IPF Research Programme

Long-term Value Methodologies in Commercial Real Estate Lending

JULY 2020

MAJOR REPORT

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This Programme supports the IPF's wider goals of enhancing the understanding and efficiency of property as an investment. The initiative provides the UK property investment market with the ability to deliver substantial, objective and high-quality analysis on a structured basis. It encourages the whole industry to engage with other financial markets, the wider business community and government on a range of complementary issues.

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Long-term Value Methodologies in Commercial Real Estate Lending

Report

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CONTENTS

GLOSSARY

Average model
This provides an estimate of long-term value based on simple averages of the underlying real estate measure (rent, yield, values). For example, if the yield across five periods is 5.0, 4.0, 7.0, 8.0 and 6.5 the average is 6.1.

Econometric estimate
An estimate of a particular variable (e.g. rent) using a statistical method to derive this estimate based on data for independent variables (underlying drivers), e.g. demand and supply, believed to explain the movements in that particular variable.

Econometric with trends (w/trends)
This refers to using the statistical relationships identified in deriving the econometric estimate but instead of using the actual data for the independent variables using trend estimates of these variables.

Equilibrium (rents or capital values)
This is the estimate of the rent or values that appears to be consistent with the variables or underlying drivers believed to explain the movements in rent or values.

Ex-ante model/ex-ante cap-rate
Ex-ante means that this is based on a set of assumptions rather than historical statistical relationships. For cap rates or yields this approach requires assumptions about the required returns of investors and long run rental growth expectations.

Log linear trend
This is an estimated trend derived by taking the log of the variable(s). Taking the log of a number means that if it growing at a constant (trend) growth rate this leads to the same change at the start of a period as at the end. For illustration, an index of economic activity increases from 50 to 51 over a year, the economy has grown by 2% and the difference in the index is 1, whilst a few decades later the index increases from 100 to 102 in a year, again growing by 2% but now a difference of 2. By taking the log of this index, the difference in the early years is 0.2 (3.912 to 3.932) the same as in the later years (4.605 to 4.625).

Market clearing rent
This is the rent at which the demand for space is equal to the supply of space.

Past trend-based model
A model that uses trends from the past.

Pro-cyclical
An economic quantity or variable that is positively correlated with the overall state of the economy or with some other aggregate measure of activity or value (e.g. real estate values) is said to be pro-cyclical.

Parsimonious
Means the simplest model/theory with the least assumptions and variables but with greatest explanatory power.

'Real' rental value
Real is after adjustment for general price inflation. For example, if nominal rents increase from £50 to £100 whilst the general price index increases from 100 to 200, rents will be unchanged in real terms (rents have doubled but prices in the wider economy have also doubled).

Regression model/regressing
A set of statistical processes for estimating the relationships between a dependent variable (e.g. rent) and one or more independent variables (e.g. demand and supply).

Simple time trend
This is a trend estimated using time only.

Sustainable rental values (and models)
This is an estimate of the rent that is sustainable given a model of how rents grow over time e.g. the rent consistent with the levels of demand and supply.

Trend-based estimate
This is an estimate derived by applying simply time trends.

Trend-input approaches
This refers to using the statistical relationships identified in deriving the econometric estimate but instead of using the actual data for the independent variables using trend estimates of these variables as the inputs to estimate the variable, e.g. rent.

EXECUTIVE SUMMARY

This study follows on from the Property Industry Alliance 2014 report, *A Vision for Real Estate Finance in the UK* and the subsequent *Long-term value methodologies and real estate lending* report (the "2017 Report"). The main aim is to examine and test different methodologies for assessing long-term value along with other indicators of when the probability and scale of potential falls in commercial real estate values is high.

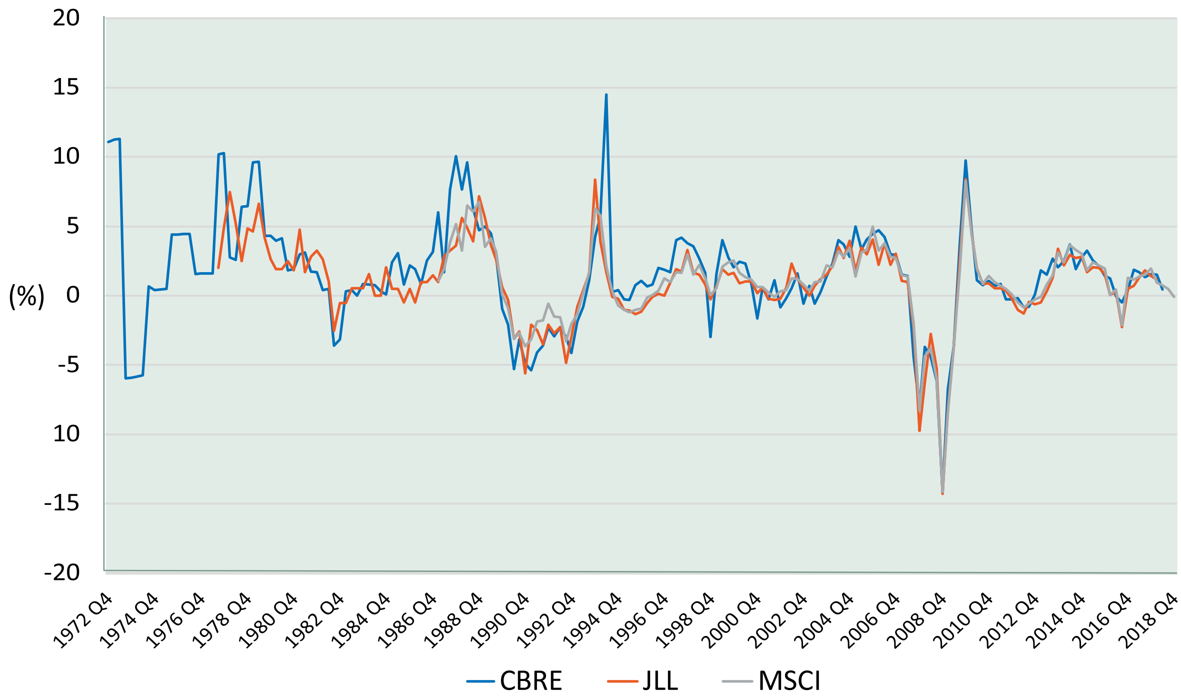
The 2017 Report identified that the trend in real capital values, Adjusted Market Value (AMV) was a simple approach to identifying sustainable values and that in the run up to the last two major property downturns, actual values were substantially above AMV. The main drawback of this approach was that it lacks an economic logic or link with any drivers of that trend. An Investment Value (IV) approach based on discounted cash flow was identified as the most viable alternative approach. In the 2017 Report, this was based upon a target return, current rents, rental forecasts and a long-run average exit yield but had the issue of using current rents and forecasts. An approach using 'sustainable' rents was suggested might provide a more robust measure. This report aims to address this issue and explores a variety of other approaches and indicators for assessing 'sustainable' value.

Data challenges are substantial. Given the absence of consistent data for the 1960s, rigorously testing models for the mid-1970s downturn is not feasible. This only leaves two major downturns with which to assess quantitatively whether different approaches would have signalled real estate market downturns. In addition, data on the supply and demand drivers of rents are not available for all sectors nor for all periods, while the property rent and yield data that are available represent a sample of the wider real estate investment market with potential bias issues. Considerable effort has gone into addressing some of these data issues, notably through new floorspace (stock) estimates, and it is hoped that the Government will recognise that having high quality, timely information on these variables has a role to play in ensuring financial stability.

Commercial real estate value, rent and yield data are produced by a number of organisations. For this research, data from the MSCI UK Real Estate Indexes (MSCI), the JLL UK Property Index (JLL) and the CBRE Rent and Yield Monitor (CBRE) have been used. MSCI and JLL indexes are based on valuations of actual properties within the investment portfolios of large professional investors while the CBRE data is based on valuations of hypothetical properties in selected locations. The start date for the MSCI is 1986 Q4 when using quarterly observations derived from their monthly index. JLL and CBRE indexes enable a longer period to be analyzed (JLL starts at a quarterly frequency in 1977 Q2 and CBRE starts in 1972 Q3). As Figure 1 shows, capital movements using data from JLL and MSCI are very similar. Movements in the CBRE series are also similar, but the stronger growth in values in this series reflects the fact that they are location-based rather than property-based indicators and so do not suffer from any building-related depreciation. A thorough review of the different property market data series used is provided in the appendices to this report.

EXECUTIVE SUMMARY

Figure 1: MSCI, JLL and CBRE All Property Quarterly Capital Value Growth



Sustainable Rental Values and Implied Market Corrections

There are three main workable approaches to the estimation of sustainable real rental values:

- Trend (like the AMV approach – this is simply a time series trend);
- Econometric estimation of the rents consistent with underlying levels of demand and supply; and
- Econometric estimation of rents consistent with demand and supply reverting to trend.

Real UK gross domestic product was used as the demand proxy for the office and industrial sectors while real UK household consumption was used for the retail sector. These series are broader than desired, but they enable a consistent and parsimonious version of the model to be estimated for every time window. Improved availability of economic time series would enable more refined versions of these models to be implemented going forwards. Meanwhile, substantial work was conducted to derive stocks of floorspace series for offices running from 1969 to 2019 for the industrial sector running from 1969 to 2019 and for retail running from 1974 to 2019.

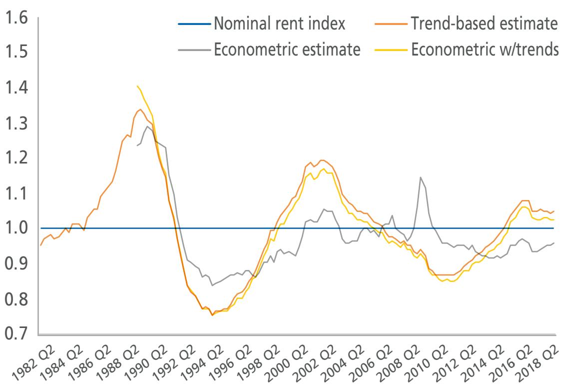
The three methods have their strengths and weaknesses – as expected, they produce sustainable rental value estimates that sometimes exceed and sometimes fall beneath the actual rental value index. As one would expect, the conventional econometric approach produces estimates that appear to shadow the rental value index more closely than trend-based estimates.

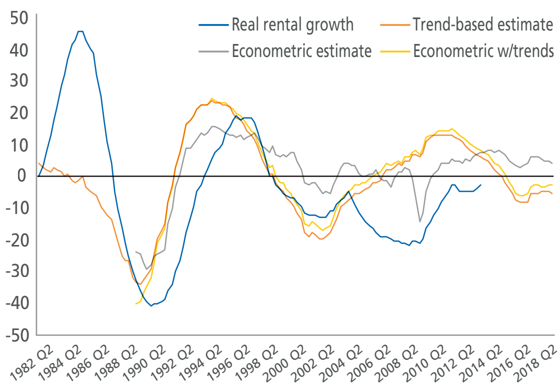
EXECUTIVE SUMMARY

The left-hand side of Figure 2 shows the ratio of actual rental values to these sustainable rental values. When this ratio is significantly above 1 (as it was in the late 1980s) it indicates a potential correction. The right-hand side of Figure 2 shows the implied percentage correction in real rents graphed against realised real rental growth over the following five-year period (the line for the actual index stops in 2013 as it signals real rent growth over 2013-2018 at that point). The implied corrections from the different models correspond well with the actual real rent growth in the late 1980s and early 1990s. The trend-based and trend-input approaches also indicate the correction in rental values in the early 2000s, but all approaches struggle to capture the downturn in rents in the wake of the GFC, which suggests that the specific triggers for growth and decline may be important.

Figure 2: Implied Corrections in Rental Values (using rolling windows) vs. Subsequent Five-year Outturn in the JLL Series

Ratio of Actual to Sustainable Rental Value	Implied Correction vs. Outturn





At sector level, the office results are like those for All Property, but the retail sector has been less cyclical in the period studied and exhibits a divergence between sustainable rental values and the actual index in the latter part of the period that may reflect structural changes affecting this sector. All models that are calibrated on historical data will have difficulty identifying sustainable rental values and potential market adjustments in the presence of structural change, but econometric models offer some scope for adaptation if the drivers of changes are known and measurable. Econometric models also perform slightly better overall in terms of the formal testing of the approaches.

EXECUTIVE SUMMARY

Sustainable Capitalisation Rates and Capital Values

The next phase of the research was to explore and test potential models for estimates of longer run capitalisation ("cap") rates and capital value – as far as possible to look through cyclical factors, including sentiment and credit conditions. In the main body of this report, both cap rates and a combination of sustainable rent and sustainable cap rate to form a capital value are investigated. In this summary, only the capital value analysis is reported.

The three approaches that appear to have the most potential to derive measures of equilibrium or sustainable long-term capital values are:

- Trend – real values relative to trend (AMV);
- Econometrics model for equilibrium rent and an econometric-derived cap rate; and
- Econometrics model for equilibrium rent and an ex-ante cap rate.

These were used to derive 'equilibrium' estimates of capital value and the extent of deviation of actual capital values from long-term value measures. The results are shown in Figure 3. All three approaches appear to work well in the sense that real values substantially above estimates of long-term equilibrium value (a significant positive deviation in the right hand chart) are associated with a substantial correction in subsequent periods[1] (1990-1992 and 2007-2009). The sector results are also generally good.

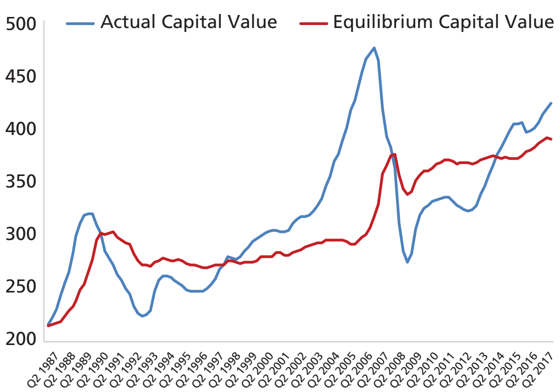
[1] The authors repeat the caveat that, with just two major downturns in the analysis period, it is unwise to overstate the significance of the results.

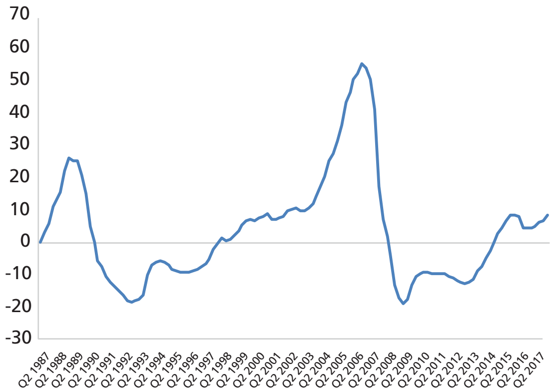
EXECUTIVE SUMMARY

Figure 3: Capital Value Results at an All Property Level (using JLL property market data)

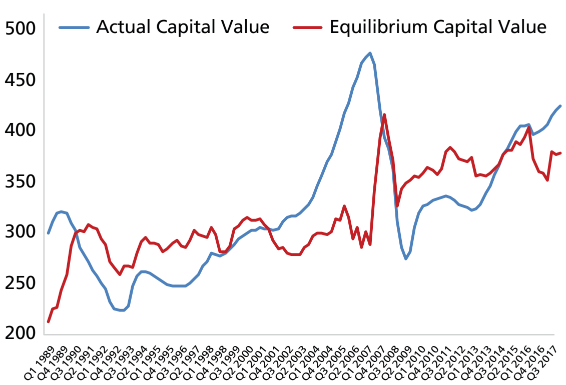
Actual and Equilibrium Capital Values	**% Deviation**

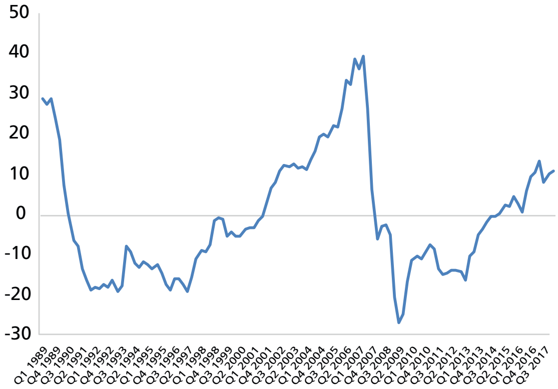
Approach 1 (AMV)



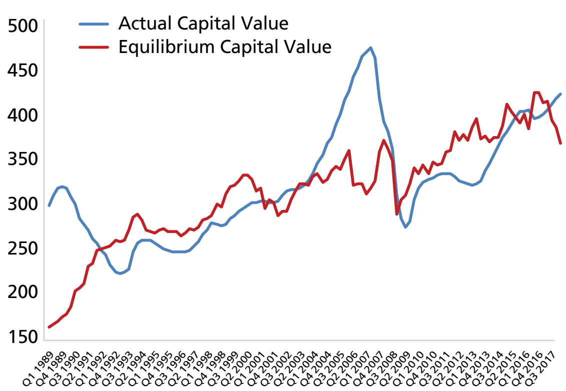


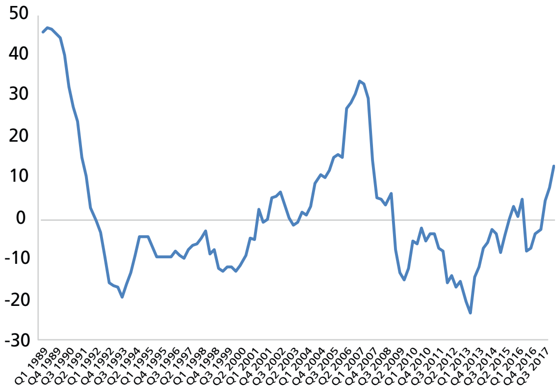
Approach 2 (Econometrics, Rolling)





Approach 3 (Ex-ante, Rolling)





EXECUTIVE SUMMARY

Leverage and Other Potential Indicators of Over-Heated Markets

This study also investigated whether there are other indicators that might indicate future substantial falls (or increases) in values. In particular, the role of leverage and its impact on both the upward and downward phases of market cycles was investigated. The relationship between lending to commercial real estate and capital values is dynamic and bidirectional. It appears that, to an extent, lending lags increases in capital values. As a result, it is not well suited to being an early indicator of a downturn. However, in the period before the two last major market corrections, a build-up of real estate debt is observed, both in aggregate and in relation to past patterns of lending, such that 'excess' debt is related to subsequent price falls – a negative relationship. This suggests that lending and leverage levels may be a useful warning signal for market participants, alongside the other indicators discussed in this report: real increases in lending, increases in commercial real estate's share of overall lending and evidence of higher leverage in the sector should be viewed with concern. Listed real estate markets do not appear to provide a useful medium-term leading indicator. Sentiment indicators may be useful in reviewing evidence on market fundamentals but there is no time series of these available in the UK currently.

The literature on asset price bubbles suggests a number of approaches to identify whether a market might be significantly over-valued and these have been reviewed and tested. The most promising is the Phillips, Shi and Yu (PSY) method, which successfully indicates a potential downturn in advance of the property crises of 1990 and 2007. The results at a sector level are also generally good but testing in international property markets suggests that the method is not always reliable – providing warning before downturns but also provides some lag generating false signals. Further, the method is not necessarily robust in the presence of a structural break.

