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Measuring European real estate investment performance: A comparison of different approaches

Dr Steven Devaney
Real Estate and Planning, Henley Business School,
University of Reading, Whiteknights, Reading, RG6 6UD, United Kingdom
E-mail: s.devaney@reading.ac.uk
Web: www.henley.ac.uk/REP/Aboutus/Staff/s-p-devaney.aspx

Abstract

The performance of real estate investment markets is difficult to monitor because the constituent assets are heterogeneous, are traded infrequently and do not trade through a central exchange in which prices can be observed. To address this, appraisal based indices have been developed that use the records of owners for whom buildings are regularly re-valued. These indices provide a practical solution to the measurement problem, but have been criticised for understating volatility and not capturing market turning points in a timely manner. This paper evaluates alternative 'Transaction Linked Indices' that are estimated using an extension of the hedonic method for index construction and with Investment Property Databank data. The two types of indices are compared over Q4 2001 to Q4 2012 in order to examine whether movements in these indices are consistent. The Transaction Linked Indices show stronger growth and sharper declines than their appraisal based counterparts over the course of the cycle in different European markets and they are typically two to four times more volatile. However, they have some limitations; for instance, only country level indicators can be published in many cases owing to low trading volumes in the period studied.

Keywords

Transaction indices; Assessed value method; Appraisal indices; Appraisal smoothing; Real estate volatility; European real estate investment

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1. Introduction

Indices of investment performance and prices are a fundamental part of the information landscape for major investment asset classes. They assist investors in both the monitoring of performance and the formulation of investment strategies through modelling and forecasting. Such indices are also of interest to economists and policy makers, particularly in the context of monitoring financial systems and the risks being taken by participants within those systems. This includes the risks being borne by certain types of investors, such as insurance companies, and the risks faced by lenders from changes in asset prices. In Europe, given the importance of commercial real estate both as loan collateral and as an alternative asset class for institutional investors, it is unsurprising that demand for indices of real estate prices and performance has risen.

However, index construction for commercial real estate is complicated by the heterogeneity of the assets concerned and the infrequent and irregular trading of these assets. Furthermore, the lack of a central, public exchange for real estate assets presents difficulties for obtaining the data needed to produce robust performance measures. For these reasons, appraisal based indices predominate in the measurement of commercial real estate performance. These are possible owing to the obligation in many countries for certain types of investors to regularly reappraise their real estate assets. These appraisals are based on definitions whereby the figures that are estimated represent the prices that each asset is expected to sell for at that time. In principle, they can be used as proxies for price in the absence of regular, repeated trading, but the frequency of such appraisals may not be high. In fact, for many European countries, the available appraisal based indices are only annual in frequency and have short time series.

Meanwhile, an extensive theoretical literature has arisen that highlights problems with appraisal based series. Some of the issues relate to micro-level appraisal processes while others concern the aggregation of appraisals into a market level index. Micro-level issues revolve around the availability of timely transaction evidence and the selection and weighting of such evidence within the appraisal process. Clayton *et al*. (2001) consider rational and behavioural explanations for the incorporation of both current and past price information into appraisals. A partial reliance on past information when conducting individual appraisals may be justifiable in the context of infrequent and noisy transaction price signals. However, any systematic tendency in appraisals to rely on past evidence is problematic for index construction as the smoothing effects cannot be removed when appraisals are aggregated.

This suggests that appraisal based indices will provide a smoothed and lagged representation of price movements in real estate markets. This then poses problems for analyses based on such series. If volatility is understated and turning points are not captured, this affects risk-return comparisons and relationships with other economic and financial variables. In particular, realistic measurement of real estate risk is of concern given current regulatory initiatives such as Solvency II that seek to limit the exposure of financial institutions to asset price changes. At an international level, the picture is further complicated by inconsistencies in practice across different appraisal regimes. Despite efforts to harmonise definitions through creation of international valuation standards, both interpretation of standards and appraisal methods still differ considerably between markets (Crosby *et al*., 2011).

Therefore, alternative approaches to tracking real estate performance might seem desirable. One option may be to monitor the share prices of listed real estate companies. Such prices are frequently and easily observed, they are set by trading activity, and procedures exist to adjust returns for the effects of corporate borrowing. However, an investment in listed real estate differs in character from direct ownership of properties as the trading environments are dissimilar, different types of investor participate and the companies concerned may engage in a wider range of activities than real estate investment.[1] Nor does country of listing necessarily correspond with the geographical scope of investment. However, there is evidence that listed real estate returns are linked to those of the underlying real estate market in the long run (see Hoesli & Oikarinen, 2012).

Another option is to create transaction based series using econometric procedures to control for variations in the quality and timing of commercial real estate transactions. Yet obtaining data at an adequate level of detail for some methods is problematic and, without sufficient observations, the resulting indices may exhibit excessive noise. Another concern is whether properties that are traded are representative of their market in terms of their characteristics and price trends, either generally or during specific phases of the real estate cycle. Nonetheless, there are many efforts to estimate transaction based indices in the academic literature and, more recently, systematic efforts by several commercial data providers to produce such series for the US and other real estate markets.

This paper reviews the ‘Transaction Linked Indices’ published for several important European real estate markets by Investment Property Databank (IPD). Its objective is to discuss how these indices are produced and whether they provide different insights as to the returns and risks of commercial real estate investments during the recent major real estate cycle in many countries. In the next section, the method used to construct these transaction based series is explained. The third section discusses the data behind these series and the appraisal based indices for the countries studied. The fourth section compares the capital returns reported by the two types of indices over Q1 2002 to Q4 2012. A final section then offers concluding reflections.

2. Discussion of methods

The methods used to construct appraisal based indices have become fairly well established. In order to control for differences in quality over a particular measurement period, they analyse the change in value of a held (non-traded) sample of properties for which appraisal inputs are recorded at both the start and end of the period concerned. In principle, these inputs should represent fresh external appraisals of asset value relevant to the times in question.[2] At the end of the period, the change in value can then be chain-linked with measurements for earlier and later periods to create a longer

[1] The extent to which this is so depends on the regulations that govern the listed sector in each country. Some countries in Europe have adopted the REIT model whereby real estate companies can apply for tax transparent REIT status in return for restrictions on their activities, borrowing and retention of income.

[2] However, in some instances, index providers roll forward appraisals from earlier periods or interpolate values between two externally provided appraisals. The former case is known as the stale appraisal problem and has been a characteristic feature of indices produced by the National Council of Real Estate Investment Fiduciaries (NCREIF) in the United States (see Geltner & Goetzmann, 2000).

series. The formula used by IPD (IPD, 2012) to calculate a single period capital return (analogous to price change) is as follows:

$$CR_t = \left(\frac{CV_t - CV_{t-1} - CX_t + CI_t}{CV_{t-1} + CX_t} \right) \times 100 \qquad (1)$$

Where CR_t is the capital return over the period concerned;
CV is the capital value at the end of a period;
CX_t relates to capital expenditure over the period; and
CI_t relates to capital receipts received over the period.

