and underperformed relative to government bonds for the Netherlands. Surprisingly, the Swiss returns adjusted for risk on housing investment underperform those on all other assets.

Despite the large confidence intervals produced by the bootstrap simulation and consequently wide range of asset allocations in a 95% confidence band, one cannot reject the hypothesis that direct residential property has an important role in the optimal allocation of institutional investors with low risk tolerance. Actually, the actual institutional allocation to property in Switzerland is consistent with our bootstrap estimates at the middle of the efficient spectrum. On the other hand, the actual institutional allocation to property in the Netherlands is lower than what is expected from bootstrap estimates. The concentration of residential institutional investment in a small number of organizations could explain the apparent discrepancy between the empirical and bootstrap allocations in the Netherlands.

The bootstrap results indicate that it is not possible to restrain within tight limits the optimal weight that institutional investors should be allocated to residential property. Furthermore, the results also suggest that institutional investors should be more active in direct residential property portfolio allocations than in indirect non-residential property.

However, these results have certain caveats. First, our model of residential property total returns for the Netherlands is comprised of appreciation and rental components about which we were forced to make assumptions. Namely, that the prices in the rented and on owner-occupied markets behave in a similar way. Additionally, we have assumed that the one-in-one-hundred rule is a valid approach to estimate the rental component in the Netherlands. Second, our MPT analysis did not take into account the illiquidity, high transaction costs and costly information that characterize the direct property market. Finally, some potential institutional assets were excluded from the present analysis.

Even though Modern Portfolio Theory (MPT) is both an elegant and powerful theory for developing insight into strategic institutional investment allocation, it is unable to fully explain the Swiss and Dutch institutional residential ownership puzzle. The empirical literature neither gives a definitive explanation as to why the typical institutional allocation to property is consistently lower than that implied by the MPT theory results, nor does it provide any explicit reasons for the large differences in residential asset allocation across countries. Much remains to be explained by institutional behavioural biases, the institutional investment and housing systems and associated, legal, regulatory and fiscal structures.

Acknowledgements

We thank Professor Bryan MacGregor, Sotiris Tsolacos and various participants at the ERES 2003 and AREUEA International 2003's meetings for their helpful comments and suggestions. We are grateful to Centre d'Information et Formation Immobilieres (CIFI), Dutch Association of Real Estate Brokers (NVM), Statistiska Centralbyran (SCB) for providing residential price data and Global Property Research (GPR) for providing non-residential price data. All remaining errors and omissions are the sole responsibility of the authors.

References

Association of Institutional Property Investors in the Netherlands (2003) available at http://www.ivbn.nl/webgen.aspx?WebsiteID=2&PageID=0&FramesetID=7

Balchin, P. (Ed.) (1996) *Housing Policy in Europe*, Routledge, London.

Ball, M. (2003) *RICS European Housing Review 2003*, RICS, London.

Ben-Shahar, D. (2001) A performance comparison between dwellings and financial assets in Israel, Working Paper, The Arison School of Business, The Interdisciplinary Center Herzliya.

Boelhouwer, P., Van der Heijden, H. and Priemus, H. (1996) The Netherlands, in *Housing Policy in Europe* (edited by P. Balchin), Routledge, London.

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

Brzeski, W.J., Austin, J.J. and Lundstrom, S. (1993) Institutional real estate investment practices: Swedish and United States experiences, *The Journal of Real Estate Research*, **8**(3), 293–323.

Chun, G., Ciochetti, B. and Shilling, J. (2000) Pension-plan real estate investment in an asset-liability framework, *Real Estate Economics*, **28**(3), 467–491.

Davison, A.C. and Hinkley, D.V. (1997) *Bootstrap Methods and their Applications,* Cambridge University Press, Cambridge.

Efron, B. (1979) Bootsrap methods: another look at the jackknife, *The Annals of Statistics*, **7**, 1–26.

Eichholtz, P. and Koedij, K. (1996) International real estate securities indexes, *Real Estate Finance*, **12**(4), 42–50.

Englund, P., Min, H. and Quigley, J. (2002) Hedging housing risk, *Journal of Real Estate Finance and Economics*, **24**(1), 167–200.

FPD Savills (2000) *UK Residential Investment Report, Residential Research*, FPD Savills, London.

Gatzlaff, D.H. (2000) The effect of single-family housing on multi-asset portfolio allocations, Working Paper, Florida State University, Tallahassee, FL.

Geltner, D. and Miller, N. (2001) *Commercial Real Estate Analysis and Investments*, South-Western Publishing, Cincinnati, OH.

Goetzmann, W.N. and Ibbotson, R. (1990) The performance of real estate as an asset class, *Journal of Applied Corporate Finance*, **3**(1), 65–76.

Gordon, J., Canter, T. and Webb, J. (1998) The effect of international real estate securities on portfolio diversification, *Journal of Real Estate Portfolio Management*, **4**(2), 83–92.

Hartzell, D., Pittman, R. and Downs, D. (1994) An updated look at thes of the US real estate market portfolio, *Journal of Real Estate Research*, **9**(2), 197–212.