Recommendations

Given the complexity of the underlying relationships, data issues and structural shifts (changes in the relationships between the real estate market and underlying drivers), robust identification of long-term value is challenging and there is no simple solution. The authors recommend:

- The use of sustainable rents to monitor if there appears to be over-heating in occupier markets;
- The use of sustainable or equilibrium capital value estimates based on both econometric modelling of cap rates and ex-ante estimation of cap rates (potentially with some scenario analysis) to monitor if investment markets appear to be over-heating;
- Monitoring of leverage to check whether there is significant growth in real terms, an increase in the share of commercial real estate lending in the total or generally higher leverage (higher LTV lending);
- Monitoring of technical indicators of bubble risks (PSY); and
- Consideration of structural change risks that may lead to a fall in values not picked up by any of the above methods.

1. INTRODUCTION

1.1. Background and Objectives

Following the Global Financial Crisis and the issues in real estate lending highlighted by the crisis there were a number of initiatives to reduce the risks from substantial falls in capital values on real estate lending. The UK property and financing industry's analysis of, and response to, the problems highlighted by the 2007/2008 Global Financial Crisis was set out in the May 2014 paper *A Vision for Real Estate Finance in the UK*. One of the key recommendations of that paper was the "use of long-term value measures for risk management: for CRE lenders subject to regulatory capital rules, loan-to-value (LTV) based capital requirements should be linked to a long-term measure of collateral value that is insensitive to the investment cycle."

Following this, the Property Industry Alliance formed a Long-term Value Working Group, which published the *Long-term Value Methodologies and Real Estate Lending* paper in June 2017 (the 2017 report), identifying and testing three methodologies that could be used to highlight and reduce the cyclical risks of real estate lending. The 2017 Report highlighted how long-term trends in real values, which formed the basis of the Adjusted Market Value approach, appeared to work in that, when values are substantially above these long-run trends there is a tendency for them to revert back and, hence, there is a high probability of significant value falls. However, this approach lacks an explicit investment or economic logic with the future simply reflecting the past. The 2017 Report also highlighted the potential use of an investment valuation approach that captures longer-term 'sustainable' rental forecasts and a discount rate built up of longer-term 'sustainable' elements. This report attempts to address these issues and look in a more systematic way at how effective different methods are at identifying subsequent downturns as well as incorporating an economic logic.

The key objective of this report is to identify whether a long-term value methodology (or methodologies) can be used effectively by lenders and regulators to guide commercial real estate (CRE) lending-related decisions and reduce the risks of CRE lending, particularly at times of extreme market overvaluation when, historically, the largest volume of loss making CRE lending occurs.

The specific objectives for the project were to:

- Review the findings of the Part 1 report (the 2017 Report), including the choice of methods, and potentially identify other methods and indicators to identify periods when the probability and scale of potential falls in value is high;
- Expand the analysis of the two main long-term valuation methodologies suggested in earlier research to disaggregate components and review alternative inputs to the model; and
- Test the original and refined models in terms of statistical significance, timeliness of advance warnings, relationship with fundamental drivers and at different levels of aggregation.

1. INTRODUCTION

1.2. Issues to be addressed

Given the complexity of the underlying relationships, data issues and structural shifts (changes in the relationships between the property market and underlying drivers) finding a way to identify robustly an indicator of long-term value is challenging. It was recognised at the outset that a number of approaches may well be appropriate and that there will remain a substantial degree of uncertainty about what represents a 'sustainable' long-term value.

The future may not reflect the past in terms of how long-term fundamentals impact on rents and yields and hence values (for example, the impact of consumer spending changes on retail rents is unlikely to be the same now as it was in the 1980s and 1990s). To some extent, this can be addressed by 'rolling window' estimation of relationships or trends when estimation is done using sub-samples (e.g. 15 years of data) of the full dataset as opposed to 'anchored window' estimation, which uses all available data in the analysis period. However, there remains the risk that any method based on looking at the past will not capture structural breaks in the market. As discussed later, some approaches using historical data provide a framework by which some of these impacts can be assessed.

Significant 'over-valuation' occurs when values move significantly above long-run fundamentals. This will either reflect rents moving significantly above the levels that seem to be supportable by long-term fundamentals or yields being pushed below (implying higher prices) the levels consistent with long-term fundamentals. This may reflect an element of 'irrationality' in the market, imperfect information and data leading to over-optimism about the sustainability of rents or yields or it is possible that there are changes in the underlying relationships.

There have been three major episodes of falling commercial real estate prices in the past f50 years 1973-1975, 1990-1992 and 2007-2009. As this report sets out, the drivers of these three downturns were different with the first two seeing very substantial falls in real rents following periods when rents had risen strongly (with these downturns reflecting both new supply and weaker demand). The 2007-2009 downturn was predominantly driven by the investment market with yields being pushed lower during the boom and then moving substantially higher through the downturn but with the GFC leading to weakness in occupier markets. Consequently, the approach used in this report first looks at occupational markets and rents and, second, looks at investment markets and capital values.

It should also be noted at the outset that data challenges are substantial – given the absence of consistent data for the 1960s, rigorously testing models for the 173-1975 downturn is not feasible. This only leaves two major downturns with which to assess whether different approaches have worked. In addition, in reviewing the fundamentals that drive rents the data that is needed in terms of supply (e.g. floorspace) and demand is not available for all sectors or all periods and the property rent and yield data available represents a sample of the wider investment market with potential bias and composition issues. Considerable effort has gone into addressing some of these data issues, notably with new floorspace (stock) estimates. It is hoped that the Government will recognise that having high quality timely information on these variables has a role to play in ensuring financial stability.

1. INTRODUCTION

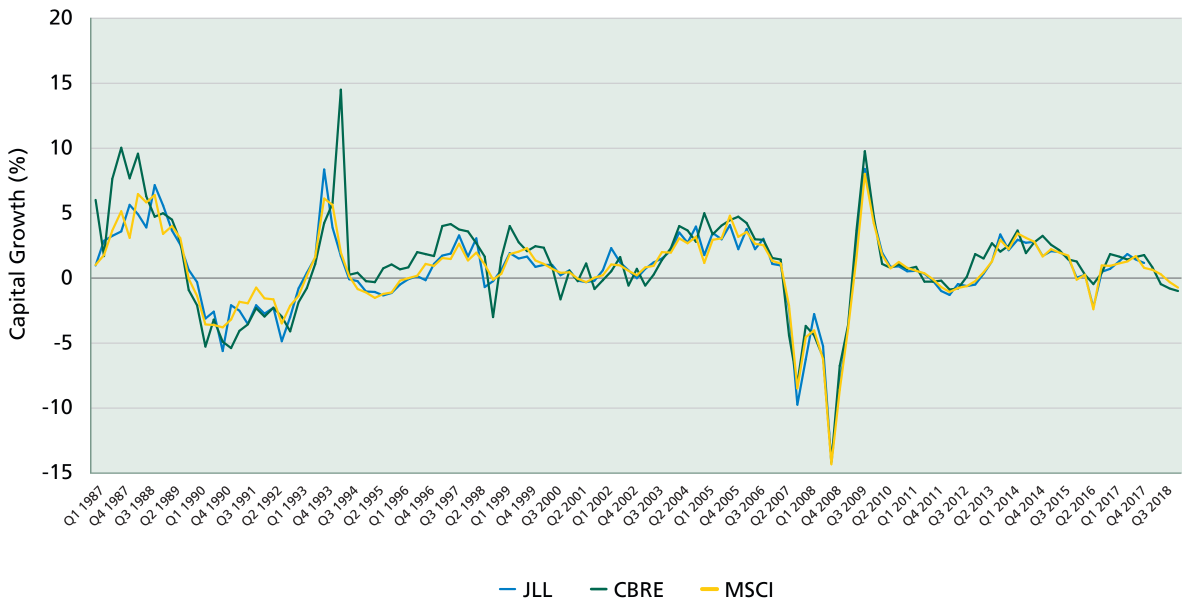
The 2017 Report, as discussed in the next section, identified two main methods that may be appropriate, namely Adjusted Market Value (AMV) and Investment Value (IV). The AMV approach fits a regression line based on past trends in real values. This raises many issues. These include, but are not confined to, the sensitivity of the regression line to the time-period and frequencies used in estimation, the impact of estimation error, the inflation measure used and the appropriate specification of the model. There are also issues around applicability and consistency of the model when applied to other periods (where the same trends may not apply) and to disaggregated segments of the market. In the testing for the 2017 Report, the model showed encouraging signs of being able to identify (all) past downturns. This might be expected should markets tend to revert to a stable, long-term equilibrium in relation to other market drivers and those drivers are not subject to significant structural breaks.

Investment value/discounted cash flow approaches did not perform so well in the 2017 Report, which identified difficulties modelling the 1990 crash, owing to its reliance on rental forecasts. The approach had more success in identifying the 2007 downturn due to the approach to exit yields, which dominated the impact of rental growth expectations. This suggested particular attention needs to be focussed on how market rents are analysed and whether a long-term sustainable rent can be identified (for example drawing on the concept of equilibrium rental value in contemporary rental adjustment models such as those of Englund et al., 2008, Hendershott et al. 2010). This issue is addressed in this report.

1.3. Property Market Data

Property value, rent and yield data are produced by a number of organisations and as part of this research data produced by MSCI, JLL and CBRE have been used. The Working Paper, *Comparison of Property Market Indices,* includes some information on how the series produced by these different data providers compare but, as the chart below shows, in terms of capital value movement the JLL and MSCI data series are very similar at an All Property level.

Figure 1: MSCI, JLL and CBRE All Property Quarterly Capital Value Growth



1. INTRODUCTION

This similarity in overall capital value movement is reflected in the main sectors:

Figure 1.2: JLL and MSCI Quarterly All Property Office Capital Value Growth

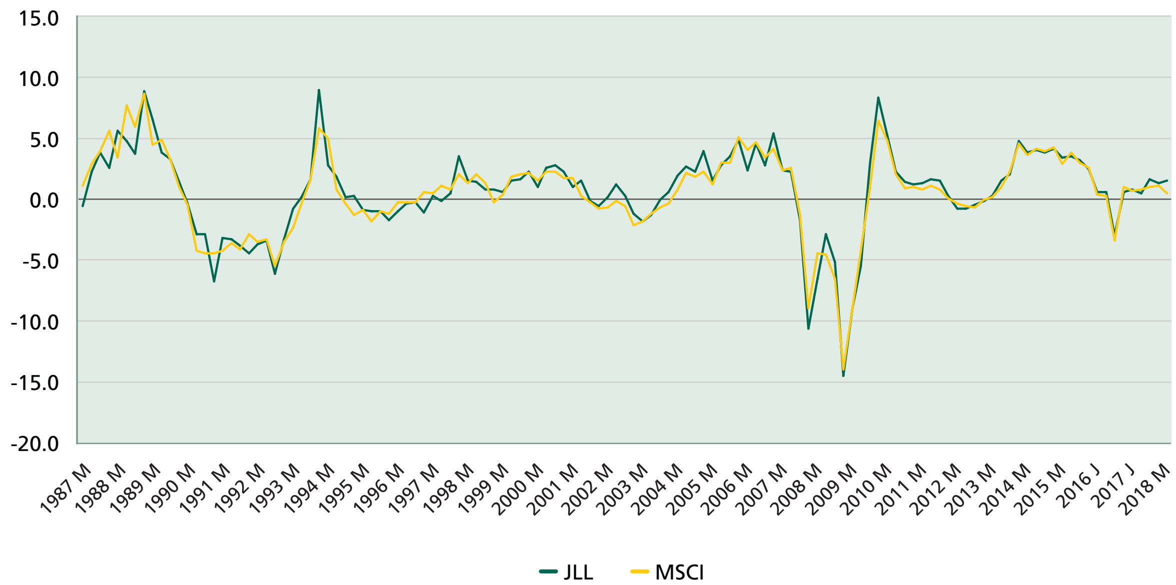
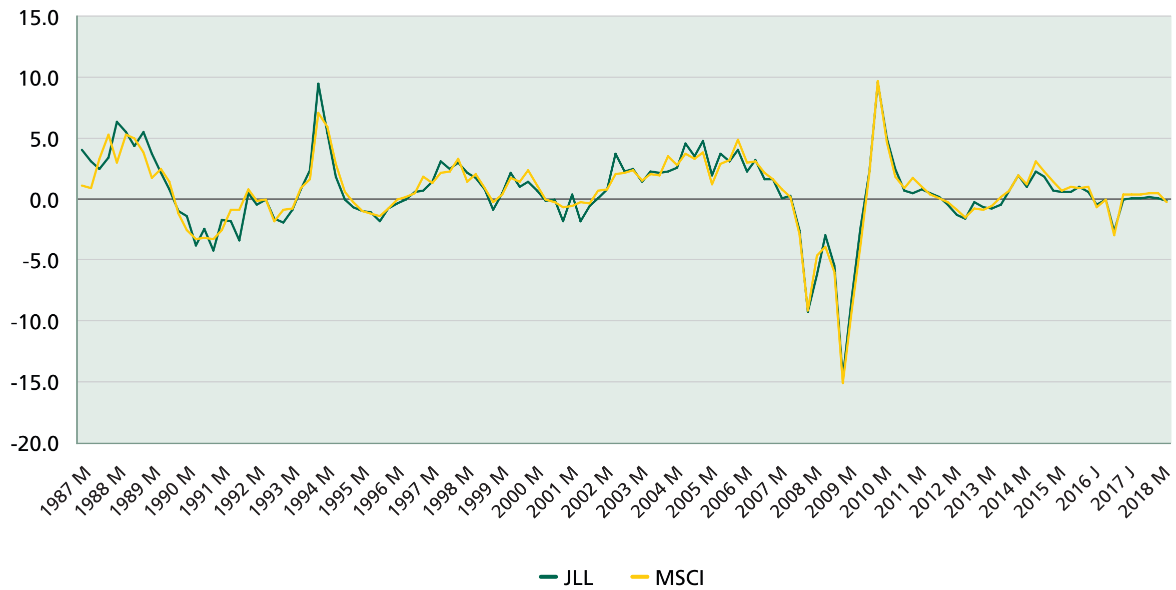
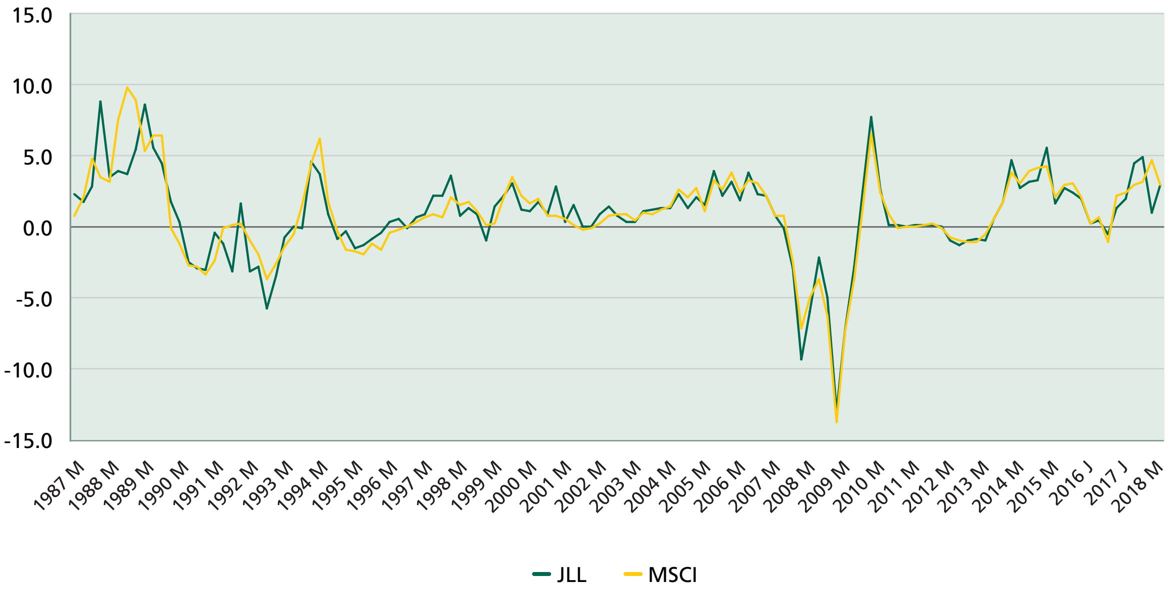


Figure 1.3: JLL and MSCI Quarterly All Property Retail Capital Value Growth



1. INTRODUCTION

Figure 1.4: JLL and MSCI Quarterly All Property Industrial Quarterly Capital Value Growth



1.4. Structure of the Report

This report is structured as follows: The next section considers the literature on drivers of long-term rents, some of the conceptual issues and the implication for approaches used along with the 'sustainable' rent results and the testing of different models. The third section discusses the literature on drivers of cap rates (yields) and related variables along with analysis and results for cap rates and capital values. This is followed by discussion of the relationship of credit with the property cycle and a review of other potential leading indicators including the information provided by listed securities and other more technical approaches. Finally, the conclusions and recommendations section sets out the main findings of the research. The appendices contain a more detailed discussion of the review of the 2017 Report, a more detailed comparison of MSCI and other property data sources, more detailed results on the analysis of sustainable rents and more detailed results on the analysis of sustainable capital values, as well as the specification of the models and references.

2. SUSTAINABLE RENTS

2.1. Sustainable Rents Introduction

The 2017 Report (Cardozo et al. (2017)) for the Property Industry Alliance concluded that weaknesses with the rental assumptions in the application of both Investment Value (IV) and Mortgage Lending Value (MLV) models needed to be overcome if either approach was to be used as a predictor of under- or overpricing in commercial real estate markets. This weakness led to the other conclusion that Adjusted Market Value (AMV) was the best performing model for this task based on work completed at that point.

The 2017 Report found that the occupier market crash of 1990 had not been picked up by either a MLV or IV model. The reasons for this were clear. First, the approach to sustainable rent in some applications of MLV, including that adopted for the 2017 Report, used market rent as a proxy for sustainable rent, without any adjustments for occupier market conditions. Market rent was also used as the starting point for sustainable rent in the IV framework. The impact of this was that, when rents were either rising or falling, the two methods reflected this in their assessments of sustainable capital value. So their valuations tended to follow market values quite closely.

Second, while the IV model should, in principle, change to account for rental booms through forecasts of rental growth in the expected cash flow, the limited amount of property market forecasting prior to 1990 did not identify the approaching downturn in rental markets. So the forecasts and the models did not identify the resultant fall in capital values either. In contrast, the 2007-2009 downturn in commercial real estate markets was not occupier market led, but was driven instead by pricing in the investment market. Hence, the yield cap within a MLV model and the assumption of reversion to long-term trend for the exit yield in the IV model meant that applications of both approaches in the 2017 Report were able to identify this downturn well before the actual event.

These findings raised two research questions related to rent determination. First, issues surrounding the accuracy of property market forecasting need to be considered should an IV model based on future cash flows continue to have a role in assessing long-term value. Second, further work on the concept and measurement of sustainable rent is required. This concept underpins MLV but the application is vague in the MLV literature and guidance. A preliminary investigation of sustainable rental value was undertaken in the 2017 Report. A basic past trend model for rent within the IV and MLV models was explored by the authors and this approach immediately identified the 1990 crash.