This formula is applied to sets of assets by summing values, receipts and expenditures for all the assets concerned prior to its computation. Information on income and minor expenditures is usually collected, too, so that income and total return measures can be produced. The focus here on capital return is driven by the fact that the Transaction Linked Indices considered later only measure capital returns.

The methods used to create transaction based series are more complex. As the sample of traded assets changes from period to period, it is necessary to control for differences in the nature of those samples over time. Otherwise, measured changes in price could simply reflect fluctuations in quality. Hedonic regression techniques explicitly model the effects of different attributes on product prices and thus allow them to be controlled for during index construction. A hedonic regression typically takes the following form:

$$\ln P = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \ldots + \beta_n X_n + \varepsilon \qquad (2)$$

Where P is the sale price of a product
X_n represent *n* characteristics of that product
β_n are coefficients that capture the price impact of each characteristic
ε equals a random error term

Equation (2) can be applied period by period or to pooled transaction data if time dummies are added. An index can then be derived by using the coefficients to project the price of a representative asset or to predict the price of a set of unsold properties. However, there are issues with the hedonic approach that include difficulties in identifying all relevant influences on price and choosing the right functional form (Shiller, 1993). In addition, there is the practical problem of gaining sufficient and adequate data on asset attributes from available data sources. Yet if important factors are excluded from equation (2), this can lead to bias in the coefficients and the indices that are produced unless the omitted factors are orthogonal to the variables that are included.

An alternative approach is the repeat sales method. In its simplest form, this works by identifying assets that transacted more than once over a specified time frame. The change in price between the two sales is then regressed on dummy variables that indicate the periods when each sale occurred. By using a subsequent price for the same asset when measuring price changes, quality differences are controlled for and without the need for extensive data on asset attributes. However, as noted by Dombrow *et al*. (1997), this assumes that individual assets do not change over time and that there is stability in the pricing of characteristics through time.[3] It also assumes that price movements of repeatedly traded properties will be representative of those that do not sell or which only sold once in the period of interest.

Another approach proposed by Clapp (1990) underlies the Transaction Linked Indices discussed in this paper. Clapp sought to analyse land prices, but the dataset for his study area lacked information on the attributes of the land being traded. However, appraisal based values for the land parcels were available, these being estimated periodically for tax assessment purposes. Clapp argued that these could be substituted for the attribute variables required by equation (2), since just as differences in characteristics reflect quality variations between assets, differences in appraisals at a specific time also reflect such variations. This is because appraisers take into account the physical and location attributes of each property when forming judgements about value. Therefore, if appraisals (denoted *A*) are available to substitute in place of characteristics, the regression to be estimated becomes:

$$\ln P = \beta_0 + \beta_1 \ln A + \varepsilon \qquad (3)$$

As with a hedonic model, time dummies can be added or (3) can be estimated period-by-period if repeated sets of reference appraisals are available. This approach does not have the extensive data requirements of the hedonic model and so is more easily applied provided that appraisal inputs are available for the market of interest. Furthermore, appraisals may capture aspects of quality that are difficult to observe or measure within a hedonic framework (Fisher *et al.*, 2003; Gatzlaff & Holmes, 2013). Differences between assets will not be quantified perfectly, though, and so the relationship between appraisals and true market values at the point of measurement could be represented in the following way:

$$\ln A = \gamma_0 + \gamma_1 \ln V + \mu \qquad (4)$$

Where A equals the assessed value

V is the true market value

γ_0, γ_1 capture potential systematic errors in assessment

μ is a random disturbance term that captures random error in assessment

The implication of this is that the substitution of appraisals for attribute variables is not as simple as suggested by equation (3). The observed appraisal is only a proxy for the true (but unobserved) value of the bundle of attributes in each case. Thus, both the appraisal and an element of error are incorporated into the regression. Assuming no systematic errors for the moment,[4] the model being estimated is:

$$\ln P = \beta_0 + \beta_1 (\ln A - \mu) + \varepsilon \qquad (5)$$

With rearrangement, this yields:

[3] The extent to which this is unrealistic is related to the length of time between the sales in each case. It might be addressed by excluding properties with known changes, augmenting the repeat sales model with hedonic variables (Shiller, 1993) or by creating a hybrid of the repeat sales and hedonic approaches (e.g. see Hwang & Quigley, 2004).

[4] In other words, assuming that γ_0 in equation (4) is equal to 0 and γ_1 is equal to 1.

$$\ln P = \beta_0 + \beta_1 \ln A + (\varepsilon - \beta_1 \mu) \quad (6)$$

Hence, the independent variable in this model will be correlated with its error term, violating the assumptions under which OLS produces unbiased estimators. One way to tackle this would be to use the instrumental variables technique. This involves finding another variable that is highly correlated with the problem variable, but which has no relationship with the error component of that variable. Both the original variable and this instrument are then used as regressors in the model. Clapp (1990) took this step, but subsequent studies that use the assessed value approach have not done likewise, relying on analysis by Clapp & Giaccotto (1992) that suggests this problem is negligible in large samples.[5]

Systematic errors may exist between either prices and appraisals (because of timing differences) or appraisals and true market values (perhaps reflecting micro-level appraisal processes). If so, these will be captured by the β coefficients. This would not prevent quality differences between properties at a given time from being represented effectively provided that the bias was consistent across the set of appraisals being used. If appraisals were systematically inconsistent in cross-section, though, this could be problematic. This might be so if a sample includes transactions from different regions or nations and appraisers in some places behave differently to appraisers in others. This motivates the inclusion of dummy variables for different areas or asset types in cases where transaction data must be pooled.

The assessed value approach is used by several studies to estimate transaction based commercial real estate indices, reflecting the nature of available data. Fisher *et al*. (2003) apply a variant of this method to sales recorded in the US National Council of Real Estate Investment Fiduciaries (NCREIF) database. Their proxy for missing hedonic information was the log of the purchase price per square foot for each property and they included dummies for property types and regions. Fisher *et al*. (2007) then use the same database and a more refined model where the log of appraised value per square foot is used as the hedonic proxy. In both cases, transaction based series were more volatile and less autocorrelated than comparable appraisal based indices while changes led those in the appraisal indices over the periods studied. Gatzlaff & Holmes (2013) have applied the assessed value approach to commercial property tax records for Florida.