Hartzell, J., Hekman, J. and Miles, M. (1986) Diversification categories in investment real estate, *Journal of American Real Estate and Urban Economics Association*, **14**(2), 230–254.

Hoesli, M. and MacGregor, B. (2000) *Property Investment – Principles and Practices of Portfolio Management*, Longman – Pearson Education Limited, Harlow.

Hoesli, M. and MacGregor, B. (2002) The role of property in mixed asset portfolios, *The RICS Foundation Research Review Series*, London.

Hoesli, M. and Hamelink, F. (1997) An examination of the role of Geneva and Zurich housing in Swiss institutional portfolios, *Journal of Property Valuation & Investment*, **15**(4), 354–371.

Hutchison, N. (1994) Housing as and investment? A comparison of returns from housing with other types of investment, *Journal of Property Finance*, **5**(2), 47–61.

Ibbotson, R. and Siegel, L. (1984) Real estate returns: a comparison with other investments, *Journal of American Real Estate and Urban Economics Association*, **12**(3), 219–242.

Jones Lang LaSalle (2000) *Institutional Investment in the US Residential Sector, Lessons for the UK?* Jones Lang LaSalle – Residential Research, London.

Key, T., Allen, C., Powell, S. and Roberts, C. (2002) Towards a European property market, Paper presented at IPD European Property Strategies Conference, London.

Kleinman, M., Matznetter, W. and Stephens, M. (Eds) (1998) *European Integration and Housing Policy*, Routledge/RICS Issues in Real Estate and Housing Series, London.

Lawrence, R. (1996) Switzerland, in *Housing Policy in Europe* (edited by P. Balchin), Routledge, London.

Liang, Y., Myer, N. and Webb, J. (1996) The bootstrap efficiency frontier for mixed-asset portfolios, *Journal of Real Estate Economics*, **24**(2), 247–256.

Liu, C., Hartzell, J. and Hoesli, M. (1997) International evidence on real estate securities as an inflation hedge, *Real Estate Economics*, **25**(2), 193–221.

MacGregor, B. and Nanthakumaran, N. (1992) The Allocation to Property in Multi-asset Portfolio: the Evidence and the theory reconsidered, *Journal of Property Research*, **9**(1), 5–32.

Maclennan, D. (1982) *Housing Economics*, Longman, Harlow.

Malpezzi, S., Shilling, J. and Yang, Y. (2001) The stock of private real estate capital in US metropolitan areas, *Journal of Real Estate Research*, **22**(3), 243–270.

Markowitz, H. (1952) Portfolio selection, *Journal of Finance*, **7**(1), 77–91.

Maurer, R. and Reiner, F. (2001) International asset allocation with real estate securities in a shortfall-risk framework: the viewpoint of German and US investor, University of Frankfurt, *Working Paper Finance & Accounting*, **82**, Germany.

Montezuma, J. (2006) A survey of institutional investors' attitudes and perceptions of residential property: the Swiss, Dutch and Swedish cases, *Housing Studies*, **21**(6), 883–908.

Muralidhar, A. (2001) *Innovations in Pension Fund Management*, Stanford University Press, Stanford, CA.

Pollakowski, H. (1995) Data sources for measuring house price changes, *Journal of Housing Research*, **6**(3), 377–388.

Sharpe, W. (1990) Asset allocation, in *Management Investing Portfolios – A Dynamic Process* (edited by J. Magin and D. Tuttle), William F. Sharpe, New York.

Wuest & Partner (2003) *Immo-Monitoring 2003*, Wuest & Partner, Zurich.

Ziobrowski, A., Cheng, P. and Ziobrowsk, J. (1997) Using a bootstrap to measure optimum mixed-asset portfolio composition: a comment, *Real Estate Economics*, **25**(4), 697–705.

Appendix A

Table A1 shows the descriptive statistics for IPD and our estimated residential returns over the 1995–2002 period for the Netherlands.

The table indicates that IPD residential total return absolute values are somewhat higher than those estimated in this study. The coefficient factor of estimated returns is, however, somewhat smaller to the one computed by IPD during the period of time considered, indicating a larger volatility for the total returns estimated in this study. The latter could be related with the fact that one-in-one rule used to calculate the residential

Table A1. Estimated total returns versus IPD total returns in the Netherlands, 1995–2002

	IPD residential	Estimated residential			
Mean (%)	13.78	10.34			
Standard deviation	3.12	5.13			
Coefficient of variation	0.23	0.50			
Correlations					
	IPD residential	Share	Bond	Non-residential	Composite
IPD residential		0.52	−0.58	0.11	0.52
Estimated residential	0.74*	0.53	−0.71*	0.45	0.61

Values marked with * are statistically significant at the 5% level.

income component actually overestimate the ‘true’ volatility of residential property’s income component in the Netherlands. Thus, one can expect that utilization of the IPD index for the Netherlands would not necessarily decrease the share of housing equity in a multi-asset portfolio. Furthermore, the correlations between IPD residential returns and the other assets’ returns are rather close to those obtained using our residential estimated returns. This suggests that for our empirical study, where correlation inputs are critical, the utilization of such estimated housing returns appear not to have an important effect in the optimization results.