Given that the AMV is a past trend model and also identified the 1990 crash, there was no surprise at this result. When an IV model is based on a past trend in rental values and a past trend in cap rate to underpin the exit yield, then it is, in effect, an AMV model with a current, market-based discount rate. It is also the solution to a recommendation in the 2017 Report that the AMV be deconstructed to create a more sophisticated and versatile tool in the hands of risk managers and regulators.

However, there are other approaches to understanding sustainable rental value rather than examining past trends in rent. The concept of equilibrium rental value has been developed by Hendershott and others as the market clearing rent at any particular point in time given demand and supply conditions in occupier markets.[2] This equilibrium rent can be estimated from a long-run model based on demand and supply conditions, while

2. SUSTAINABLE RENTS

an accompanying short-run model can be used to examine the effects of deviations from equilibrium rent on short-term market movements. This model can be developed for the UK commercial real estate market and a major objective of this chapter is to develop that model and examine alongside alternative approaches based on market trends.

The rest of the chapter is structured as follows. The next section reviews sustainable rent as a concept and explores different approaches that have been used to approximate a sustainable or fundamental level of rent for use in market analysis. The third section outlines the data used in this study to measure sustainable rental values and estimate potential corrections in rental markets based on those values. The fourth section shows the results of measuring sustainable rental value using datasets from MSCI, JLL and CBRE. The fifth section considers formal tests of forecasting accuracy to try and distinguish which model of the available alternatives performs best. The final section then concludes.

2.2. Concept and Measures of Sustainable Rent

The concept of sustainable rent is like that of sustainable value. It recognises that rental income from real estate assets is prone to fluctuations through time in response to market conditions, and that the rent received at a point in time might not be a good signal of the ongoing income-generating capacity of a building, just as the capital value at a point in time might not be a good signal of longer-term levels of value for the purpose of underpinning a loan. Therefore, sustainable rent is a figure that represents the likely rent that a building can command through time rather than at a point in time. In combination with estimates of a sustainable yield (or capitalisation rate), sustainable rent can be used to estimate sustainable capital values and be compared against actual rents to understand why sustainable values diverge from observed market values in different periods.

Fluctuations in income for individual assets will be influenced by the occurrence of vacancy within the property. This is recognised in discussions of Mortgage Lending Value. TEGoVA (2016) refer to a 'stable occupancy level' in their discussion of sustainable income from real estate. Fluctuations in income will be influenced also by lease contracts and the frequency with which rents can adjust to market levels. Traditionally, lease lengths for UK commercial properties were long and included upward-only review clauses at five-year intervals. This protected owners to some extent from market fluctuations, but UK leases have evolved over time with more frequent lease events resulting from shorter lease lengths.[3] This enables rent to adjust to market levels at more frequent intervals and so makes estimation of a sustainable rental income more pertinent.

The concept of sustainable rent can be generalised to a more aggregate level, such that a sustainable level of rent for a sector or segment might be estimated. In this case, it captures the level of rent (or a rental index) that a market segment can support in the long-term as opposed to that which prevails currently (in which case, it will reflect a certain class or type of property on which indicators or indexes for a segment are based). Vacancy is also important at the aggregate level, but incorporating vacancy is hindered by lack of good time series data. Another issue is how to reflect the impact of incentives such as rent-free periods, and whether a sustainable rent series should track the effective rent for a building, segment or sector through time. Hence, developing a sustainable rent indicator using existing rental data has limitations, but represents a starting point for putting the concept into practice.

[2] See Hendershott (1996), Hendershott, MacGregor and Tse (2002), Englund et al. (2008) and Hendershott, Lizieri and MacGregor (2010), among others.

2. SUSTAINABLE RENTS

Exploring sustainable rent was highlighted by Cardozo et al. (2017) as necessary to progress research on sustainable value. That report found that the use of market rental values to represent sustainable rental values was inadequate. A trend-based approach was found to be superior, but it was not tested against alternative models. The aim of each model that is tested here is to produce through-the-cycle measures of rental value that help to identify when pricing in real estate occupier markets is above or below sustainable levels, contributing potentially to disequilibrium in capital values. Sustainable rents need not be constant, as structural changes in the economy, stock and fortunes of specific locations can lead to long-term shifts in rental values and what can be regarded as a sustainable level of rental value. Ideally, any model that is adopted should be sensitive to this.

Before proceeding to specific models and their assumptions, an initial question is whether sustainable rent should be modelled in nominal terms or real terms. Much analysis in economics and finance is conducted using series in constant price (real) terms, which are adjusted for the effects that inflation has on price levels over time, such that the impact of changes in other variables can be more clearly discerned. Here, the interest lies in the effects that market conditions, as reflected in demand and supply, have on rent. For instance, one may wish to measure the quantity of demand and supply from period-to-period, and to understand how sustainable and actual rental values change in response to movements in demand and supply. Inflation makes it harder to compare conditions in occupier markets from different periods as the monetary values of rent, output, etc., can differ greatly, even if the demand and supply pressures in those periods are similar.

Some variables are naturally measured in terms of quantities. For example, measures of stock or new supply are often expressed in terms of the quantity of floorspace built or added, while some proxies for demand are measured in terms of quantity as well, e.g. levels of employment. Other variables such as output or rental value are typically measured in monetary terms. Hence, they change not only in response to relevant economic drivers, but also because of inflation. When such series are deflated, this involves restating them as if the general level of prices at a specific point in time prevailed at all other points of time in the series. For output, this helps reveal how the quantity or volume of economic activity has changed over time.

Deflating a rental value index does not change the fact that the original series itself is a price indicator, tracking the cost of leasing space in a specific sector or area. When a rental value index is deflated, it shows how rental values have altered relative to prices in the economy generally. Rises or falls in the deflated values are then likely to be driven by short- and long-term shifts in demand and supply. These can be modelled explicitly, or a more implicit technique might be used to determine whether rental values are at sustainable levels given underlying market conditions.

Assuming no long-term shifts in demand or supply, a very simple model might posit that sustainable rental value should be constant in real terms. This model is as follows:

Equation 2.1:

$$\text{Average Real Rent Index}_1 = \frac{\Sigma\ \text{Real Rent Index}_{T0\quad T\text{-}1}}{\text{Number of observations}}$$

2. SUSTAINABLE RENTS

where T0 is the start of the measurement window and T-1 is the time point prior to the date of interest. An indicator of whether real rental values at time T are sustainable or not would be to relate the reported real rental value at that time to the long-term average real rent as measured above. This can be written in ratio form, as follows:

Equation 2.2:

$$\text{Real Rent Ratio}_T = \frac{\text{Real Rent Index}_T}{\text{Average Real Rent Index}_T}$$

where a ratio over 1 indicates that real rental values are above their sustainable level and a ratio under 1 signals that they are below sustainable level. Subtracting 1 from this ratio will indicate the extent to which real rental values have departed from their sustainable level and the correction required to restore the ratio to 1. While a ratio to long-term average is a simple model, it has been used in several studies of commercial real estate pricing as an indicator of the prospects for future cash flows (see Chervachidze et al. 2009; Chervachidze and Wheaton 2013).

The evidence presented in the Working Paper, *Comparison of Property Market Indices,* where the datasets used for the rent, yield and capital value parts of this study are examined and compared, indicates that real rental values are not constant over the long-run. For the period 1987-2018, where the different source datasets overlap, negative average real rent growth was observed for the MSCI and JLL rental value series. Furthermore, preliminary tests confirmed that the sustainable rental value estimates based on average real rents were not plausible when applied to the MSCI and JLL datasets; rental values did not revert to a stable long-term average in real terms. Thus, further evidence for this approach is not presented.

Another possibility is that there are long-term economic processes, which are leading real rental values to become either more expensive or less expensive relative to prices overall. In this case, sustainable real rental values might then follow a trend path either upwards or downwards as the characteristics of the economy and stock of real estate change through time. One way of capturing this could be to model a linear trend in real rental values, although a log-linear trend is likely to be more realistic, such that the compound growth rate in real rental values is stable. This echoes the approach taken to modelling capital values in the AMV model, and hence it may be inappropriate if there are structural breaks in relationships through time.

The log-linear trend approach involves regressing real rental values (in log form) on to a time trend and predicting a sustainable real rental value using the coefficients obtained from that estimation:

Equation 2.3:

$$\text{Ln (Trend Real Rent}_T) = \beta_0 + \beta_1 \text{Time}$$

where β_0 is the intercept from the regression and β_1 is the slope coefficient. β_1 captures the trend growth (or decline) in sustainable real rental values through time, so that, as time increases by one period, sustainable real rental values change by a factor of β_1.

2. SUSTAINABLE RENTS

The error term (or residual) from the estimation of this model provides one measure of whether real rental values at time T are sustainable. A positive residual suggests that real rental values are above trend and so above their sustainable level and a negative residual suggests the opposite. However, for ease of presentation and interpretation, the real rental value at time T can be related to the predicted long-term trend value in ratio form, as follows:

Equation 2.4:

$$\text{Real Rent Ratio}_T = \frac{\text{Real Rent Index}_T}{\text{Trend Real Rent}_T}$$

where a ratio over 1 indicates that real rental values are above their sustainable level and a ratio under 1 signals that they are below their sustainable level. As before, subtracting 1 from this ratio indicates the extent to which real rental values have deviated from their sustainable level and the correction required to restore the ratio to 1. Deviations from a log-linear trend have been used in several studies of commercial real estate pricing as an alternative indicator of the prospects for future cash flows (see Hendershott and MacGregor 2005a, 2005b).

Neither an average nor a trend approach involves explicit modelling of how demand or supply cause sustainable rental values or actual rental values to change over time. The results will reflect the impact of economic drivers, but the models do not disclose anything about the relationships between rental values and these drivers, and how those relationships are changing. Another approach is to construct an econometric model in which variables that represent demand for and supply of real estate are used to model real rental values. The coefficients from such a model could then be used to predict a sustainable, long-run equilibrium rent for any given values of the independent variables.

There is a long tradition in both industry and academia of modelling the fundamental drivers of real estate occupier markets econometrically, using rental values or vacancy rates as dependent variables and proxy measures for demand and supply as independent variables. This includes single and multi-equation models of occupier market dynamics.[4] In the last two decades, academic research has settled on error correction models for this purpose. A long-run relationship is posited between rents, demand and supply, and deviations from the long-run relationship are used to explain short-run adjustments in rental values and other indicators such as vacancy rates and stock changes. The long-run equation in an error correction model of real rental values typically takes the following form:

Equation 2.5:

$$\text{Ln (Real Rental Value}_T) = \beta_0 + \beta_1 \text{Ln (Demand proxy}_T) + \beta_2 \text{Ln (Stock proxy}_T) + \varepsilon$$

where β_0 is the intercept from the regression and β_1 and β_2 are slope coefficients measuring the relationship between real rental values and the independent variables. ε measures the deviation of real rental values from their equilibrium value at each time point. The error term (or residual) from estimation of this model provides a measure of whether real rental values at time T are at or near to their equilibrium. A positive residual suggests that real rental values are above their equilibrium level and a negative residual suggests the opposite.

An equilibrium real rental value can be produced using the coefficients from estimation of the long-run model: it is the fitted value from the equation stated above. In other words:

[4] For reviews of the literature and approaches taken to modelling, see Hendershott, MacGregor and Tse (2002) and Lizieri (2009).

2. SUSTAINABLE RENTS

Equation 2.6:

$$\text{Ln (Equilibrium Real Rental Value}_T\text{) = Ln (Real Rental Value}_T\text{) - }\varepsilon$$

It is important to consider whether an equilibrium real rent measured in this manner is the same as a sustainable rent. The long-run model estimates the level of real rent that should clear the market given the levels of demand and supply at different times, but it does not indicate whether demand or supply are, themselves, in equilibrium at that point. It is possible that either one or both input variables are not at their sustainable, long-term level in any given period. In that case, as an alternative to using the fitted value from the regression model, a value can be estimated using independently determined figures for the inputs. For instance, one could take trend values for the demand and supply variables and use these with the model coefficients to predict a sustainable real rental value for each period. This approach is illustrated later and is described as the trend-input approach. However, this assumes that a trend gives an appropriate long-run equilibrium path for each input and so is subject to some of the criticisms of the trend-based model for rents, reviewed earlier. Alternatively, explicit models for each input variable could be constructed and linked to the rent model via a system of equations. This increases sophistication but requires information about how each input is determined. It also requires that the relationships between variables are specified appropriately.

Whichever inputs are used to infer a sustainable equilibrium rental value (actual values, trend values or some other assumption), the reported real rental value at time T can be related to the equilibrium real rental value in ratio form, as follows:

Equation 2.7:

$$\text{Real Rent Ratio}_T = \frac{\text{Real Rent Index}_T}{\text{Equilibrium Real Rental Value}_T}$$

where a ratio over 1 indicates that real rental values are above their sustainable level and a ratio under 1 signals that they are below their sustainable level. Subtracting 1 from this ratio indicates the extent to which real rental values deviated from their sustainable level and the correction required to restore the ratio to 1.

Although not of central concern in this chapter, the short-run adjustment process in real rental values can be modelled in the following manner:

Equation 2.8:

$$\Delta\text{Ln(Real Rental Value)}_T = \beta_0 + \beta_1\,\Delta\text{Ln(Demand proxy)}_{1\text{-}N} + \beta_2\,\Delta\text{Ln(Stock proxy)}_N + \beta_3\,\varepsilon_{T\text{-}1} + \varepsilon$$

where β_0 is the intercept from the regression, β_1, β_2 and β_3 are slope coefficients measuring the relationships to independent variables, Δ represents changes in the variables and T-N represents possible lags in the independent variables. ε_{T-1} is the lagged error correction term, capturing the disequilibrium existing already at the start of each period, and ε is a random error term. A negative coefficient is expected on the lagged error correction term and the size of the coefficient indicates the speed with which real rental values return to their equilibrium level as represented by the fitted values from the long-run model.

The error correction model in the form shown above was introduced to rent modelling in studies by Hendershott, MacGregor and Tse (2002) and Hendershott, MacGregor and White (2002). It has been used in numerous academic studies since then. A list of such studies is provided in Table 2.1 and this list shows that most articles have focused on the office sector, but there are some that have modelled the retail and industrial sectors in this manner.

2. SUSTAINABLE RENTS

Table 2.1: Error Correction Modelling of Commercial Real Estate Rents

Panel A: Office Sector Study	Locations and Periods	Demand Proxy
Hendershott, MacGregor and Tse (2002)	City of London 1977-1996	Financial and business services employment
Hendershott, MacGregor and White (2002)	UK regions	Financial and business services employment
Mouzakis and Richards (2007)	12 European cities 1980-2001	Service sector output (gross value added)
Stevenson (2007)	Central London submarkets 1990-2004	Service sector employment
De Francesco (2008)	Sydney, Melbourne 1974-2003	Office employment based on selected sectors
Englund, Gunnelin, Hendershott and Söderberg (2008)	Stockholm 1977-2002	Office employment based on selected sectors
Brounen and Jennen (2009a)	15 US MSAs 1990-2007	Financial and business services employment
Brounen and Jennen (2009b)	10 European cities 1990-2006	Service sector employment; real gross domestic product
Hendershott, Lizieri and MacGregor (2010)	City of London 1977-2006	Financial and business services employment
Adams and Fuss (2012)	30 German cities 1991-2007	Office employment based on selected sectors
McCartney (2012)	Dublin 1978-2010	Real gross national product
Ibanez and Pennington-Cross (2013)	34 US MSAs 1990-2009	Office employment based on selected sectors
White and Ke (2014)	Shanghai submarkets 1994-2010	Gross domestic product; foreign direct investment
Bruneau and Cherfouh (2015)	Paris 1990-2013	Regional total employment
Chau and Wong (2016)	Hong Kong 1981-2013	Service sector employment and sub-categories
Panel B: Retail Sector Study	**Locations and Periods**	**Demand Proxy**
Hendershott, MacGregor and White (2002)	UK regions	Real consumer expenditure
Hendershott, Jennen and MacGregor (2013)	11 US MSAs 1982-2007	Real retail sales
Ibanez and Pennington-Cross (2013)	34 US MSAs 1990-2009	Real retail sales
Ke and White (2015)	Beijing and Shanghai 1999-2012	Real income per capita
Panel C: Industrial Sector Study	**Locations and Periods**	**Demand Proxy**
Ibanez and Pennington-Cross (2013)	34 US MSAs 1990-2009	Industrial employment based on selected sectors

2. SUSTAINABLE RENTS

Error correction modelling is compared here with trend-based approaches. An error correction model allows changes to economic fundamentals to inform the measurement of sustainable real rental value and it does not assume that sustainable real rental values are constant or follow a constant trend. It also provides more information about how real rental values behave in relation to fundamentals. Yet, in common with average rent and trend rent models, the error correction models are estimated from historical data. They involve assumptions about how real estate occupier markets function, and they require more data to operationalise than the average rent or trend rent approaches.

Having outlined how sustainable rental values might be measured, the next section explains how the methods were applied, with results of this exercise then presented in Sections 2.4 and 2.5.

2.3. Measurement Process

Measures of sustainable rental value for the UK commercial real estate market were derived from and then compared to rental value indexes from three datasets: the MSCI UK real estate indexes, the JLL UK Property Index and the CBRE Rent and Yield Monitor. The analysis focused on the all property and sector series (i.e. office, retail and industrial) in each case, although further disaggregation is possible for the MSCI and CBRE datasets. The start date for the MSCI indexes is 1980 Q4 for annual observations and 1986 Q4 for quarterly observations, using quarterly data points derived from their monthly index. The JLL indexes begin in 1967 Q2 at an annual frequency and 1977 Q2 at a quarterly frequency, while the CBRE series start at 1972 Q3 and are quarterly throughout. The characteristics of these datasets are discussed further in the Working Paper, *Comparison of Property Market Indices.*

Analysis of sustainable rental values was conducted using real rental value series beginning from the earliest possible date in each case and ending at Q1 2019 for MSCI and CBRE datasets, and Q1 2018 for the JLL dataset.[5] Different options were available for an inflation index with which to deflate rental values. The official UK consumer price index (CPI) was one option, but this did not offer time series of sufficient length to match the real estate series. Two alternatives that were used here were as follows:

- Retail Price Index (RPI): an all-items Retail Price Index runs back to 1947 on a quarterly basis; and
- The implied deflator for gross domestic product: this runs back to 1955 on a quarterly basis.

Both these alternatives were tested lest use of a specific inflation index affected the results. Broad movements in the two series are similar, but RPI indicates stronger inflation over the period than the GDP deflator. RPI is no longer an official national statistic, but it is still in common use as an economic indicator, in many contracts with inflation clauses, and for determining index-linked gilt coupons. The reported rental value indexes were deflated into real terms by using the following standard formula in conjunction with either RPI or the GDP deflator:

Equation 2.9:

$$\text{Real Rent Index}_T = \frac{\text{Rent Index}_T}{\text{Inflation Index}_T} \times \text{Inflation Index}_B$$

where T is the time period for the data point being deflated and B is the base time period. The base period used was 2000 Q4 for the MSCI and JLL indexes (both rebased) and 2003 Q1 for the CBRE series (base period used by data provider).[6] Stronger inflation in the RPI means that real rental growth for each series is lower when this is used as a deflator than when the UK GDP deflator is applied.

[5] This reflected a delay to the production of the JLL index in 2019 that was resolved post-publication.