Devaney & Martinez Diaz (2011) applied the approach to UK commercial real estate data held by IPD. Like Fisher *et al*. (2007), they use appraisals as a hedonic proxy, but their study differs in that separate models are estimated for each time interval rather than a single model for the entire time frame covered by the data. Furthermore, coefficients from these models are used to predict prices for all unsold assets in their dataset, enabling value weighted indices to be constructed. In common with US research, they found transaction indices to be more volatile and less autocorrelated than appraisal based comparators, but the authors did not find that these captured turning points earlier. They suggest that this reflects limitations with their sales data and approach.

Some of the studies recognise that sample selection effects may be present in their data. Sample selection concerns the interrelationship between asset characteristics and the behaviour of market

[5] The need for instrumental variables was tested empirically by Devaney & Martinez Diaz (2011). They report that IV-based estimates produced series that were near identical to ones derived from OLS models, though the results are not presented.

participants over time in bidding for and accepting bids on properties, which affects the likelihood of different assets trading and the prices that will be observed. In essence, those assets that sell may give a distorted picture of movements in real estate prices. Hence, Gatzlaff & Haurin (1998) proposed the use of a two-step procedure developed by Heckman (1979) to test and correct for the existence of any bias caused by sample selection effects.

Using a dummy dependent variable to indicate whether or not an asset sold in that period, the first step models the influence of different factors on the likelihood of a sale occurring as well as the overall likelihood of sale for each observation. From this model, a parameter (the inverse Mills ratio) can be extracted that estimates the amount of error that an uncorrected regression of prices on to appraisals would predict should that asset be in the sample of sales. The values of this parameter for the sold assets are then used as an additional regressor in (3) to counteract any bias in the errors of this model that may arise from sample selection effects. The significance of the coefficient on this variable indicates whether such bias is present in the data being studied.

This procedure may be problematic if a dataset has only limited information on the factors that influence sale decisions at different times. This is likely to be true where use of hedonic modelling is ruled out owing to inadequate attribute data. Furthermore, findings from using this procedure with the assessed value approach are mixed with regard to its importance. Results in Fisher *et al*. (2003) suggest that selection bias has an important impact on index figures, but Fisher *et al*. (2007) found that it did not significantly affect their series. Devaney & Martinez Diaz (2011) found that selection bias was time varying; its effects appear to be stronger during downturns in commercial real estate markets. As a result, their selection corrected index behaves more plausibly than an uncorrected series during the downturn covered by their study.

At present, Transaction Linked Indices for European real estate markets are generated from OLS estimations of an expanded version of equation (3). The model, which is set out further in the next section, is estimated on a quarter by quarter basis using a dataset that includes transactions from a number of countries. It is not preceded by tests for sample selection bias. Two-step models were tested on this dataset, but their parameters were highly unstable and this stems from small and sharply fluctuating numbers of transactions for some countries and asset types in both absolute terms and relative to the number of unsold assets. It is noted that the absence of a correction for selection bias is an important limitation of the series that follow.

3. Data and implementation

The data used in this study are drawn from the databases of Investment Property Databank (IPD) who provide performance measurement services for real estate investors in over 20 countries. At the end of 2012, their databases contained information on €580 billion of direct real estate assets in Europe.[6] These assets are owned primarily by investment institutions such as insurance companies, pension funds, open-ended funds, publicly listed property companies and REITs. As such, the data represent investment grade real estate in different countries, but the coverage of the real estate investment market in different countries varies, as indicated by Table 1. Nonetheless, in terms of

[6] IPD, personal communication.

scale and scope, the data source is one of the best available for studying international real estate markets.

INSERT TABLE 1 AROUND HERE

The IPD databases consist of appraisals and cash flow information for individual properties, which are then used to measure the investment returns achieved by real estate portfolios. The appraisals are usually externally conducted assessments of the Market Value of individual assets as at the date of valuation. This information is used to generate appraisal based indices, the frequencies of which are dependent on the underlying appraisal regimes that contributing funds have adopted. It can be seen from Table 1 that this frequency is annual in most European real estate markets. This, together with the relatively recent creation of performance measurement services in many cases, means that time series data on returns for many direct real estate markets is limited.

One way to address the limited frequency of these series is to use interpolation techniques with reference to another source of performance information or a pre-determined process such as linear interpolation. However, as an appraisal is required at both the start and end of each year in order to interpolate intervening values, this cannot increase the speed of reporting and the resulting series are highly smoothed. Another option is to adopt a transaction based method, using information on sales throughout the year. Given the availability of prior appraisals and only a limited number of attribute variables within the IPD databases, the assessed value approach was selected to generate new indices for European real estate markets.

Data for all countries listed in Table 1 except Finland and the UK are used to estimate a Europe-wide model from which individual indices are then derived. This model is set out below. The UK data is used in a similar, but country-specific model that is discussed in detail by Devaney & Martinez Diaz (2011). From the Europe-wide model, indices are produced for Denmark, France, Germany, Ireland, the Netherlands, Norway and Sweden. These countries were chosen on the basis of the size or time series of the available dataset in each case. A series for Southern Europe is also produced using data for Italy, Portugal and Spain.[7] Finally, Eurozone and Pan-European aggregates are possible through weighting the results for individual countries according to estimates of market size.

Indices were estimated for Q4 2001 to Q4 2012 and this is guided by when records start for most countries, though some have been monitored by IPD for a longer period. Table 2 shows the number of sales per year for each market that could be used in the price models. This is not equal to the total number of sales recorded by IPD as filters are applied to remove outliers. For instance, properties must be held for at least six months before the quarter studied, so that prior appraisals are available, while their value or sale price should not be less than €12,500 or above €1 billion. Cases are also excluded where the mark up on prior appraisal lies outside the range -50% to +50%, so that these sales do not distort estimations.

INSERT TABLE 2 AROUND HERE

[7] Separate indices could not be constructed for these countries owing to small, variable samples of sales. In particular, there is an extreme drop in the number of sales for Portugal and Spain from 2008 onwards.

In Panel A of Table 2, differences in sale counts between countries and time periods partly reflect changes in market coverage and size. Overall, though, the number of sales rose to 2007 before falling in the wake of the global financial crisis and economic problems in the Eurozone. This is broadly consistent with the patterns in capital flows discussed in Newell *et al*. (2010), except that the fall in activity seems more gradual within this sample of investors. Some countries such as Norway and Sweden exhibit increases in sales in 2008, which is also consistent with the patterns identified by Newell *et al*., but the large increase for the UK was unexpected given general conditions and activity levels in this market.