2. SUSTAINABLE RENTS

The next consideration was the nature and length of window over which to measure sustainable rental value. One option is to use all available data from the start of each series up to a given time point to estimate sustainable rental value at that point. An alternative is to use data for a fixed, pre-defined length of time prior to the point of interest. The former is described as an anchored window and the latter as a rolling window. In the latter case, the measurement window updates such that, when data for the latest time point is incorporated, observations for the previous earliest time point are removed. Both anchored and rolling windows were tested. Anchored windows maximise available observations and so include more information, but might be problematic if a structural break leads to a shift in the long-term trend or the economic relationships between real rent and other variables. Rolling windows do not eliminate issues around structural breaks, but allow measurements of sustainable rental value to adapt more easily to changes in the market through time. The trade-off is that not all the available information is used, so relevant older data might be discarded in the process.

In either case, a minimum window length must be specified. Both 10- and 15-year windows were examined. Measures of sustainable rental value based on 10-year windows were influenced far more by cyclical movements in the reported rental indexes than those based on 15-year windows. As a long-term sustainable value is meant to indicate where markets are distorted by cyclical movements, 15-year windows were adopted to minimise this influence. So, the analysis proceeded with:

- Anchored windows where the minimum length was 15 years and the length increased as more periods were added.
- Rolling windows where the estimation period was always 15 years in length.

Based on index start dates and window lengths, measurements of sustainable rental values have been made from 1995 Q4 where the MSCI data were used, 1982 Q2 where the JLL data were used and 1987 Q3 where the CBRE data were used. Analysis of the JLL and CBRE datasets allows the performance of different models to be studied for the cycles in rental values of the late 1980s and early 1990s, as well as for the aftermath of the GFC. Quarterly measurements of sustainable rental values were produced, but some are based on estimation windows where there are missing observations, since the MSCI and JLL datasets begin with annual frequency data. This is not a major issue for either the trend models or the long-run econometric model, but it would create issues for a short-run error correction model, as this can only be estimated where quarterly data are available throughout the window studied.

The trend rent approach can be implemented using only the rental value and inflation series. The error correction model required additional data, namely proxy variables for demand and supply. Variables used for occupier demand in previous studies using an error correction model are listed in Table 2.1 above. Office sector studies have tended to use a measure of financial or service sector employment as a proxy for demand, though some have used output measures. Real consumer expenditure and real retail sales have been used for retail, while employment was used in the sole example for the industrial sector. Data availability usually plays a key role in the identity and form of the variable chosen.

[6] In the case of the MSCI series, 2000 Q4 is the reference quarter for the UK quarterly index, to which the other MSCI indexes are spliced. The usual base period for the JLL index is 1977 Q2. Note that the choice of base period for indexing and deflating the series is arbitrary and has no substantive effect on the analysis.

2. SUSTAINABLE RENTS

A key issue for this analysis was whether a consistent proxy for demand should be used throughout, and, if so, which variables would span the period studied. A number of aggregate output measures are available at quarterly frequency from the mid-1950s as part of the UK national accounts dataset. These include gross domestic product, gross value added, household consumption and household disposable income. Sectoral and regional data are more disparate. While indexes of production and manufacturing are available back to the mid-1950s, retail sales indexes could only be obtained from the mid-1980s onwards. Similarly, time series on total workforce and employee jobs could be obtained from the late 1950s, but a breakdown by SIC code to separate out manufacturing from service sector employment could only be obtained from 1978.

In this exercise, real UK gross domestic product has been used as the demand proxy for the office and industrial sectors. Real UK household consumption was used as the demand proxy for the retail sector. Although these series are broader than desired, their selection enabled a consistent and parsimonious version of the error correction model to be estimated for every window possible given the limitations of the rent and stock data. Improved availability of economic time series through time enables more refined versions of these models to be implemented going forwards. For example, the retail sector could be modelled using the retail sales index for a demand proxy and with adjustments to that index for the proportion of sales occurring online as opposed to in-store.[7]

Nonetheless, even with the broad aggregates, the in-sample fit of the error correction models was typically good.

To measure stock and supply for each sector, the floorspace statistics produced by the Valuation Office Agency were consulted first. These statistics cover England and Wales, but not Scotland. Such figures should be comprehensive, but they are challenging to use in an econometric model. Data frequency is one issue and consistency another, given changing classifications through time. Availability is a third issue. Floorspace statistics were produced regularly from the mid-1960s to the mid-1980s but were then discontinued. Regular publication of floorspace estimates recommenced from 1998, but there are several issues that affect comparisons between the newer and older data, as discussed in ODPM (2006).[8] The latest floorspace estimates for different types of commercial property are available online and cover 2001-2019.[9] While these are easily accessible, they are affected by further revisions to how floorspace is captured and reported.

[7] Exploratory adjustments were made to the household consumption variable to reflect online sales activity, but these produced only minimal improvements to the retail rent models and were not pursued further.

[8] Department of the Environment (1995) released estimates of floorspace as at end-1994, but these estimates are disregarded in ODPM (2006) owing to concerns about their accuracy.

[9] See www.gov.uk/government/collections/non-domestic-rating-business-floorspace-statistics [August 2019].

2. SUSTAINABLE RENTS

An alternative source of data relates to construction orders and output. These series offer advantages in terms of their availability, frequency and length of time series, as quarterly data exist for both back to the 1950s.[10] Orders and output are recorded in both nominal and real values at national level, but a long-time series in real terms is only now available for orders, reflecting revisions to deflators and other aspects of the series. Private commercial and private industrial orders are separately identified, but data on property types within these categories is more limited. Furthermore, these series do not provide information on the size of the stock or the effects of depreciation and demolition on supply. Further issues relating to data collection and recording are noted by Ball and Tsolacos (2002), though improvements to the series are set out by Crook and Sharp (2010).

Difficulties with supply side data are common in property market modelling, particularly for non-US markets. Some studies attempt to overcome the problem by taking what data are available on stock and using measures of the flow of activity to interpolate or extrapolate for periods where the stock is not observed (see Hendershott, MacGregor and White 2002; Mouzakis and Richards 2007; Englund et al. 2008). Here, floorspace estimates for each sector were taken at two time points, which were adjusted as far as possible for changes in definitions; the intervening observations were then interpolated using data on real construction orders. More specifically, the compound growth in stock was calculated between the two time points and the growth rates for specific periods were then adjusted with reference to deviations from a trend in real construction orders, assuming a three-year lag between orders and completion of new floorspace. This is similar to the approach taken by Hendershott, MacGregor and White (2002).

The outcome of this process was a stock series for the office sector and a stock series for the industrial sector running from 1969 to 2019, and a stock series for the retail sector running from 1974 to 2019.[11] These series enabled estimates of equilibrium rent from an econometric model to be produced and compared against trend-based rent measures across an extended period spanning two major cycles and several minor cycles in property rents and values.

While models have been estimated using data in real terms, there is a need to present results in nominal terms that are more familiar to the industry . To address this, the measurements of sustainable real rental values were reflated into nominal terms, reversing the formula used to deflate the raw data:

Equation 2.10:

$$\text{Sustainable Rental Value}_T = \frac{\text{Real Sustainable Rental Value}_T}{\text{Inflation Index}_B} \times \text{Inflation Index}_T$$

where T is the period for the data point being deflated and B is the base period as set out above. The graphs presented below show nominal indexes against reflated, nominal sustainable rental values, but the implied market corrections are graphed against subsequent real rental growth.

[10] See www.ons.gov.uk/businessindustryandtrade/constructionindustry [August 2019].

[11] Further details about the stock series are available in a separate academic paper. The industrial sector was the most problematic to model and estimates are based on warehouse floorspace as at the start and the end of the period. The help of Mark Callender in drawing attention to sources of earlier data is acknowledged.

2. SUSTAINABLE RENTS

2.4. Sustainable Rental Values and Implied Market Corrections

The core results for this exercise are the estimates of sustainable rental value from different modelling approaches, and the implied market correction based on the difference between actual rental index values and the sustainable rental values. Estimates of sustainable rental value are produced for the national 'all property' level and for the office, retail and industrial sectors. The MSCI and CBRE datasets permit analysis of other types or regions, but this is not pursued here, particularly as the econometric models rely on the availability of appropriate demand and supply variables in those cases. Regression coefficients for the econometric models provide further information on relationships between rental values, demand and supply through time and whether these might have changed. These are available from the authors in a supplementary document.

The econometric models are run for property types only and not for All Property, in reflection of the different economic drivers and stock levels in each case. Estimates of an All Property sustainable rental value for the econometric approach are then derived by weighting sector level outputs by the share of each sector in the All Property index.[12] Information on these shares is presented in the discussion of datasets in the Working Paper, *Comparison of Property Market Indices*. This contrasts with the trend-based rent models, which can be applied directly to the All Property indexes.

Figure 2.1 displays the All Property sustainable rental value estimates based on analysis of the MSCI rental value indexes. Annual, monthly and quarterly MSCI indexes are spliced to generate the rental value series shown here. The left-hand side of Figure 2.1 shows the results from using rolling windows for the estimation period while the right-hand side shows results from using anchored windows. The graphs begin at 1995 Q4 since the first estimation window (whether rolling or anchored) runs from 1980 Q4 to 1995 Q3. Different colours in each chart then identify the time series of sustainable rental values generated by individual methods. A consistent colour scheme is used for all the charts below to aid comparison.

Figure 2.1 shows that there is only limited correspondence between the MSCI rental value series and the sustainable rental values from any of the models. Both the values of and movements in sustainable rental values differ from market rental values over time as tracked by the published index, but this is to be expected if deviations from fundamental or sustainable levels of value are a feature of private real estate markets. Both trend-based and econometric models produce sustainable rental value estimates that sometimes exceed and sometimes fall beneath the actual rental value index. The conventional econometric approach produces estimates that appear to shadow the rental value index more closely, but all the methods indicate periods where rental values are either above or below their sustainable levels.

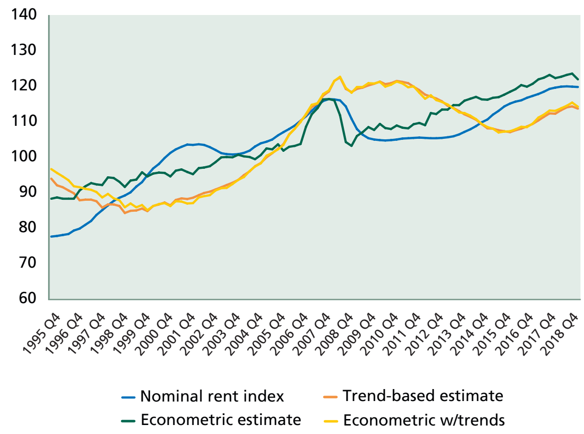
The greatest disagreement between the different methods occurs in the wake of the GFC. Here, both the trend-based method and trend-input approach produced sustainable rental values that fell only slightly in 2008-2009 and then stayed some way above actual rental values for a considerable period. In contrast, output from the conventional econometric approach suggests that sustainable rental values declined considerably and that this decline was contemporaneous with that in the actual index. The sustainable rental values then remained below or around actual rental values until c. 2012. Intuitively, this seems more sensible, but it is difficult to determine from this chart which set of sustainable rental values is most appropriate. Hence, other ways of presenting, comparing and testing the results are required.

[12] Technically, a weighted growth rate is created, using period-to-period percentage changes in sustainable rental value for each sector. This allows for more reliable projections of the All Property sustainable rental value than by weighting the outputs in levels.

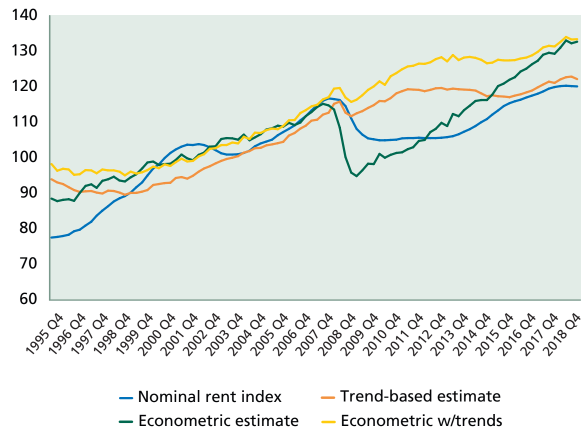
2. SUSTAINABLE RENTS

Figure 2.1: Sustainable Rental Values and the MSCI Rental Value Index through Time

Rolling Windows



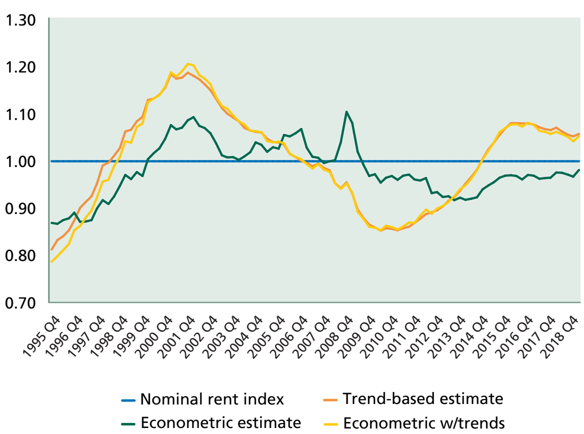
Anchored Windows



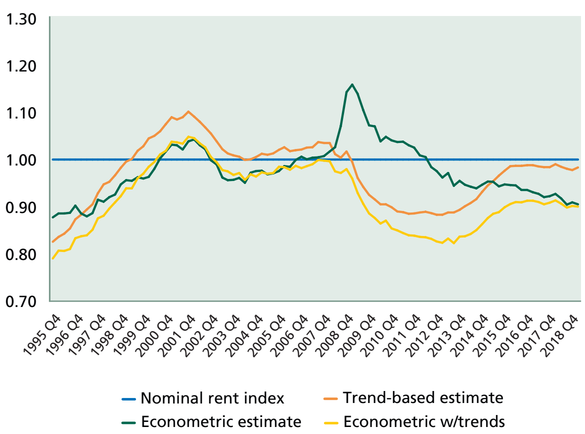
Sustainable rental values are measured using real rental value series and then reflated into nominal terms. These results are based on using Retail Price Index as the deflator. The reference period for the nominal rent index is 2000 Q4 where the index = 100.

Figure 2.2: Ratio of MSCI Rental Value Index to Sustainable Rental Value

Rolling Windows



Anchored Windows

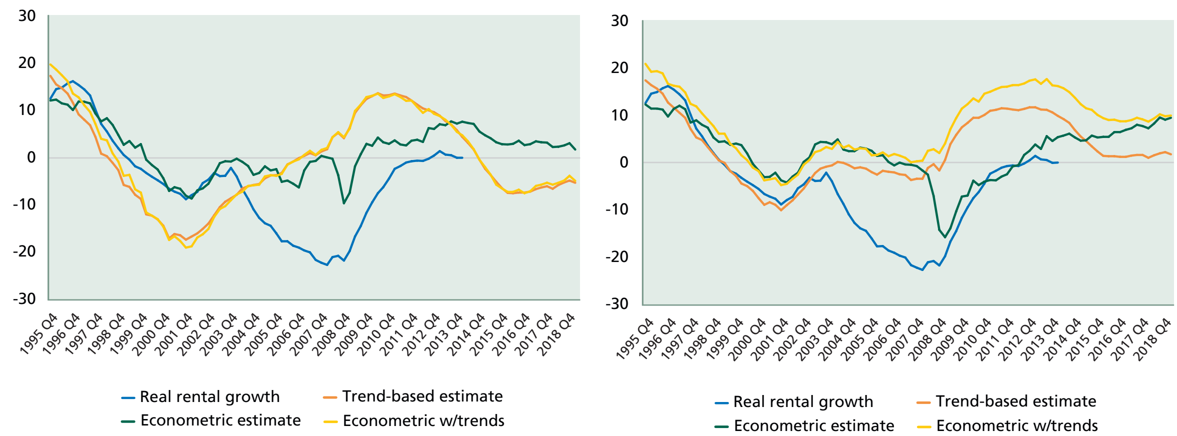


Sustainable rental values are measured using real rental value series and then reflated into nominal terms. The ratio divides the actual rental value index by the sustainable rental value at each time point. These results are based on using Retail Price Index as the deflator.

2. SUSTAINABLE RENTS

Figure 2.3: Implied Correction in Rental Values vs. Subsequent Five-Year Outturn in the MSCI Series

Rolling Windows | Anchored Windows



Implied corrections indicate the real rental growth that is required for rental values to equal sustainable rental values. (A positive number implies that rents need to rise and vice versa.) These are compared with the recorded real rental growth for the five-year period following the date indicated.

Figure 2.2 extends the comparison by taking the MSCI rental value series and dividing this through using each series of sustainable rental values to identify the ratio between the two at different points. This ratio more clearly identifies suggested periods of over and under-valuation relative to sustainable rental values. The trend-based model suggests overvaluation from c. 1999 to c. 2004 and under-valuation from c. 2009. Rolling window and anchored window results then vary on whether and when this period ends. The econometric-based results are more erratic. For the conventional econometric approach, there is more fluctuation between under- and overvaluation and a noticeable spike at the end of 2008, but this might reflect difficulties in weighting the sector level outputs satisfactorily, so analysis of specific sectors is required to test the approaches more thoroughly.

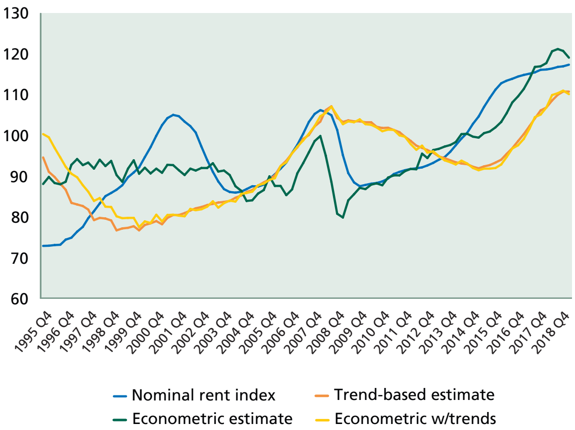
Figure 2.3 shows the corrections required to restore rental values to sustainable levels based on ratios of actual to sustainable values. This presumes no other market developments, shocks to fundamental drivers or even inflation in the period ahead. There is no prediction as to how long a correction might take, but the figures are benchmarked to outturn for the MSCI rent series over the following five years. Outturn is measured in real terms and no inflation prediction has been added to the implied correction at each date. The blue series tracks the actual growth of the index from each date to a date five years hence, with the final value in that series showing real rental growth from 2013 Q4 to 2018 Q4. This then can be compared to the implied correction from the results of different models as at 2013 Q4.

The rolling window results suggest that implied corrections based on the conventional econometric approach most closely resemble subsequent outturn. The anchored window results are more mixed, suggesting initially that outputs from the trend-based approach match outturns the best. However, in both cases, the approaches only do well with signalling the growth and decline in rental values of the late 1990s and early 2000s, whereas they perform poorly for periods that include GFC years, failing to predict the extent of the decline in rents as the UK economy slowed. This suggests the specific triggers for growth and decline are important, but it requires further study at sector level to ensure that the aggregation of data into 'All Property' does not distort the picture.

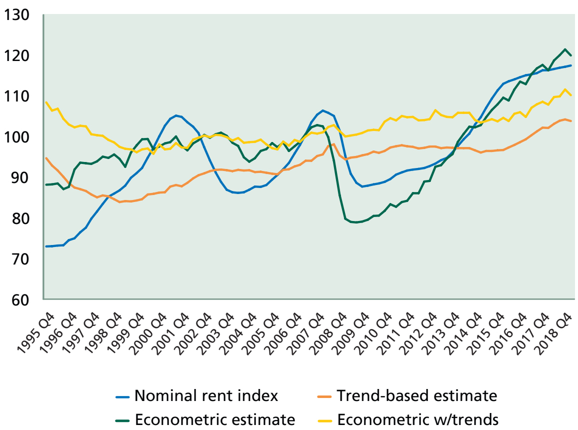
2. SUSTAINABLE RENTS

Figure 2.4: Sustainable Rental Values and the MSCI Rental Value Index through Time – Sectors

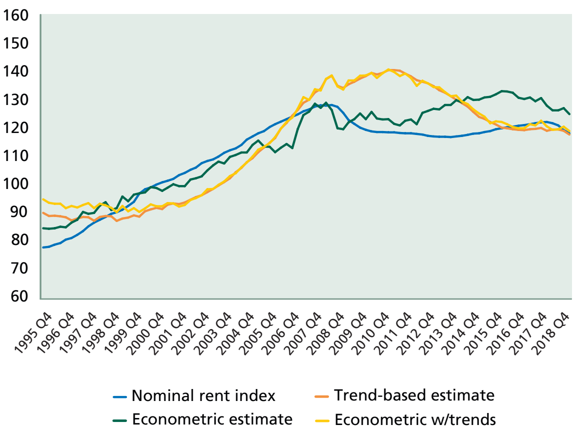
Office – Rolling Windows



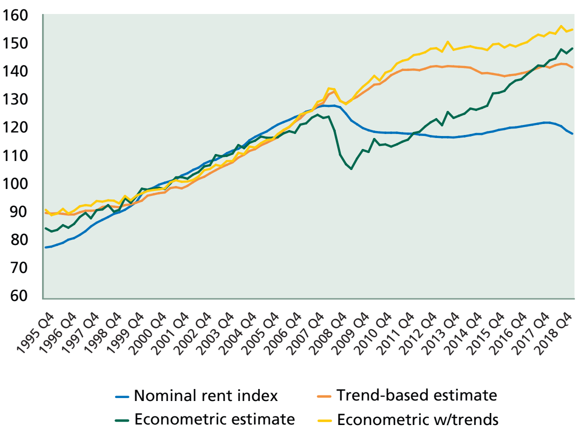
Office – Anchored Windows



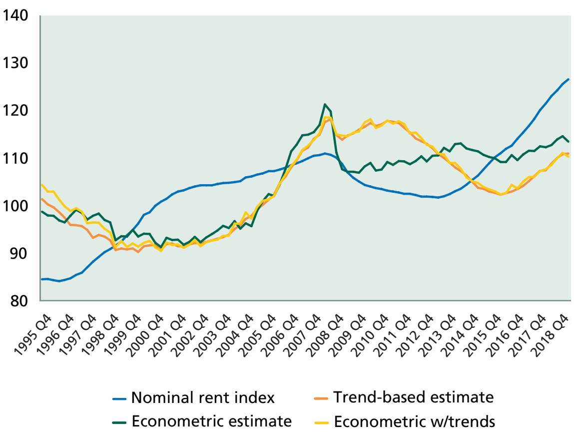
Retail – Rolling Windows



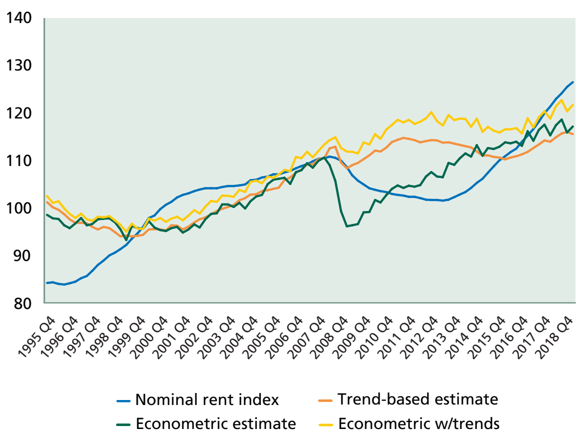
Retail – Anchored Windows



Industrial – Rolling Windows



Industrial – Anchored Window

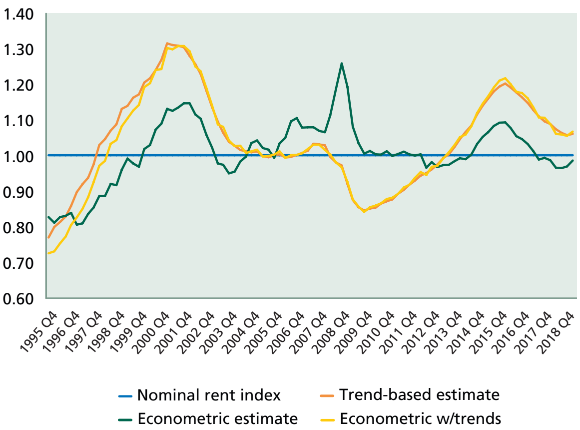


Sustainable rental values are measured using real rental value series and then reflated into nominal terms. These results are based on using Retail Price Index as the deflator. The reference period for the nominal rent index is 2000 Q4 where the index = 100.

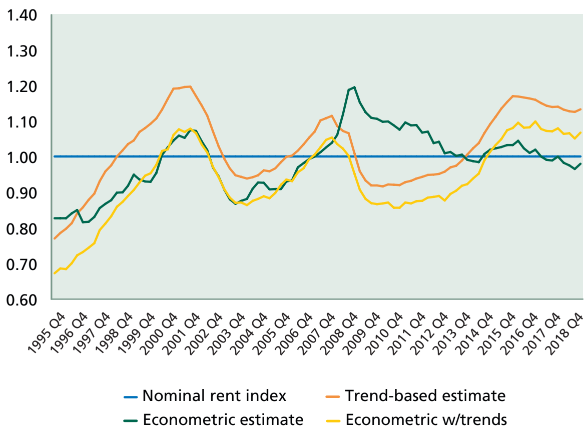
2. SUSTAINABLE RENTS

Figure 2.5: Ratio of MSCI Rental Value Index to Sustainable Rental Value – Sectors

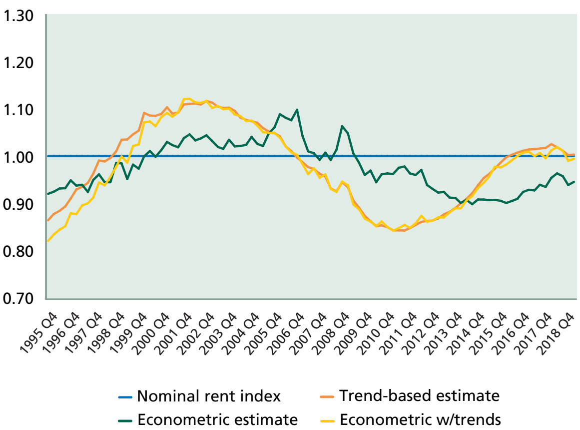
Office – Rolling Windows



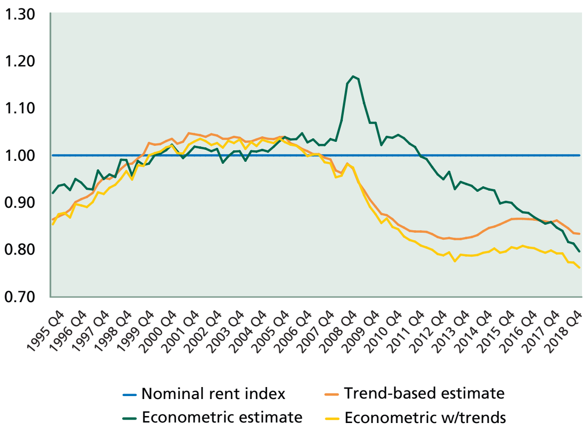
Office – Anchored Windows



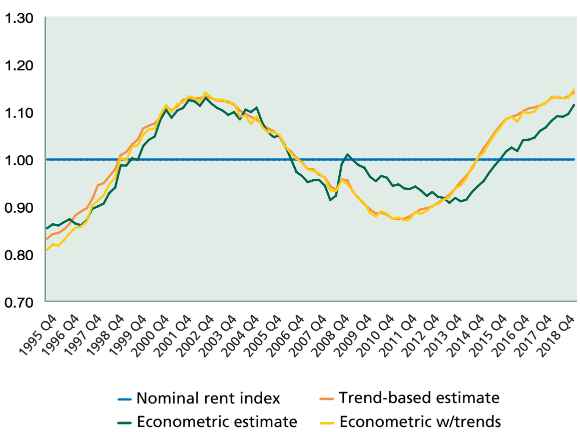
Retail – Rolling Windows



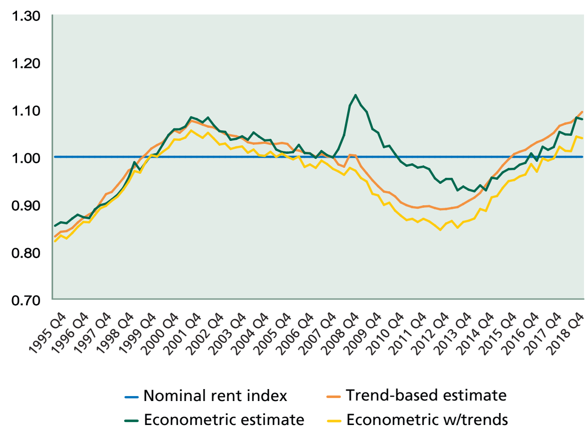
Retail – Anchored Windows



Industrial – Rolling Windows



Industrial – Anchored Window

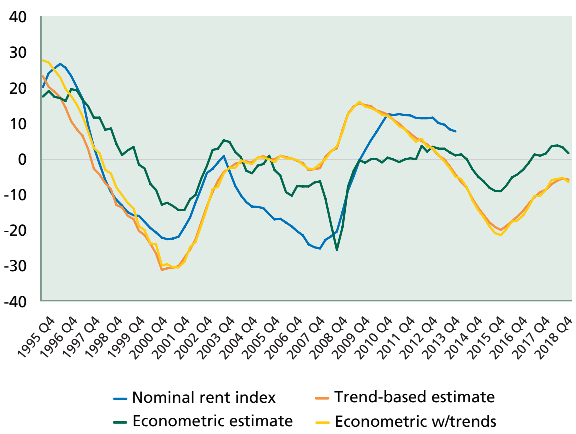


Sustainable rental values are measured using real rental value series and then reflated into nominal terms. The ratio divides the actual rental value index by the sustainable rental value at each time point. These results are based on using Retail Price Index as the deflator.

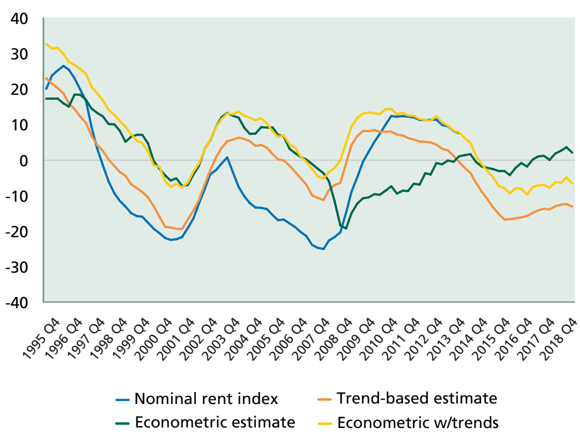
2. SUSTAINABLE RENTS

Figure 2.6: Implied Correction in Rental Values vs. Subsequent Five-Year Outturn in the MSCI Series – Sectors

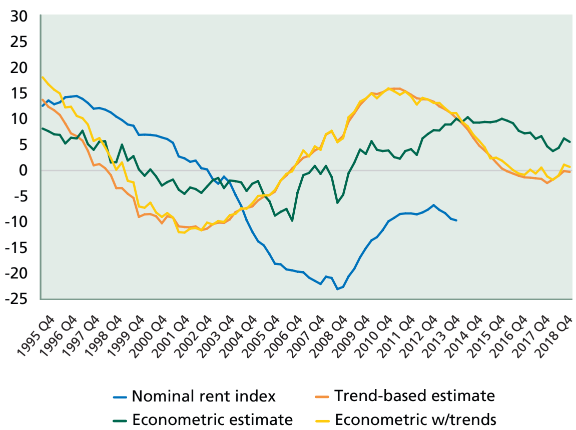
Office – Rolling Windows



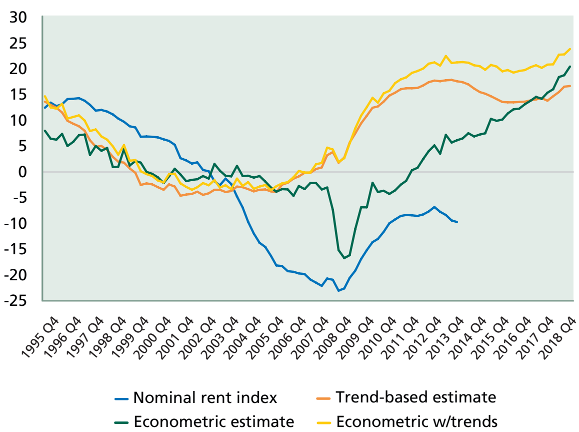
Office – Anchored Windows



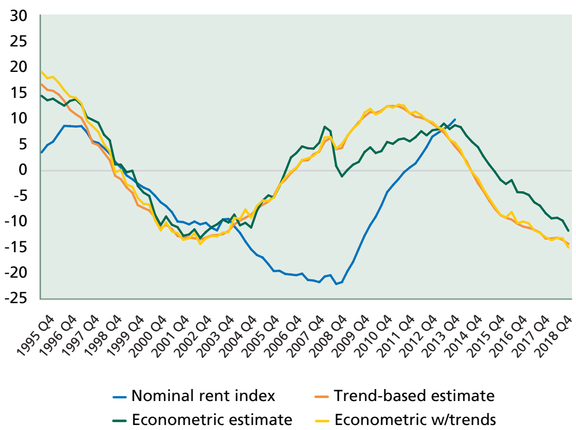
Retail – Rolling Windows



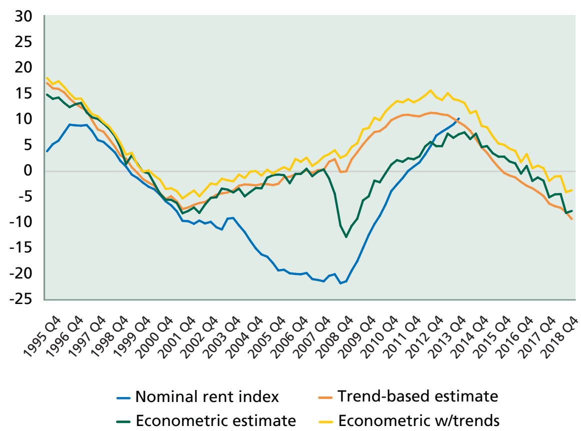
Retail – Anchored Windows



Industrial – Rolling Windows



Industrial – Anchored Window



2. SUSTAINABLE RENTS

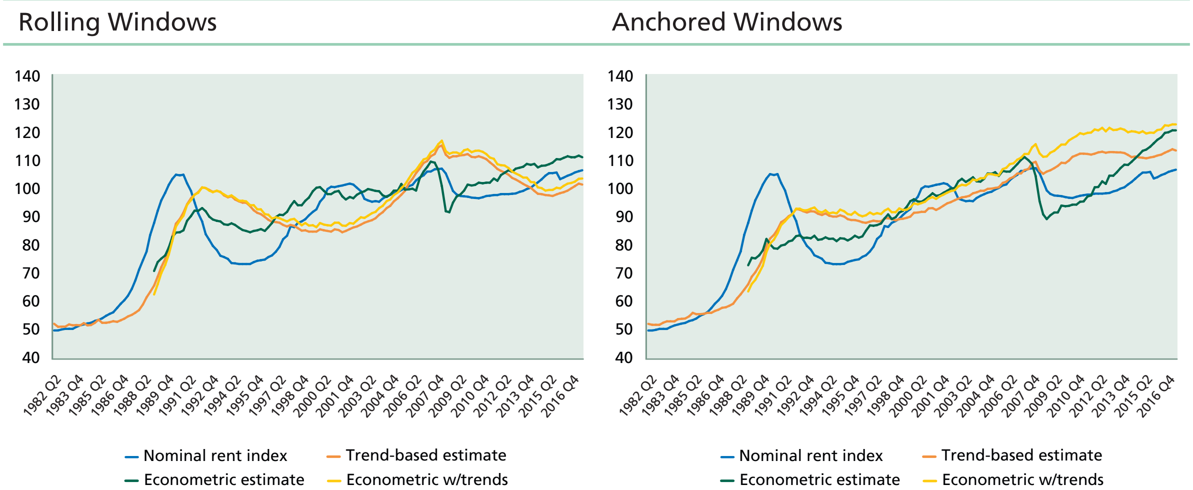
Implied corrections indicate the real rental growth that is required for rental values to equal sustainable rental values. (A positive number implies that rents need to rise and vice versa.) These are compared with the recorded real rental growth for the five-year period following the date indicated.

Figure 2.4 shows estimates of sustainable rental value at sector level. The patterns in the office sector results are not dissimilar to those discussed for All Property, though the results for anchored windows show a greater spread in outcomes across the approaches used. The retail sector index was much less cyclical, with a prolonged period of growth from the mid-1990s to the mid-2000s that the sustainable rental values broadly follow. There is a divergence between sustainable rental values and the actual index in the latter part of the period that is only corrected in results for rolling window trend-based models from 2016 onwards. This may reflect the structural changes currently affecting UK retail and all models that are calibrated on historical data will have difficulty in gauging sustainable values and possible market adjustments in the presence of such structural change.

Figure 2.5 shows the ratios of actual to sustainable rental value by sector. Trend-based models identify periods of sustained under and over valuation in all cases, as does the trend-input approach. Results from the standard econometric approach are more erratic. Figure 2.6 illustrates whether corrections in rental values implied by different models are borne out by subsequent real rent growth. This appears to be the case for the late 1990s and early 2000s in the office and industrial sectors, and to a more limited extent for the office sector post-GFC. Yet, implied corrections do not match subsequent outturn post-GFC for the retail and industrial sectors. Once again, this might reflect ongoing structural changes in these sectors. Note that results from formal tests of the forecasting ability of each approach are presented in Section 2.5.

The start date for the MSCI rental indexes is not early enough to allow estimation of sustainable rental values for the late 1980s and early 1990s cycle in UK real estate rents, but the JLL index begins in the 1960s. The first estimation window (whether rolling or anchored) for the JLL data is from 1967 Q2 to 1982 Q1, so sustainable rental values can be estimated from 1982 Q2.