Meanwhile, figures in Panel B of Table 2 indicate that several countries had at least one quarter where no sales were recorded. Therefore, the Europe-wide price model for each quarter has been estimated using sales completed in that quarter and sales completed in the preceding quarter (i.e. a six month rolling sample of sales). For example, for Q4 2012, the model utilises sales occurring from July to December of that year in order to get a transaction based estimate of market movement. This temporal aggregation of sales evidence is far from ideal, but is applied to reduce estimation noise and ensure that certain markets are always represented in the models. Note that this approach was not adopted when constructing the UK series owing to the much greater volume of evidence here on a quarter-to-quarter basis, as statistics in Panel B demonstrate.

The dataset does record some asset attributes, such as asset type and size and this enables both the country where an asset is located to be identified and the sector of the market (office, industrial, retail or residential) to which each property belongs, with residential being an important part of the property investment market in several of the countries being studied. Intercept dummies for sectors were added to the basic price model in order to test and distinguish differences in pricing between them. Dummy variables were also used to identify countries and these enable the separate national indices to be constructed.[8] Thus, the price model estimated each quarter for the European dataset is as follows:

$$\ln P = \beta_0 + \beta_1 \ln A + \sum \delta_j C_{i,j} + \sum \lambda_k S_{i,k} + \varepsilon \qquad (7)$$

Where P equals the sale price in Euros
A is the appraised capital value in Euros for two quarters prior to sale
C_j are 0/1 dummy variables for j countries
S_k are 0/1 dummy variables for k sectors of the real estate market
ε is a random error term

The data used in the models is denominated in Euros in all cases, regardless of whether a country is in the Eurozone or not. This should not affect the relativity between prices and values in each case and it ensures that inputs are consistently scaled. For non-Eurozone countries, the indices produced are then converted to local currency terms post-estimation. As in Fisher *et al*. (2007) and Devaney & Martinez Diaz (2011), the appraisals used for the hedonic proxy are not those for the quarter end immediately prior to sale, but those for the preceding quarter end. This is to try and ensure that the

[8] In principle, slope dummies could also be added to test for further differences in pricing behaviour, but early experiments have not proved successful in terms of producing stable and useable models.

appraisal variable is independent of the price variable. For instance, if an appraiser became aware of negotiations surrounding a sale, the amount under discussion may influence the appraisal that is produced for that property.

Once (7) has been estimated for each quarter using OLS, coefficients are then extracted for use in a mass appraisal process. This process is adopted to ensure that indices are both value-weighted and mirror the composition of the appraisal based indices that IPD produce for the different markets. It is conducted as follows. In a given quarter, all assets that did not trade in that quarter are identified. Coefficients from the regression for the preceding quarter are then used to predict a start (ln) price for this set of assets. Next, coefficients from the regression for the current quarter are used to predict end (ln) prices for this sample. Predicted log prices are then exponentiated, but, since this provides biased predictions of cash prices, these values are adjusted subsequently in the manner recommended by Miller (1984):

$$\hat{P} = \exp(\ln \hat{P}) \times \exp(\hat{\sigma}^2 / 2) \qquad (8)$$

Here, σ^2 is the Mean Squared Error of the regression that generated the predicted ln price.

For a specified set of properties, such as those pertaining to a particular country, estimated start and end prices for each quarter are then separately summed and the change between these totals is computed. The percentage change provides a value-weighted capital return rate that may be chain-linked with other such return rates into a longer series where samples for individual intervals remain constant, but can change between intervals as the composition of the real estate market changes over time. However, unlike the appraisal based capital return indices produced by IPD, these series do not currently take into account capital expenditure or capital receipts for the sample that is mass appraised. This is one source of inconsistency in a process that otherwise seeks to be consistent in calculation and segment representation once predicted price inputs have been created.

4. Results

The first set of results to consider are the coefficients for the price models that are estimated in each quarter. Selected coefficients and tests for models up to Q4 2012 are shown in Table 3. The constant (β_0) and the coefficient for the logged appraisal variable (β_1) provide measures of systematic bias in appraisals relative to prices. β_0 captures any bias that is consistent across assets regardless of their value while β_1 captures variation between high and low value assets. However, interpretation of β_0 is complicated by the use in the model of intercept dummies for different countries and sectors. Thus, in isolation, it only captures bias in terms of the base groups; these being France and offices for the country and sector dummies, respectively.[9]

INSERT TABLE 3 AROUND HERE

[9] However, using the coefficients for the dummy variables (the δ_j in equation 7), parameters relevant to other sectors and countries may be computed and tested.

The relevant tests for bias are whether a null hypothesis of equality with zero can be rejected in the case of the intercept and a null hypothesis of equality with one can be rejected for β_1. Table 3 shows that β_0 is only significantly different from zero at the 5% level on 13 out of 45 occasions during this period, despite the inbuilt time gap between appraisal and transaction dates that arises from the research design. It is notable, though, that eight of those occasions are during the years 2007 to 2010 when the real estate cycle in most countries moved from boom to downturn. Meanwhile, β_1 varies significantly from unity at the 5% level on only 11 out of 45 occasions. Again, eight of those occasions are in the years 2007 to 2010.

Tests for joint significance of the country dummies and similar tests for the sector dummies are reported on the right of Table 3. These tests detect whether the relationship between prices and appraisals varies systematically between the countries or property types included in the model. The country dummies are jointly significant at the 5% level in 34 out of 45 quarters and are important in practical terms for identifying different price trends between nations. The sector dummies are jointly significant at the 5% level on 27 out of 45 occasions. These results appear to support the inclusion of additional dummy variables in order to capture pricing differences between different property types and areas.

Table 4 contains summary statistics for the period Q4 2001 to Q4 2012 for indices produced using the regression coefficients and the mass appraisal procedure described earlier. UK results based on the OLS approach outlined in Devaney & Martinez Diaz (2011) are shown for comparison. The same statistics for appraisal based indices of each market are also shown. The latter include published IPD quarterly indices in the case of Ireland, the Netherlands and the UK and quarterly indices that have been derived using interpolation procedures in the case of other countries. The statistics shown are the average capital return rate (Panel A), the standard deviation in capital return rates (Panel B) and the first order autocorrelation in return rates (Panel C). The comparison is of All Property indices in each case and this should be borne in mind when comparing different countries, as the sector make-up of each country is different. This should not affect comparisons across different types of index for each country, though, as here the contributions of each sector will be similar.

INSERT TABLE 4 AROUND HERE

In principle, long run average returns shown by transaction based and appraisal based indices for each country should be the same, with the main influence of appraisal smoothing thought to be on the volatility and correlations of the latter. As can be seen from Panel A, there are mostly only minor differences between the average capital return from the two types of series, with Transaction Linked Indices typically showing stronger growth over this period. In contrast, standard deviations for the transaction series are larger in all cases. They are typically 2 to 4 times higher than those measured from appraisal based returns, but Germany and the UK are outliers in this respect. For Germany, the ratio of 13 is driven by an extremely low standard deviation for its appraisal based series, which can be questioned in the light of continuing debate around German appraisal processes (see Crosby *et al*., 2011).

The other ratios are consistent with earlier research that tries to establish the ‘true’ volatility of real estate markets using desmoothing techniques. This research is reviewed by Geltner *et al*. (2003)

who report that standard deviations increase by 1.5 to 5 times over those measured from appraisal based data when such procedures are implemented, depending on the techniques and data used. Meanwhile, Panel C shows the extent to which current period return rates are related to those in the prior period. A value of zero indicates that returns in the immediate past have no predictive power for the present, which is suggestive of weak form efficiency. The appraisal based series exhibit high serial correlation in their return rates and all of these correlations are significantly greater than zero at the 1% level. This is in contrast to the Transaction Linked Indices where figures for first order autocorrelation are always lower and only significantly different from zero (at the 5% level) for the Netherlands and the UK.

The time series performance of the indices for different countries is shown visually by Figures 1 and 2. The former displays capital return series for countries in the Eurozone and the latter presents indices on a local currency basis for non-Eurozone real estate markets.

INSERT FIGURE 1 AROUND HERE

INSERT FIGURE 2 AROUND HERE

The charts demonstrate the consistency of the two types of series in terms of their overall trends and highlight the comparative smoothness of the appraisal based series in each case. Typically, the Transaction Linked Indices plot a plausible path through time, but some of the series shown in Figure 2 exhibit a saw-tooth profile in places that may be a product of estimation noise rather than genuine volatility.[10] It is also interesting that the transaction based series do not seem to lead when marking the peak of the cycle. However, they often display a more distinct trough in real estate prices than their appraisal based counterparts whilst the magnitude of the rise and fall in each case tends to be greater. The exception here is Germany where no clear cycle in either of the direct real estate series is evident.

These comparisons are complicated by the need for interpolation in several cases to create the quarterly appraisal based series. For example, if a market peaks in Q1 2008, but the appraisals for contributing investors are only conducted at each calendar year end, an appraisal based index for that market may misreport the peak as Q4 2007 or Q4 2008 under linear interpolation approaches. Therefore, in Table 5, a comparison of peak and trough points is only presented for countries where the appraisal indices rely on quarterly valuation inputs. Panel A shows that peaks in the Transaction Linked Indices occur in the same or an adjacent quarter to those in the appraisal based series. In Panel B, though, only the UK has a trough appearing in both direct market measures, this occurring in Q2 2009 in both cases.

INSERT TABLE 5 AROUND HERE

[10] Table 4 shows negative first order autocorrelation coefficients for Norway and Sweden that could be another signal of excessive estimation noise in these cases.

That the Transaction Linked Indices do not lead the appraisal based indices across all markets is a surprising finding and runs counter to expectations given the literature on issues with appraisals. The temporal aggregation of sales evidence from two preceding quarters during the modelling phase is a possible explanation, but one that does not hold for the UK where there are sufficient sales in each quarter to allow this step to be avoided. Another explanation relates to the fact that the timing of each sale has been based on its formal completion date. Crosby & McAllister (2004) and Scofield (2013) show that, for UK commercial real estate transactions, the point of price agreement typically occurs two to three months prior to formal completion, but the former date is not recorded in the data used here.[11] This illustrates that lagging can be a feature of transaction based indices as well as appraisal based indices depending on the nature and quantity of available transaction data.

5. Conclusions

This study examined the production of Transaction Linked Indices for several European real estate markets using IPD data on sales of investment grade real estate. Its objective was to establish what new information such indices provide about risk and turning points in these markets, especially when compared to information given by appraisal based series. The series are constructed using the assessed value method that was first proposed by Clapp (1990) and more recently applied to US real estate by Fisher *et al*. (2007) and UK data by Devaney & Martinez Diaz (2011). Value-weighted series are derived for each real estate investment market using a mass appraisal process based on output from models of sale prices that are estimated for each quarter in the period studied.

The indices provide new evidence on capital returns from European real estate investments over the period Q4 2001 to Q4 2012, which encompasses a major cycle both in real estate values and the wider economies. In terms of long run average return, the rates indicated by the Transaction Linked Indices were similar to those shown by appraisal based comparators, but the intervening rise and fall in values was usually greater. The Transaction Linked Indices also exhibited higher volatility, with the standard deviation in capital return rates being typically two to four times larger than that produced from corresponding appraisal based series. These increases in volatility are consistent with research that applies de-smoothing techniques to appraisal based data.

The Transaction Linked Indices have several limitations. First, they appear to be no faster than appraisal based series in marking the peak of the real estate cycle in different countries and may not be faster in marking the trough either. This could reflect their reliance on sale completion dates to determine the quarters in which a price observation contributes. Second, it is difficult to produce plausible series at a lower level of aggregation than country level owing to the relatively low number of sales for each country that are available each quarter. Third, for the same reason, it was difficult to adequately test and correct for sample selection bias, though such corrections are usually absent from other transaction based indices based on deal-driven rather than performance measurement databases.

These issues limit the utility of Transaction Linked Indices as a barometer of values for different markets. However, the potential for these indices to be produced on a quarterly basis for otherwise

[11] Oikarinen *et al*. (2013) describe this delay as the "escrow lag" and attempt to adjust for it in their analysis of whether public real estate returns in the US lead those in the private market.

annually valued markets provides a practical advantage for understanding market trends on a more timely basis. This is because they can use sales as they occur throughout the year and need not wait for a year-end valuation. More widely, they could be of value in asset class level research owing to the estimates that they provide of the volatility of real estate investment markets at an aggregate level. Such estimates could be used to inform risk modelling and asset allocation as they provide an alternative estimate of risk to appraisal based series or de-smoothed variants of such series. Yet, for applications that require detail and continuity at disaggregate levels, such as benchmarking of real estate performance, Transaction Linked Indices are unlikely to replace the existing appraisal based indicators.

References

Clapp, J. M. (1990), "A methodology for constructing vacant land price indices", *Journal of the American Real Estate and Urban Economics Association*, Vol. 18 No. 3, pp. 274-293.

Clapp, J. M. and Giaccotto, C. (1992), "Estimating Price Indices for Residential Property: A Comparison of Repeat Sales and Assessed Value Methods", *Journal of the American Statistical Association*, Vol. 87 No. 418, pp. 300-306.

Clayton, J., Geltner, D. and Hamilton, S. W. (2001), "Smoothing in Commercial Property Valuations: Evidence from Individual Appraisals", *Real Estate Economics*, Vol. 29 No. 3, pp. 337-360.