Figure 2.7: Sustainable Rental Values and the JLL Rental Value Index through Time

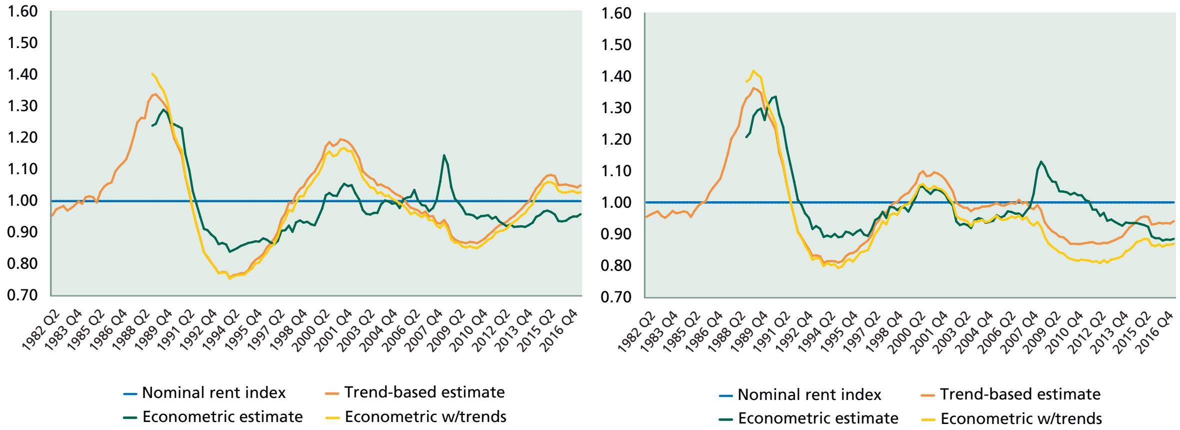


Sustainable rental values are measured using real rental value series and then reflated into nominal terms. These results are based on using Retail Price Index as the deflator. The reference period for the nominal rent index is 2000 Q4 where the index = 100.

2. SUSTAINABLE RENTS

Figure 2.8: Ratio of JLL Rental Value Index to Sustainable Rental Value

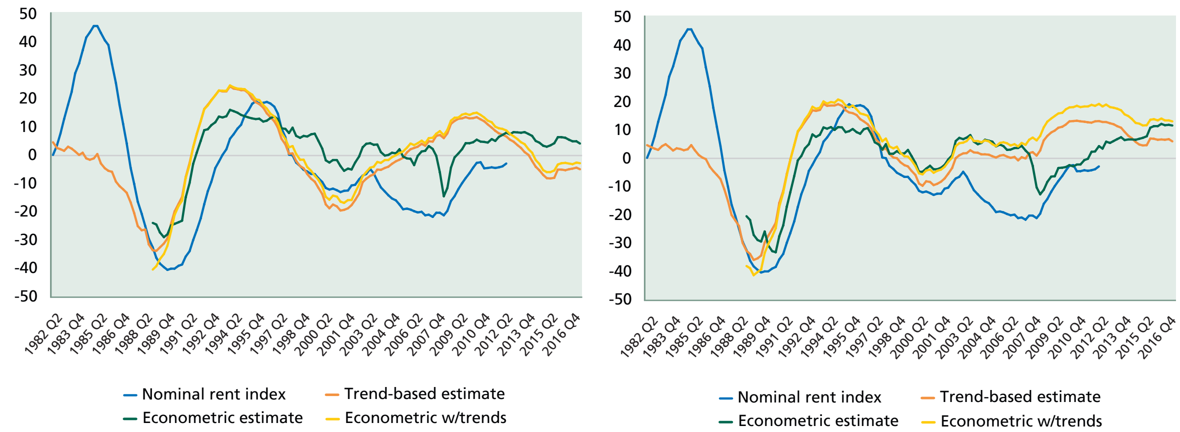
Rolling Windows | Anchored Windows



Sustainable rental values are measured using real rental value series and then reflated into nominal terms. The ratio divides the actual rental value index by the sustainable rental value at each time point. These results are based on using Retail Price Index as the deflator.

Figure 2.9: Implied Correction in Rental Values vs. Subsequent Five-Year Outturn in the JLL Series

Rolling Windows | Anchored Windows



Implied corrections indicate the real rental growth that is required for rental values to equal sustainable rental values. (A positive number implies that rents need to rise and vice versa.) These are compared with the recorded real rental growth for the five-year period following the date indicated.

2. SUSTAINABLE RENTS

Figures 2.7-2.9 show sustainable rental values, ratios and implied corrections for models estimated using the JLL All Property rent index. Figure 2.7 shows that the two rental cycles analysed using the MSCI data are dwarfed by the increase and decrease in rental values in the late 1980s and early 1990s. Both the trend-based and econometric approaches seem to generate sustainable rental values that follow the boom upwards and then follow the slump downwards, this being more marked when using rolling windows and most marked with the trend-based models and the trend-input approach. For the later years, the results mirror those found from using the MSCI data.

Figure 2.8 shows that the ratios of actual to sustainable rental values were much higher in the late 1980s and much lower in the early 1990s than for subsequent cycles. Meanwhile, Figure 2.9 shows the corrections required to restore rental values to sustainable levels based on the ratios of actual to sustainable values. Despite the apparent lag in sustainable rental values shown by Figure 2.7, implied corrections from the different models correspond well with subsequent real rent growth through the 1980s and 1990s. They do not signal the magnitude of the boom in the late 1980s, but they do capture the magnitude of the downturn in the early 1990s. The trend-based and trend-input approaches also indicate the correction in rental values in the early 2000s, but they struggle thereafter in line with the results shown earlier for the MSCI dataset.

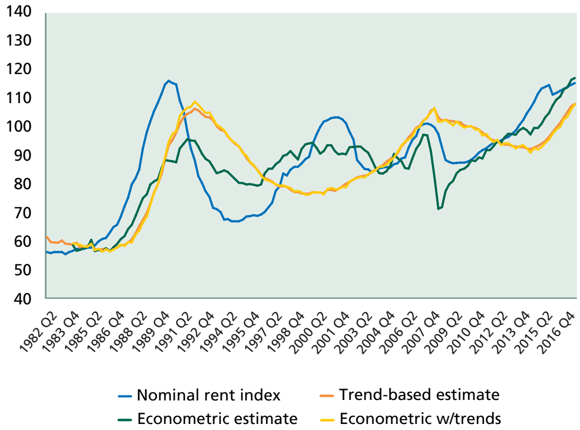
Figures 2.10-2.12 show the sector level results for the JLL dataset. These results echo patterns found in the earlier analyses. For all three sectors, the sustainable rental value series generated by different approaches appear to follow actual rental values through the late 1980s and early 1990s. Despite this, the implied corrections map on well to the downturn in real rental values for the early 1990s. This holds both for trend-based and econometric approaches. The models perform reasonably well for all three sectors in the earlier years, but similar patterns emerge for the later years whereby sustainable rental values diverge substantially from actual rental values in the case of the retail sector.

Although it has a longer history, the JLL index is like the MSCI index in terms of being a portfolio-based measure of rental values, albeit on a smaller sample of assets. This might explain why the results using this index are very similar over the period covered by both series. The CBRE rent and yield monitor offers an alternative perspective based on assessments of what hypothetical prime properties might rent for at different times. Regarding retail, this source monitors high street shops rather than all types of retail. The CBRE dataset enables the conclusions reached using the first two datasets to be checked against both a different source and different type of index.

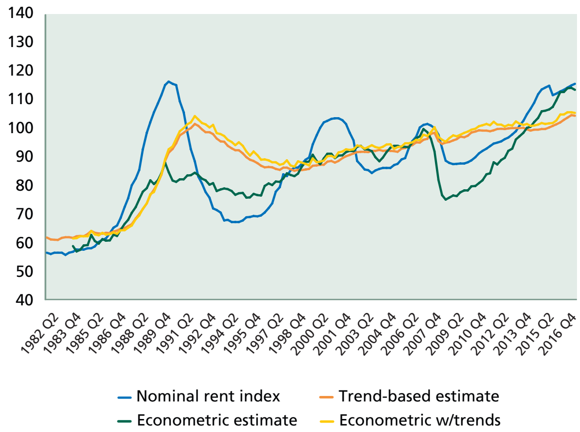
2. SUSTAINABLE RENTS

Figure 2.10: Sustainable Rental Values and the JLL Rental Value Index through Time – Sectors

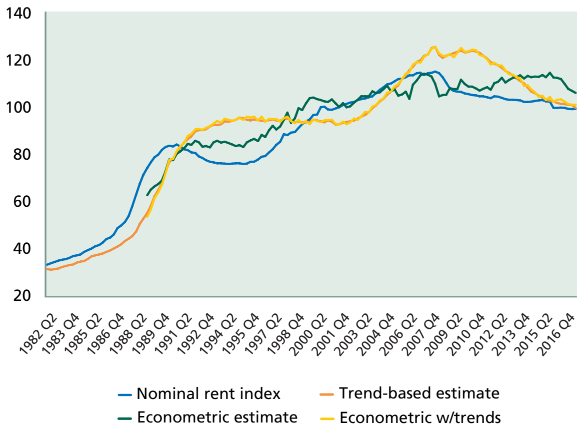
Office – Rolling Windows



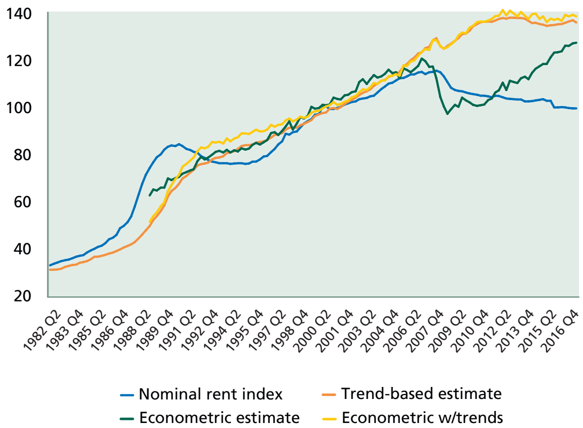
Office – Anchored Windows



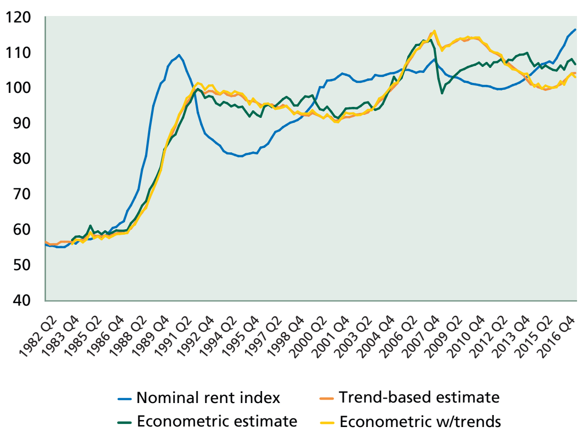
Retail – Rolling Windows



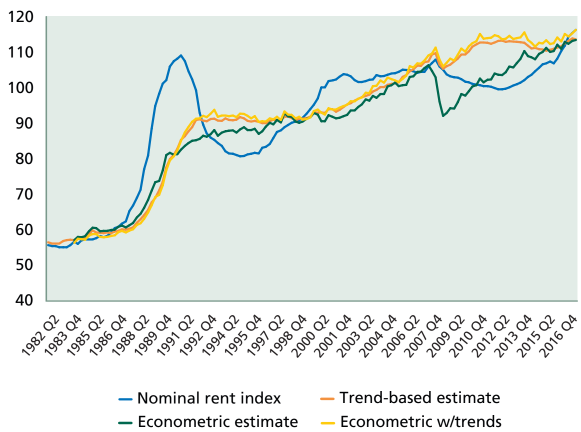
Retail – Anchored Windows



Industrial – Rolling Windows



Industrial – Anchored Window

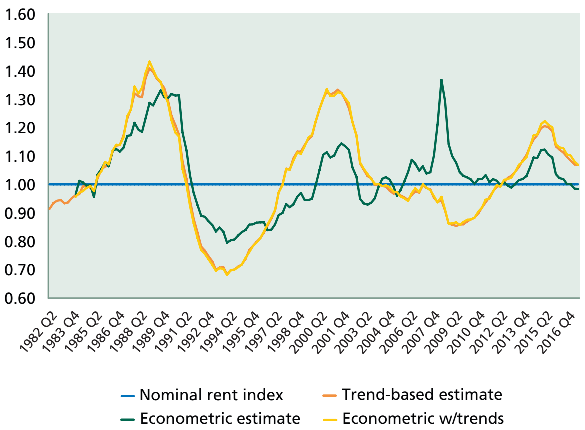


Sustainable rental values are measured using real rental value series and then reflated into nominal terms. These results are based on using Retail Price Index as the deflator. The reference period for the nominal rent index is 2000 Q4 where the index = 100.

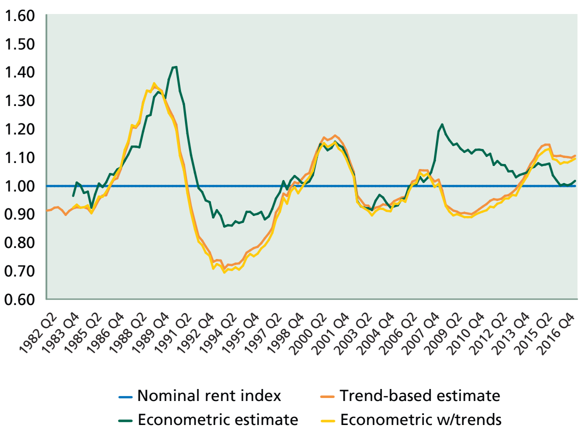
2. SUSTAINABLE RENTS

Figure 2.11: Ratio of JLL Rental Value Index to Sustainable Rental Value – Sectors

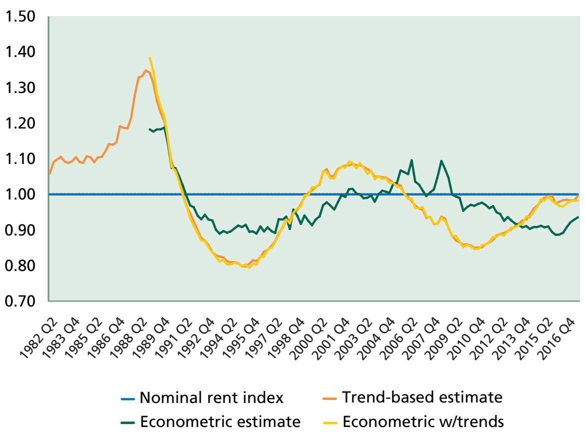
Office – Rolling Windows



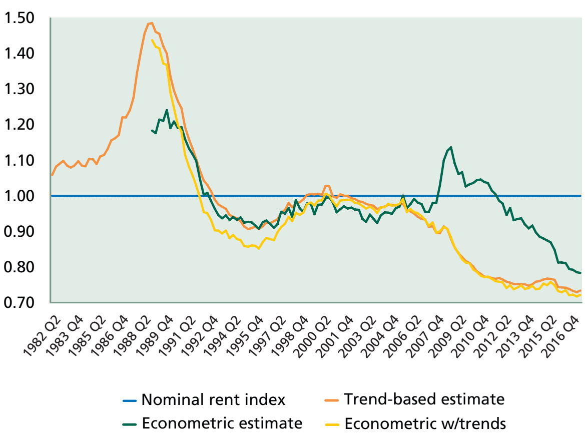
Office – Anchored Windows



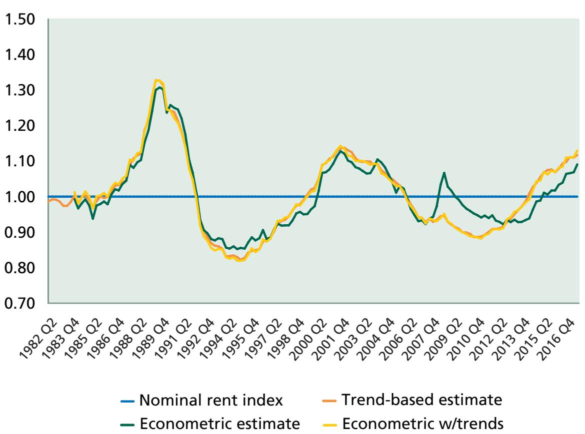
Retail – Rolling Windows



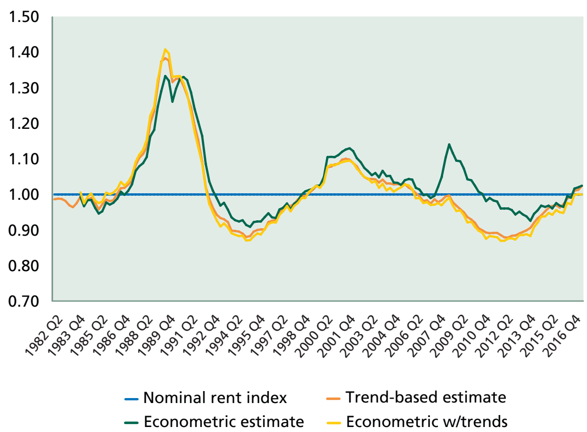
Retail – Anchored Windows



Industrial – Rolling Windows



Industrial – Anchored Window

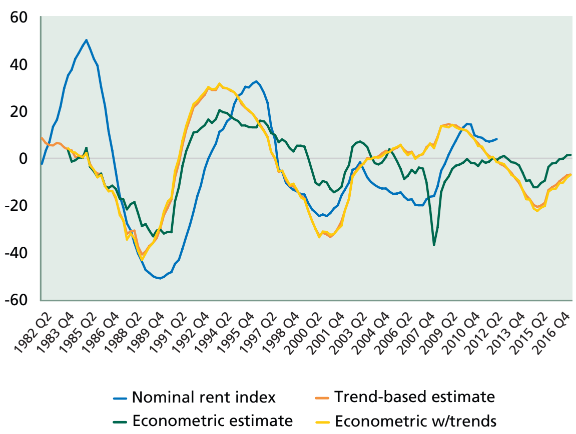


Sustainable rental values are measured using real rental value series and then reflated into nominal terms. The ratio divides the actual rental value index by the sustainable rental value at each time point. These results are based on using Retail Price Index as the deflator.