Crosby, N., Devaney, S. and Law, V. (2011), "Benchmarking and valuation issues in measuring depreciation for European office markets", *Journal of European Real Estate Research*, Vol. 4 No. 1, pp. 7-28.

Crosby, N. and McAllister, P. (2004), 'Deconstructing the Transaction Process: An Analysis of Fund Transaction Data', Working Paper Two, *Liquidity in Commercial Property Markets*, Investment Property Forum.

Devaney, S. and Martinez Diaz, R. (2011), "Transaction based indices for the UK commercial real estate market: an exploration using IPD transaction data", *Journal of Property Research*, Vol. 28 No. 4, pp. 269-289.

Dombrow, J., Knight, J. R. and Sirmans, C. F. (1997), "Aggregation Bias in Repeat-Sales Indices", *Journal of Real Estate Finance and Economics*, Vol. 14 No. 1, pp. 75-88.

Fisher, J., Gatzlaff, D., Geltner, D. and Haurin, D. (2003), "Controlling for the Impact of Variable Liquidity in Commercial Real Estate Price Indices", *Real Estate Economics*, Vol. 31 No. 2, pp. 269-303.

Fisher, J., Geltner, D. and Pollakowski, H. (2007), "A Quarterly Transactions-based Index of Institutional Real Estate Investment Performance and Movements in Supply and Demand", *Journal of Real Estate Finance and Economics*, Vol. 34 No. 1, pp. 5-33.

Gatzlaff, D. H. and Haurin, D. R. (1998), “Sample Selection and Biases in Local House Value Indices”, *Journal of Urban Economics*, Vol. 43 No. 2, pp. 199-222.

Gatzlaff, D. and Holmes, C. (2013), “Estimating Transaction-Based Price Indices of Local Commercial Real Estate Markets Using Public Assessment Data”, *Journal of Real Estate Finance and Economics*, Vol. 46 No. 2, pp. 260-281.

Geltner, D. and Goetzmann, W. (2000), “Two Decades of Commercial Property Returns: A Repeated-Measures Regression-Based Version of the NCREIF Index”, *Journal of Real Estate Finance and Economics*, Vol. 21 No. 1, pp. 5-21.

Geltner, D., MacGregor, B. D. and Schwann, G. M. (2003), “Appraisal Smoothing and Price Discovery in Real Estate Markets”, *Urban Studies*, Vol. 40 No. 5/6, pp. 1047-1064.

Heckman, J. J. (1979), “Sample Selection Bias as a Specification Error”, *Econometrica*, Vol. 47 No. 1, pp. 153-161.

Hoesli, M. and Oikarinen, E. (2012), “Are REITs real estate? Evidence from international sector level data”, *Journal of International Money and Finance*, Vol. 31 No. 7, pp. 1823–1850.

Hwang, M. and Quigley, J. M. (2004), “Selectivity, Quality Adjustment and Mean Reversion in the Measurement of House Values”, *Journal of Real Estate Finance and Economics*, Vol. 28 No. 2/3, pp. 161-178.

Miller, D. M. (1984), “Reducing Transformation Bias in Curve Fitting”, *The American Statistician*, Vol. 38 No. 2, pp. 124-126.

Newell, G., Adair, A. and McGreal, S. (2010), “Robustness of capital flows into the European commercial property markets during the global financial crisis”, *Journal of European Real Estate Research*, Vol. 3 No. 3, pp. 182-202.

Oikarinen, E., Hoesli, M. and Serrano, C. (2013), “Do public real estate returns really lead private returns?”, *Proceedings of the 20th Annual Conference of the European Real Estate Society*, Vienna, pp. 189-218.

Scofield, D. (2013), “Time to completion liquidity in UK commercial real estate investment: 2000-2008”, *Journal of European Real Estate Research*, Vol. 6 No. 1, pp. 34-47.

Shiller, R. J. (1993), *Macro Markets: Creating Institutions for Managing Society’s Largest Economic Risks*, Clarendon Lectures in Economics, Oxford University Press, Oxford.

Table 1: Database size, market coverage and index frequency at end 2012 – Europe

Country	Number of properties[1]	Capital value (€ bn)[1]	Est. market size (€ bn)[1]	IPD coverage (%)[1]	Frequency of appraisal index
Austria	595	7.1	26.1	27.3	Annual
Belgium[2]	373	8.2	41.9	19.5	Annual
Czech Rep[2]	115	2.8	11.5	24.7	Annual
Denmark	995	15.3	33.6	45.4	Annual
France	6,190	97.8	240.6	40.7	Annual, Biannual
Finland (KTI)[3]	2,356	21.8	45.7	47.7	Annual
Germany	4,027	45.9	261.8	17.5	Annual
Hungary	90	1.7	9.2	18.6	Annual
Ireland	304	2.0	5.0	40.2	Quarterly
Italy	1,946	26.5	76.2	34.7	Annual, Biannual
Netherlands	4,521	37.3	114.7	32.5	Annual, Quarterly
Norway	488	16.1	42.0	38.3	Annual
Poland[2]	226	6.2	17.2	36.0	Annual
Portugal	921	8.3	14.8	56.1	Annual
Spain	554	16.4	37.7	43.4	Annual
Sweden	1,482	33.1	120.4	27.5	Annual
Switzerland	4,050	60.4	146.0	41.4	Annual
UK	21,012	173.1	286.1	60.5	Ann, Qtr, Monthly
Eurozone	21,787	271.2	864.6	31.4	Annual
Pan-Europe	50,245	580.0	1,530.6	37.9	Annual

[1] Numbers are as reported by IPD and are subject to rounding.

[2] Indices have consultative status rather than full index status.

[3] The index for Finland is produced by KTI using procedures and methods that are consistent with those of IPD.