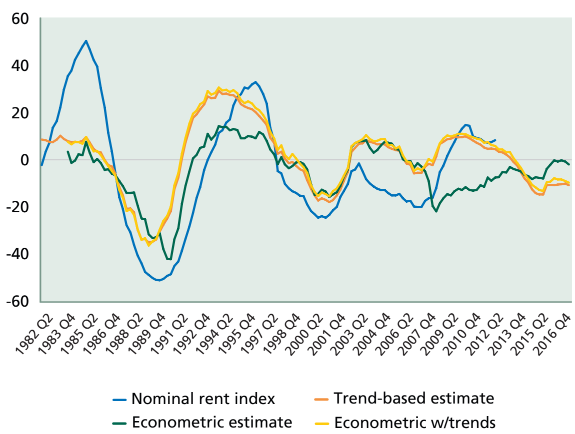
2. SUSTAINABLE RENTS

Figure 2.12: Implied Correction in Rental Values vs. Subsequent Five Year Outturn in the JLL Series – Sectors

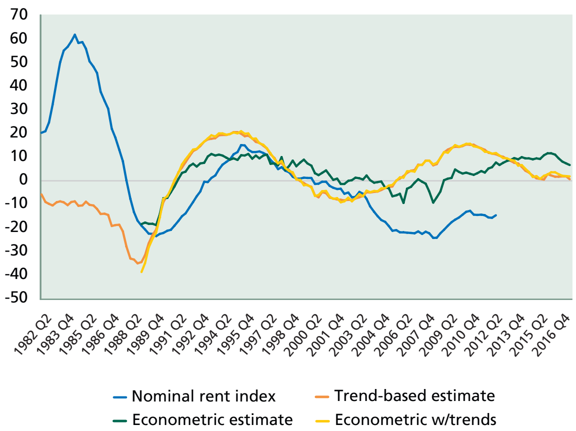
Office – Rolling Windows



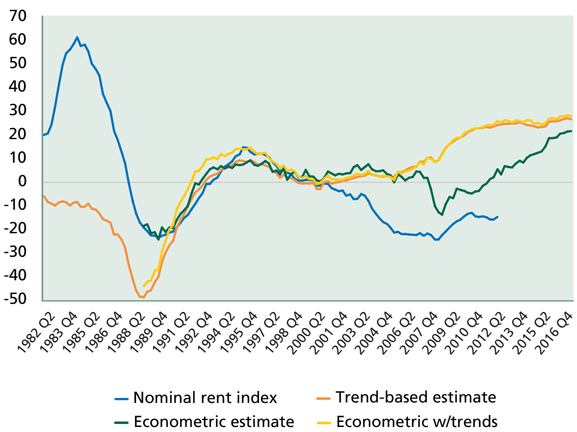
Office – Anchored Windows



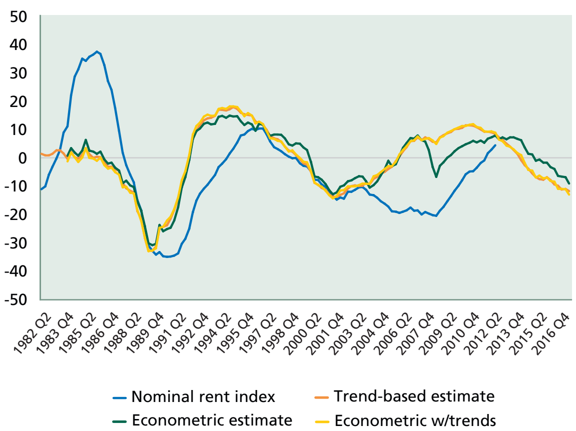
Retail – Rolling Windows



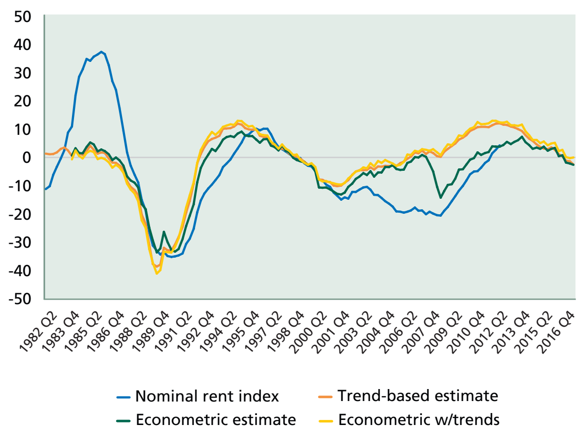
Retail – Anchored Windows



Industrial – Rolling Windows



Industrial – Anchored Window



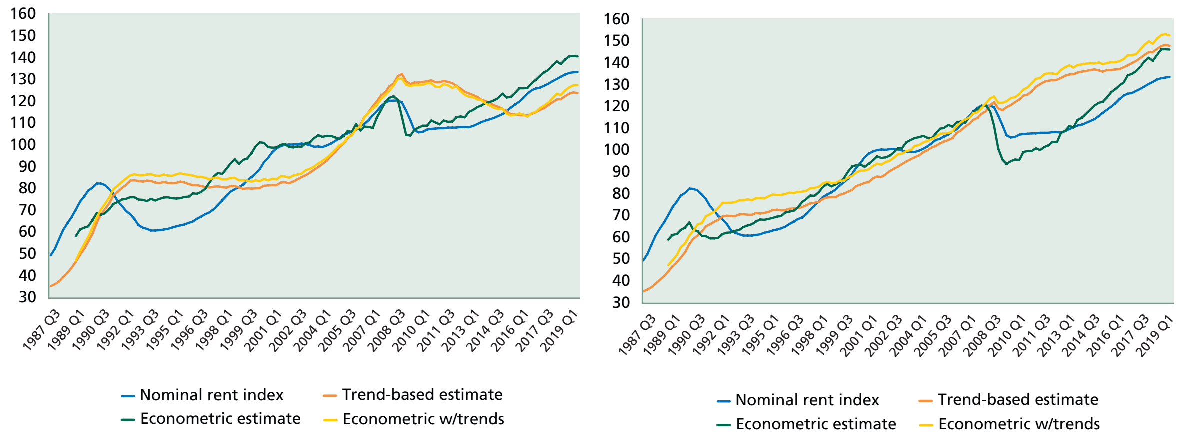
Implied corrections indicate the real rental growth that is required for rental values to equal sustainable rental values. (A positive number implies that rents need to rise and vice versa.) These are compared with the recorded real rental growth for the five-year period following the date indicated.

2. SUSTAINABLE RENTS

The CBRE rent monitor series begins in the 1970s and the first estimation window for this dataset is from 1972 Q3 to 1987 Q2, allowing sustainable rental values to be measured from 1987 Q3. Figure 2.13 plots the All Property sustainable rental values based on this series. This shows that sustainable rental values exhibit some pronounced divergences from actual rental values that mirror those found from using the MSCI and JLL datasets. Despite the different basis for this index, the All Property results are similar and reinforce the conclusions and insights into the relative behaviour of the three approaches used to estimate sustainable rental values.

Figure 2.13: Sustainable Rental Values and the CBRE Rent Monitor Series through Time

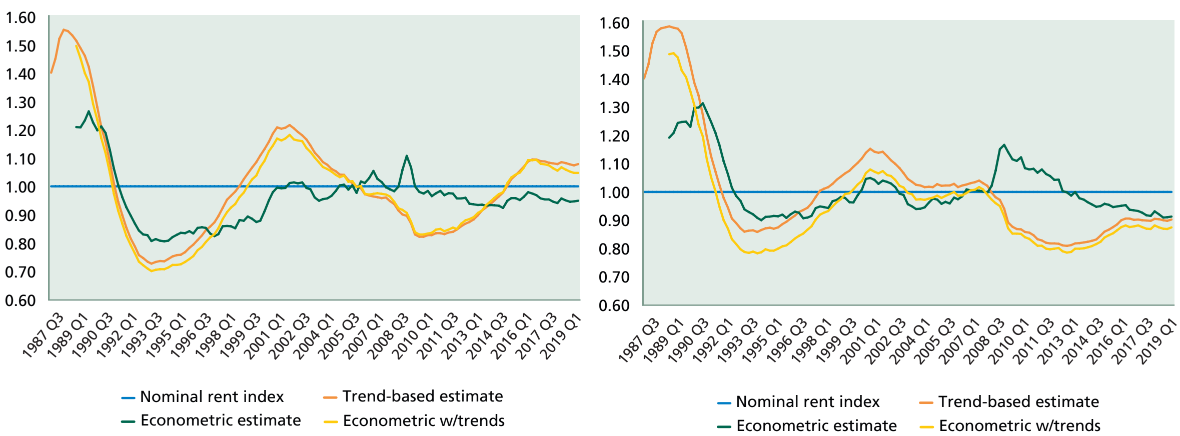
Rolling Windows | Anchored Windows



Sustainable rental values are measured using real rental value series and then reflated into nominal terms. These results are based on using Retail Price Index as the deflator. The reference period for the nominal rent index is 2003 Q1 where the index = 100.

Figure 2.14: Ratio of CBRE Rent Monitor Series to Sustainable Rental Value

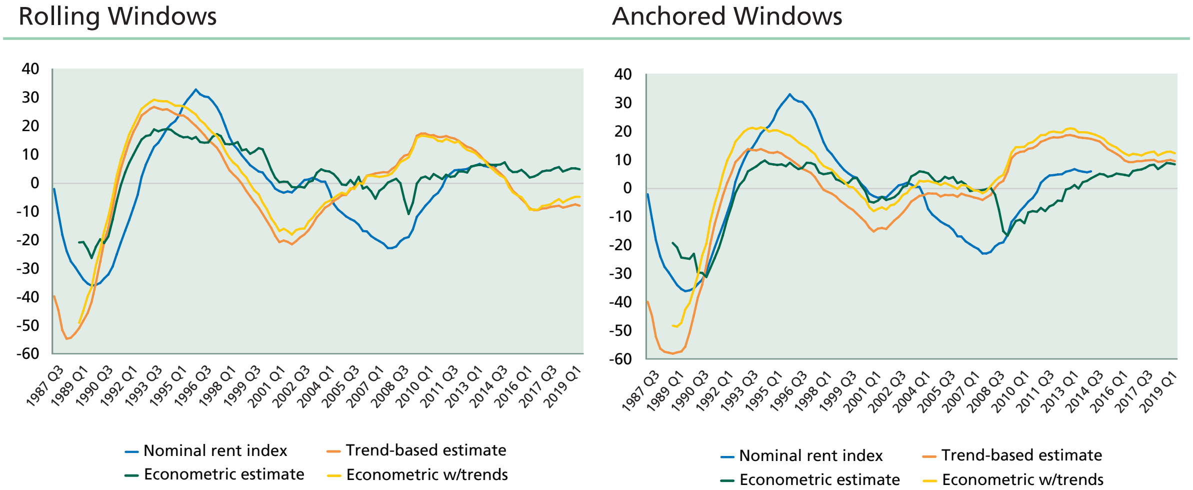
Rolling Windows | Anchored Windows



Sustainable rental values are measured using real rental value series and then reflated into nominal terms. The ratio divides the actual rental value index by the sustainable rental value at each time point. These results are based on using Retail Price Index as the deflator.

2. SUSTAINABLE RENTS

Figure 2.15: Implied Correction in Rental Values vs. Subsequent Five-Year Outturn in the CBRE Series



Implied corrections indicate the real rental growth that is required for rental values to equal sustainable rental values. (A positive number implies that rents need to rise and vice versa.) These are compared with the recorded real rental growth for the five-year period following the date indicated.

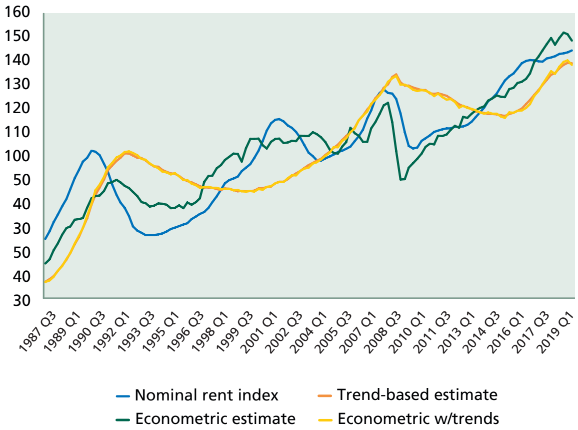
Figure 2.14 shows the ratios of actual to sustainable rental value for the CBRE series and Figure 2.15 shows the implied corrections required to return rental values to sustainable levels based on these ratios. All the approaches seem to do well at signalling subsequent real rent growth for the late 1980s and early 1990s. For the early 2000s, trend-based and trend-input approaches suggest larger drops in real rental values than transpired, while the standard econometric model was better at gauging the magnitude. However, for all approaches, the results are weak for the post-GFC drop in rental values, echoing the findings using other datasets.

Finally, Figures 2.16 to 2.18 show sector level results based on CBRE data. Of the three property types, the office sector appears to be the one where the models perform best in terms of tracking the general trend and signalling corrections in rental value. For the industrial sector, there seems to be moderately good signalling of market movements before the GFC, but divergence between the trend-based model outputs and actual real rent growth thereafter. It is the shop sector, though, that the models struggle most to capture. This includes overstating the scale of the 1990s downturn, under-predicting growth in the early 2000s, and failing to signal adequately a post-GFC correction in rental values, especially in the case of the trend-based and trend-input models.

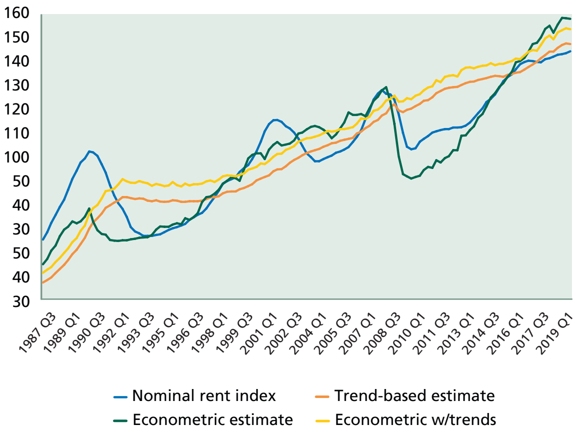
2. SUSTAINABLE RENTS

Figure 2.16: Sustainable Rental Values and the CBRE Rent Monitor Series Through Time – Sectors

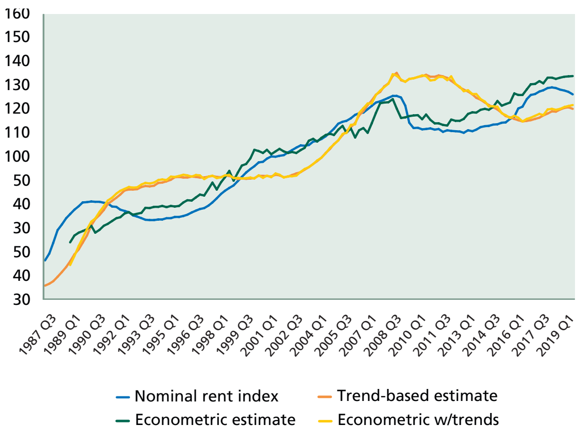
Office – Rolling Windows



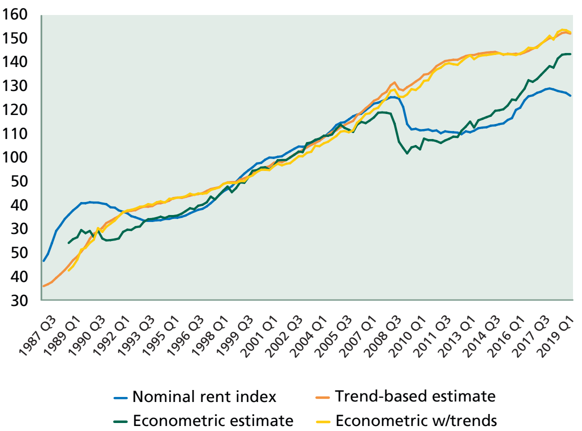
Office – Anchored Windows



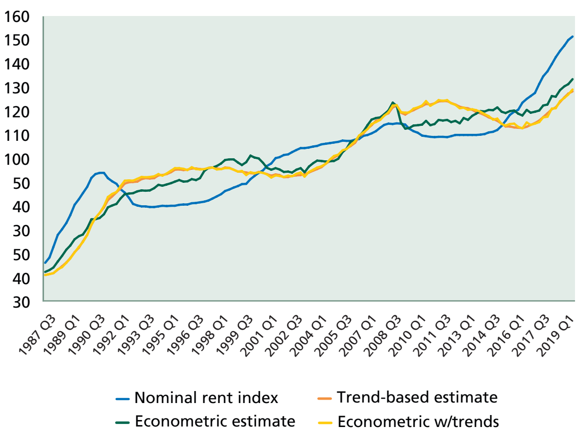
Retail – Rolling Windows



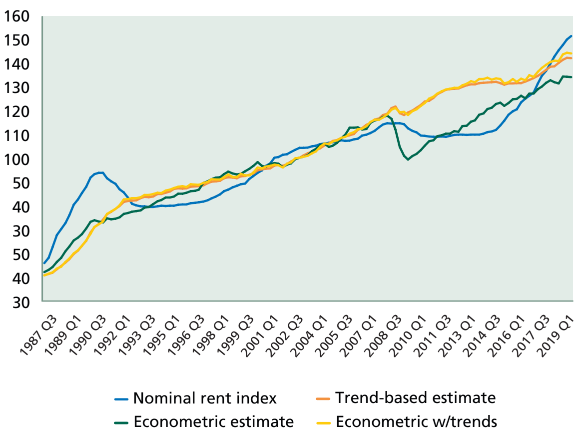
Retail – Anchored Windows



Industrial – Rolling Windows



Industrial – Anchored Window

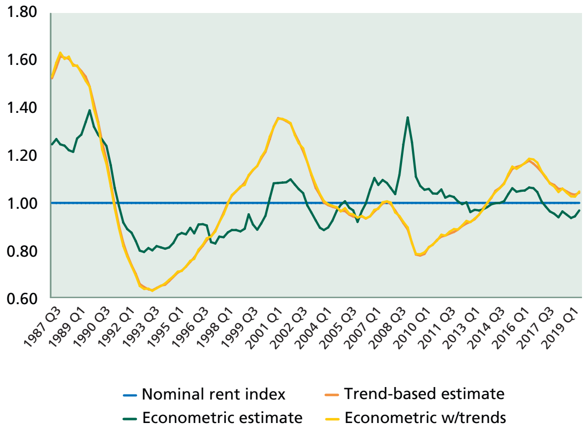


Sustainable rental values are measured using real rental value series and then reflated into nominal terms. These results are based on using Retail Price Index as the deflator. The reference period for the nominal rent index is 2003 Q1 where the index = 100.