Table 2: Number of transactions available for modelling

	Denmark	France	Germany	Ireland	Netherlands	Norway	Sweden	Southern Europe[1]	Europe ex. UK[2]	UK
Panel A – Transactions per year										
2002	76	292	275	32	408	16	295	25	1,424	1,074
2003	104	341	218	24	291	34	328	44	1,437	1,075
2004	127	283	229	12	182	23	120	56	1,101	650
2005	124	314	213	8	403	20	104	52	1,380	877
2006	127	392	472	13	240	22	44	94	1,531	818
2007	87	484	416	7	342	6	118	85	1,683	597
2008	82	480	246	7	287	29	209	58	1,573	1,043
2009	23	464	98	28	186	18	66	109	1,214	760
2010	15	440	151	10	201	21	85	94	1,179	463
2011	9	328	201	2	136	18	73	113	1,092	406
2012[2]	41	281	122	9	153	25	134	57	956	439
Panel B – Per quarter statistics[3]										
Mean	18.2	92.8	59.3	3.6	67.2	5.2	39.4	17.6	335.3	190.8
Maximum	73	284	252	16	218	29	197	46	738	383
Minimum	0	33	9	0	11	0	4	2	160	84
Mean Q1	8.1	51.3	62.3	2.8	35.9	5.5	23.0	13.5	234.9	171.6
Mean Q2	14.0	59.9	36.5	4.5	56.5	3.9	35.6	18.4	254.3	188.4
Mean Q3	20.2	95.5	45.1	2.0	52.2	4.2	44.4	15.0	304.9	194.4
Mean Q4[3]	29.5	158.4	90.6	4.8	119.6	7.1	53.3	22.9	529.4	207.3

Note 1: This aggregation consists of Italy, Portugal and Spain.

Note 2: Includes additional transactions from Austria, Belgium, Czech Republic, Poland and Switzerland.

Note 3: Includes transactions for Q4 2001.

Table 3: Price model – selected coefficients and tests

	CONSTANT		Prob.	LN A		Prob.	COUNTRIES		SECTORS	
	β	s/e	β = 0	β	s/e	β = 1	F-stat	P-value	F-stat	P-value
Q1 2002	-0.08	0.04	0.07	1.01	0.003	0.07	9.15	0.00	5.96	0.00
Q2 2002	-0.07	0.04	0.10	1.01	0.003	0.03	1.95	0.07	0.84	0.47
Q3 2002	0.17	0.05	0.00	0.99	0.004	0.02	3.77	0.00	1.95	0.12
Q4 2002	0.15	0.06	0.01	0.99	0.004	0.05	3.38	0.00	3.38	0.02
Q1 2003	-0.06	0.05	0.17	1.01	0.003	0.13	2.47	0.02	2.75	0.04
Q2 2003	0.04	0.05	0.42	1.00	0.003	0.51	2.82	0.00	1.95	0.12
Q3 2003	0.07	0.08	0.39	1.00	0.005	0.50	1.39	0.20	0.38	0.77
Q4 2003	-0.04	0.06	0.47	1.00	0.004	0.48	1.72	0.09	1.96	0.12
Q1 2004	-0.04	0.04	0.27	1.00	0.002	0.20	4.42	0.00	2.86	0.04
Q2 2004	-0.04	0.04	0.37	1.00	0.003	0.34	5.33	0.00	5.48	0.00
Q3 2004	0.06	0.07	0.35	1.00	0.004	0.72	1.48	0.16	2.11	0.10
Q4 2004	0.07	0.06	0.22	1.00	0.004	0.47	0.49	0.86	2.61	0.05
Q1 2005	-0.09	0.05	0.07	1.01	0.003	0.02	3.12	0.00	5.98	0.00
Q2 2005	0.00	0.05	0.98	1.00	0.003	0.66	3.71	0.00	3.62	0.01
Q3 2005	0.14	0.07	0.04	0.99	0.005	0.20	1.09	0.37	2.61	0.05
Q4 2005	0.12	0.06	0.04	1.00	0.004	0.38	6.30	0.00	2.66	0.05
Q1 2006	-0.02	0.05	0.63	1.01	0.003	0.09	8.95	0.00	6.83	0.00
Q2 2006	-0.07	0.06	0.25	1.01	0.004	0.13	2.47	0.01	5.61	0.00
Q3 2006	-0.05	0.10	0.57	1.01	0.006	0.34	1.84	0.07	2.46	0.06
Q4 2006	-0.02	0.08	0.79	1.01	0.005	0.08	4.28	0.00	6.50	0.00
Q1 2007	0.12	0.05	0.01	1.00	0.003	0.28	6.38	0.00	7.83	0.00
Q2 2007	-0.04	0.05	0.47	1.01	0.003	0.16	3.61	0.00	25.21	0.00
Q3 2007	-0.18	0.08	0.02	1.01	0.005	0.01	0.98	0.45	6.57	0.00
Q4 2007	-0.16	0.07	0.02	1.01	0.004	0.00	1.89	0.07	1.90	0.13
Q1 2008	-0.05	0.04	0.18	1.01	0.003	0.00	2.71	0.01	5.23	0.00
Q2 2008	0.05	0.04	0.21	1.00	0.003	0.56	3.05	0.00	3.05	0.03
Q3 2008	0.10	0.05	0.06	1.00	0.004	0.20	3.69	0.00	0.56	0.64
Q4 2008	-0.05	0.05	0.31	1.00	0.004	0.24	12.29	0.00	4.65	0.00
Q1 2009	0.04	0.06	0.51	1.00	0.003	0.60	15.69	0.00	0.36	0.78
Q2 2009	0.16	0.06	0.01	0.99	0.004	0.01	15.39	0.00	5.49	0.00
Q3 2009	0.42	0.09	0.00	0.97	0.006	0.00	3.50	0.00	4.91	0.00
Q4 2009	0.17	0.06	0.01	0.99	0.004	0.00	7.84	0.00	0.60	0.62
Q1 2010	0.14	0.04	0.00	0.99	0.002	0.00	20.34	0.00	4.58	0.00
Q2 2010	0.17	0.04	0.00	0.99	0.003	0.00	15.91	0.00	1.61	0.19
Q3 2010	0.11	0.07	0.10	1.00	0.004	0.26	6.14	0.00	0.57	0.64
Q4 2010	0.03	0.06	0.62	1.00	0.004	0.83	11.25	0.00	0.96	0.41
Q1 2011	0.07	0.04	0.10	1.00	0.003	0.55	4.08	0.01	3.38	0.02
Q2 2011	0.02	0.04	0.66	1.00	0.003	0.88	6.36	0.00	13.95	0.00
Q3 2011	-0.02	0.06	0.72	1.01	0.004	0.27	3.33	0.00	10.77	0.00
Q4 2011	0.00	0.06	0.97	1.00	0.004	0.37	4.35	0.00	1.30	0.27
Q1 2012	0.09	0.04	0.04	1.00	0.003	0.43	1.40	0.20	5.85	0.00
Q2 2012	0.06	0.05	0.18	1.00	0.003	0.85	1.52	0.16	7.99	0.00
Q3 2012	0.06	0.08	0.46	1.00	0.005	0.85	4.17	0.00	0.48	0.69
Q4 2012	0.13	0.08	0.08	0.99	0.005	0.33	3.67	0.00	4.19	0.01

Table 4: Descriptive statistics for the quarterly capital return series: 2002-2011

Panel A – Average quarterly capital return rate (%)[1]			
	IPD Transaction Linked Index	IPD appraisal-based index	*Difference*
Denmark	0.6	0.6	*0.0*
France	1.1	0.8	*0.3*
Germany	-0.3	-0.4	*0.1*
Ireland	-1.2	-1.4	*0.1*
Netherlands	0.2	0.2	*0.0*
Norway	0.7	0.5	*0.2*
Sweden	0.6	0.4	*0.3*
Southern Europe	0.5	0.1	*0.4*
Eurozone	0.3	0.1	*0.2*
UK	0.2	0.1	*0.1*
Panel B – Standard deviation of capital return rates			
	IPD Transaction Linked Index	IPD appraisal-based index	*Ratio TBI/VBI*
Denmark	4.8	1.1	*4.2*
France	2.9	1.6	*1.8*
Germany	4.2	0.3	*13.0*
Ireland	9.1	5.2	*1.8*
Netherlands	2.2	1.1	*1.9*
Norway	7.0	1.5	*4.7*
Sweden	4.6	1.5	*3.1*
Southern Europe	4.7	1.1	*4.3*
Eurozone	2.5	0.8	*3.3*
UK	4.9	3.9	*1.2*
Panel C – First order autocorrelation in return rates			
	IPD Transaction Linked Index	IPD appraisal-based index	
Denmark	0.05	0.88	
France	0.21	0.87	
Germany	-0.03	0.84	
Ireland	0.22	0.87	
Netherlands	0.31	0.72	
Norway	-0.11	0.81	
Sweden	-0.22	0.84	
Southern Europe	0.21	0.91	
Eurozone	0.19	0.88	
UK	0.47	0.76	
Note 1: Geometric mean measured from Q4 2001.			

Table 5: Peak and trough points in the recent major real estate cycle

Panel A – Timing and magnitude of index peak				
	IPD Transaction Linked Index		IPD appraisal-based index	
	Quarter occurred	Rise from 2001.4	Quarter occurred	Rise from 2001.4
Ireland	2007.2	113%	2007.3	66%
Netherlands	2008.3	32%	2008.3	26%
UK	2007.3	61%	2007.2	53%

Panel B – Timing and magnitude of subsequent trough				
	IPD Transaction Linked Index		IPD appraisal-based index	
	Quarter occurred	Change from peak	Quarter occurred	Change from peak
Ireland	2012.1	-73%	-	-
Netherlands	-	-	-	-
UK	2009.2	-44%	2009.2	-42%

Dash (-) indicates no clear peak or trough

Figure 1: Comparison of capital returns series for each Eurozone market: 2002-2012

Indices track performance in local currency terms. Q4 2005 = 100.

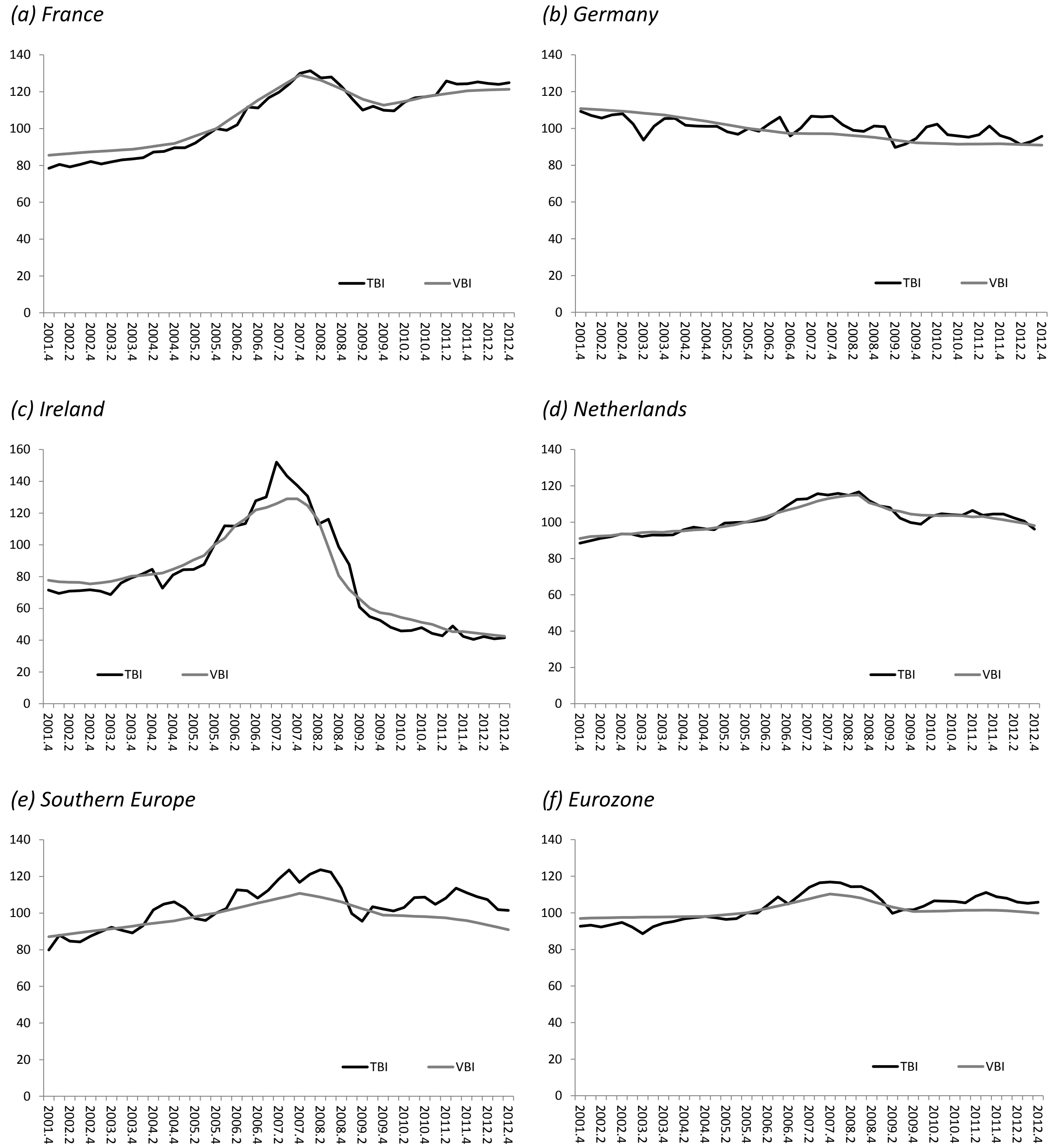

Figure 2: Comparison of capital returns series for non-Eurozone markets: 2002-2012

Indices track performance in local currency terms. Q4 2005 = 100.