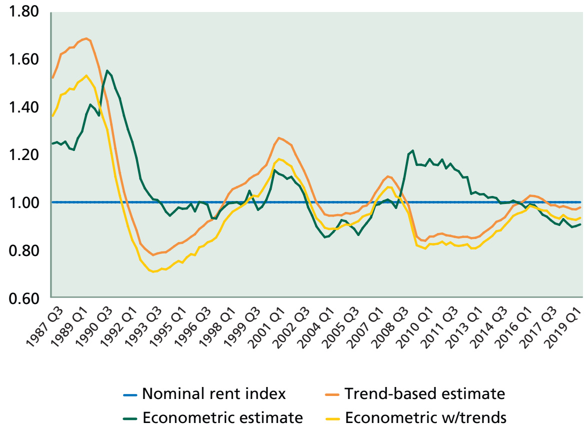
2. SUSTAINABLE RENTS

Figure 2.17: Ratio of CBRE Rent Monitor Series to Sustainable Rental Value – Sectors

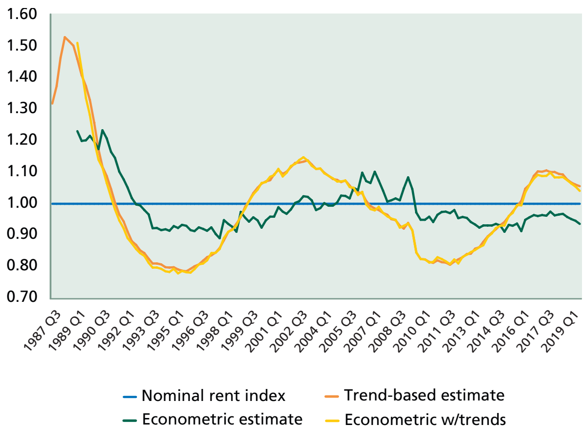
Office – Rolling Windows



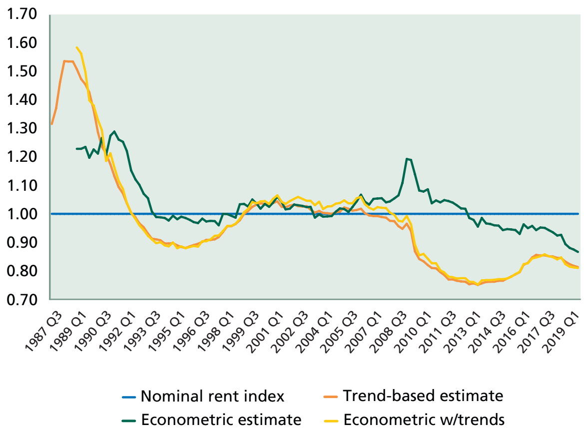
Office – Anchored Windows



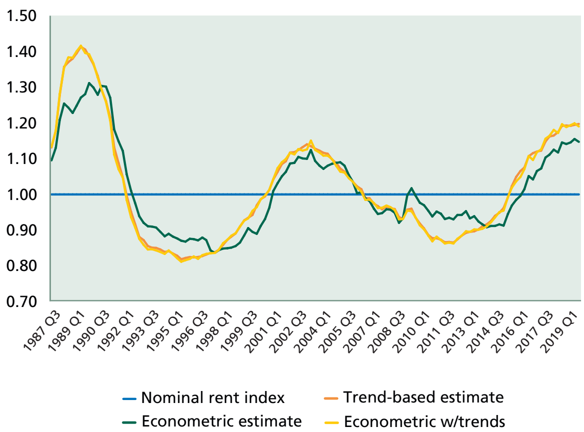
Retail – Rolling Windows



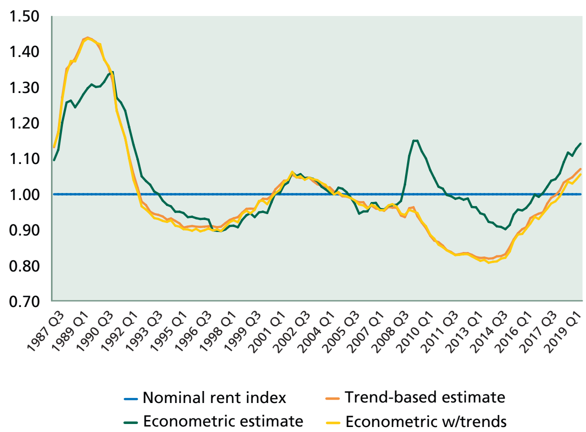
Retail – Anchored Windows



Industrial – Rolling Windows



Industrial – Anchored Window

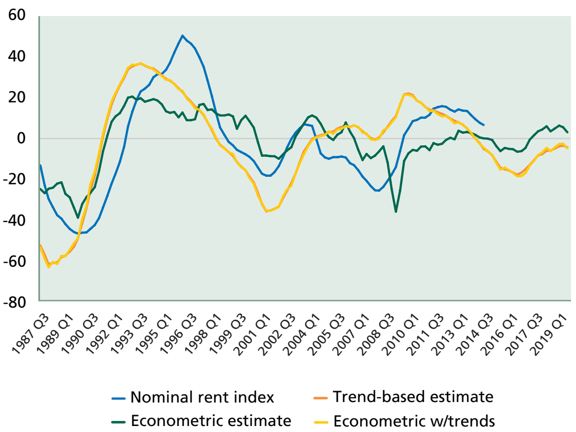


Sustainable rental values are measured using real rental value series and then reflated into nominal terms. The ratio divides the actual rental value index by the sustainable rental value at each time point. These results are based on using Retail Price Index as the deflator.

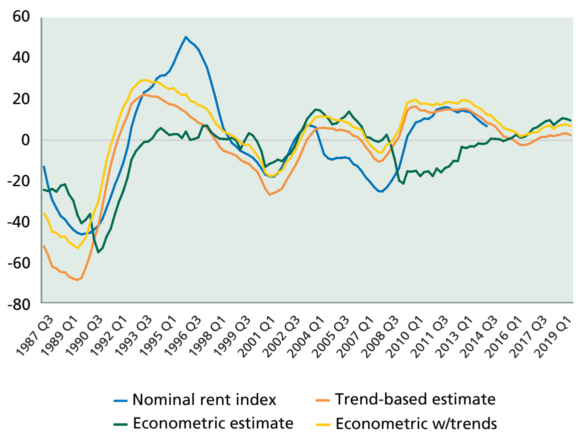
2. SUSTAINABLE RENTS

Figure 2.18: Implied Correction in Rental Values vs. Subsequent Five Year Outturn in the CBRE Series – Sectors

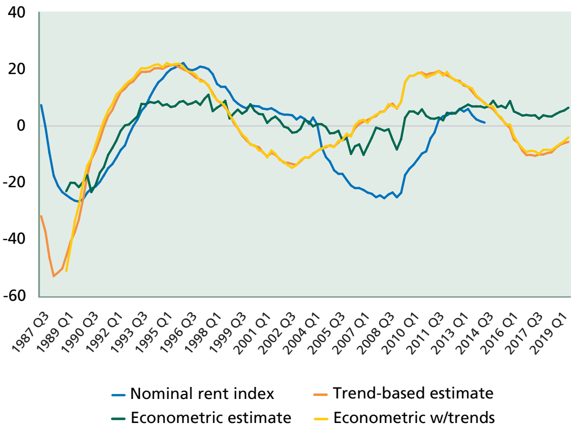
Office – Rolling Windows



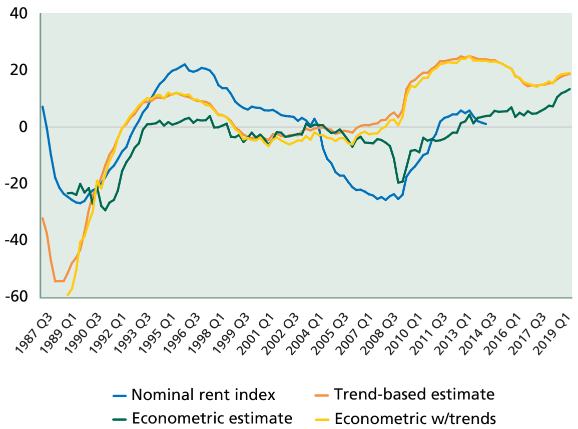
Office – Anchored Windows



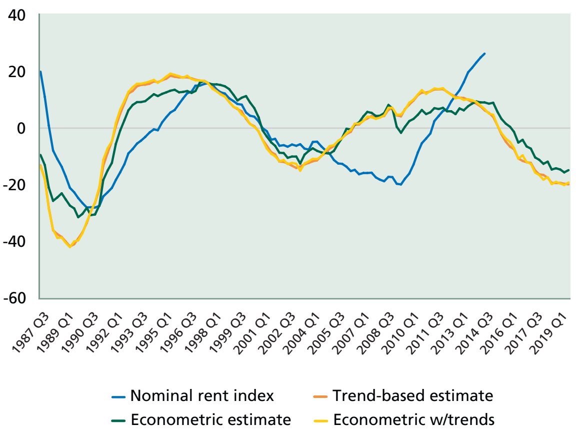
Retail – Rolling Windows



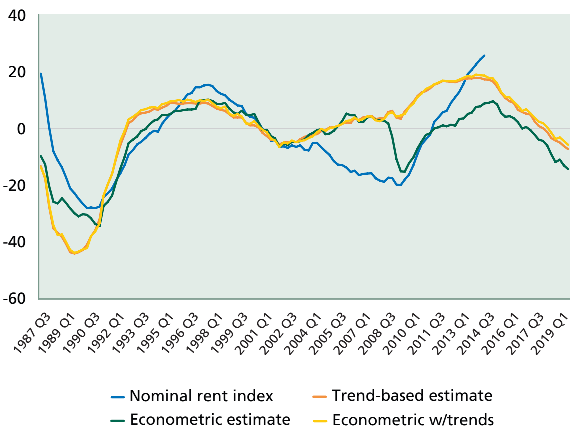
Retail – Anchored Windows



Industrial – Rolling Windows



Industrial – Anchored Window



Implied corrections indicate the real rental growth that is required for rental values to equal sustainable rental values. (A positive number implies that rents need to rise and vice versa.) These are compared with the recorded real rental growth for the five-year period following the date indicated.

2. SUSTAINABLE RENTS

Across the three datasets, results for the trend-based approach are like those from the trend-input approach. Therefore, there is little to be gained by using both. In contrast, using conventional inputs to forecast sustainable rental values from econometric models produces a distinct series that appears to work better in some periods than the trend-based series. All approaches perform reasonably well for the 1980s and 1990s, but all have difficulty in signalling the post-GFC drop in rental values. Yet, it is hard within a visual framework to formally discern which approach is statistically superior, so the next section presents statistical tests of the ability of each approach to capture subsequent corrections, drawing on tests from the literature on forecasting accuracy.

2.5. Statistical Testing of Market Correction Forecasts

In this section, the market corrections implied by the difference between sustainable rental value and the reported rental value index are examined further. They are treated as forecasts of subsequent real rental growth and benchmarked against the growth experienced in the market over the following five years. Although the purpose of such indicators is to function as signals or warnings rather than precise forecasts, measures and tests of forecasting accuracy provide a formal framework for comparing the different models. They can capture the scale of any errors in assessing subsequent market outcomes, whether there are tendencies to understate or overstate future market movements, and the ability of a model to outperform naïve forecasts or a competing model.

Ling (2005), Tsolacos (2006), McAllister et al. (2008) and Papastamos et al. (2015) all comment on the paucity of analyses of real estate forecasts versus the significant number of studies that have looked at the forecasting of macro-economic series and stock markets. Nonetheless, literature on real estate forecasting has grown, often with a focus on comparing either published forecasts or model outputs against market outcomes over one and two year horizons. This study is different in considering longer-term real estate market adjustments. However, although a five-year horizon has been chosen for the analysis, it cannot be stated with certainty that this is the most appropriate horizon, though it appears to work better than other lengths of time for the periods studied in this research.

The main measures of forecasting accuracy presented in this section are standard measures that have been used regularly in the literature.[13] In particular, the following three measures are used to indicate accuracy and bias:

- Mean Error (ME): the average of the differences between the outturn and the forecast, taking the direction of the difference into account. This captures whether, on average, subsequent market movements were above or below the prediction;
- Mean Absolute Error (MAE): the average of the differences in absolute terms between outturn and forecast. This captures the scale of the differences between predictions and subsequent market movements; and
- Root Mean Squared Error (RMSE): the square root of the average of the squared differences between outturn and forecast. This captures the scale of the differences between predictions and subsequent market movements, but punishes large errors more than the MAE.

[13] See Tsolacos (2006) and Brooks & Tsolacos (2010) for more discussion and presentation of the formulas.

2. SUSTAINABLE RENTS

Three tests are then used to further evaluate the quality of the forecasts. Theil (1966, 1971) proposes two metrics. The U1 metric scales the RMSE to the root of the average squared outturns plus the root of the average squared forecasts. The closer to zero for the U1 metric, the better the accuracy of the forecast. The U2 metric compares the mean squared error for a set of forecasts to the mean squared error of an alternative set of forecasts, usually a naïve model. The naïve model specified here was to assume that the real rental growth rate observed for the previous five years continued into the next five years. If the U2 metric is less than 1, then the forecasts from the model are better than the naïve (or alternative) approach.

Finally, the third test used here was that proposed by Diebold & Mariano (1995) (hereafter DM test). This also compares the forecasts of a selected model against those of an alternative model. The null hypothesis of the test is that there is no difference in the accuracy of two sets of forecasts as captured by the errors. The alternative hypothesis is that one set of forecasts is more accurate than the other. This is assessed by first calculating the loss differential, which is the difference between the forecast errors from one model and the forecast errors from another. In this case, absolute errors have been used. The loss differential is then regressed on to a constant term and the statistical significance of the resulting coefficient is tested using conventional standard errors and standard errors adjusted for serial correlation.

Each of these measures and tests has been used in previous studies that have examined the accuracy of forecasts for UK real estate using the IPF consensus forecast dataset (see Tsolacos, 2006; McAllister et al., 2006; McAllister et al., 2008; Matysiak et al., 2012; Papastamos et al., 2015). This consists of a sample of forecasts from real estate investors, service providers and independent research firms that is gathered each quarter, with the average forecast and range in the forecasts then published by IPF. Although the consensus forecast dataset includes five year forecasts for rental growth, capital growth and total return from 2005 onwards, analysis has focused on the performance of either the consensus itself or the underlying forecasts over shorter timescales.

The consensus forecasts are not considered here because the time series for the five-year forecasts is relatively short, particularly in the light that a comparison to outturn requires five years of subsequent real rental growth to be observed. So, while sustainable rental values and implied market corrections can be measured up to the end of 2018, testing can only be done on the implied corrections measured up to 2013, as the implied corrections measured in that year are compared to subsequent real rental growth over 2013-2018 to test their accuracy. Furthermore, the consensus forecasts are reported in nominal terms and so forecasts of inflation would be needed either to convert these to real terms or to adapt the implied corrections from the sustainable rental value models. Hence, testing focuses on the same models for which results were presented above in Section 2.4.

2. SUSTAINABLE RENTS

Table 2.2: Forecast Accuracy for Models Based on MSCI All Property Rental Value Indexes

Panel A: Models Using Rolling Windows	ME	MAE	RMSE	Theil U1	Theil U2
Trend-based estimates	-5.5	11.4	13.5	0.63	1.36
Econometric estimates	-6.2	7.0	9.2	0.53	0.93
Econometric model using trends	-5.9	11.2	13.5	0.61	1.36
Past growth continues (naïve)	-2.6	8.1	9.9	0.55	1.00
Panel B: Models Using Anchored Windows					
Trend-based estimates	-7.7	8.7	11.3	0.58	0.97
Econometric estimates	-6.2	7.1	9.5	0.54	0.82
Econometric model using trends	-12.2	12.2	14.5	0.66	1.25
Past growth continues (naïve)	-2.9	9.5	11.6	0.82	1.00

Comparison based on forecasts dated 1995 Q4 to 2014 Q1, the latter relating to outturn over 2014.1-2019.1.

Table 2.2 presents tests in relation to the MSCI rental value indexes, comparing the implied corrections from models of these series with the subsequent actual outturn in real rental growth. The mean errors are negative for both rolling window and anchored window models, indicating that real rental growth was lower on average than predicted growth based on corrections to sustainable rental value. This is largely a reflection of the GFC period, where all models underestimated the magnitude of the falls in real rent. MAE and RMSE give a consistent ranking whereby the econometric estimates produced the smallest errors on average, followed by the naïve approach and then the trend-based and trend-input approaches. The conventional econometric estimates also produced the best scores on the U1 and U2 metrics.

2. SUSTAINABLE RENTS

Table 2.3: Forecast Accuracy for Models Based on MSCI Sector Rental Value Indexes

	Rolling Windows					Anchored Windows				
A: Office	**ME**	**MAE**	**RMSE**	**U1**	**U2**	**ME**	**MAE**	**RMSE**	**U1**	**U2**
Trend	-2.2	9.9	11.9	0.41	0.78	-4.6	8.2	9.7	0.38	0.57
Econometric	-3.6	9.1	10.3	0.41	0.68	-6.1	15.1	16.4	0.65	0.97
Econ w/trends	-3.3	9.4	11.6	0.39	0.76	-13.5	13.5	15.9	0.55	0.94
Naïve	5.6	13.4	15.2	0.55	1.00	2.5	14.5	16.9	0.75	1.00
B: Retail										
Trend	-6.2	16.0	18.0	0.81	1.35	-8.6	13.9	16.6	0.77	1.13
Econometric	-5.1	10.7	12.1	0.69	0.91	-3.8	8.8	9.9	0.56	0.67
Econ w/trends	-7.3	15.3	17.7	0.78	1.32	-10.1	14.0	17.5	0.77	1.19
Naïve	-9.4	10.4	13.3	0.84	1.00	-8.9	12.2	14.8	0.83	1.00
C: Industrial										
Trend	-7.7	9.7	13.0	0.61	1.33	-9.3	9.3	11.9	0.61	1.06
Econometric	-7.4	8.2	11.7	0.58	1.19	-6.7	7.0	9.3	0.50	0.83
Econ w/trends	-8.3	10.0	13.3	0.61	1.36	-11.6	11.6	13.7	0.67	1.23
Naïve	-0.8	8.3	9.8	0.48	1.00	0.6	9.9	11.2	0.59	1.00

Comparison based on forecasts dated 1995 Q4 to 2014 Q1, the latter relating to outturn over 2014.1-2019.1.

Table 2.3 presents results at sector level for the MSCI dataset. Across the three sectors, there was a tendency for real rental growth to be lower than predicted growth based on corrections to sustainable rental value. For the retail and industrial sectors, the same pattern occurs as at the All Property level, with the smallest error metrics for results based on conventional econometric models. For the office sector, the performance of the trend-based models is much better, with the best performance coming from trend models estimated on anchored windows.

DM tests were conducted comparing the econometric approach with both the naïve and trend-based approaches. The results of these tests were mixed. For All Property (rolling windows) and retail (rolling and anchored windows), the tests suggest that the difference in accuracy between the trend-based and econometric models is statistically significant at the 1% level in favour of the econometric approach. Yet the tests suggest the opposite for the office sector (anchored windows), where the trend-based approach is better. The remaining cases do not show a statistically significant difference between the methods. This rather inconclusive picture might reflect the comparatively short time series of forecast errors available for the MSCI-based results.

2. SUSTAINABLE RENTS

Table 2.4 provides results for the JLL rental value indexes, for which a longer time series of predictions can be tested, including for the 1980s boom and 1990s downturn. Once again, there is a tendency for real rental growth to be lower than predicted growth based on corrections to sustainable rental value. Under-prediction of the 1980s boom in real rental values is counteracted by under-prediction of the subsequent fall, as well as a failure to capture the drop in rental values following the GFC. As with the MSCI dataset, the econometric approach has smaller forecast errors than the other approaches and produces the lowest scores for the U1 and U2 metrics. However, the naïve approach exhibits less bias as indicated by the mean error statistic.

Table 2.4: Forecast Accuracy for Models Based on JLL All Property Rental Value Indexes

Panel A: Models Using Rolling Windows	ME	MAE	RMSE	Theil U1	Theil U2
Trend-based estimates	-3.6	15.8	20.1	0.58	1.26
Econometric estimates	-11.3	12.2	13.6	0.43	0.85
Econometric model using trends	-12.4	13.6	17.3	0.48	1.08
Past growth continues (naïve)	0.9	12.0	16.0	0.57	1.00
Panel B: Models Using Anchored Windows					
Trend-based estimates	-4.7	14.0	17.4	0.52	0.79
Econometric estimates	-8.6	10.3	12.2	0.39	0.56
Econometric model using trends	-14.3	14.8	17.2	0.47	0.78
Past growth continues (naïve)	-1.2	16.9	22.0	0.89	1.00

Comparison based on forecasts dated 1989 Q1 to 2013 Q1, the latter relating to outturn over 2013.1-2018.1.

2. SUSTAINABLE RENTS

Table 2.5: Forecast Accuracy for Models Based on JLL Sector Rental Value Indexes

	Rolling Windows					Anchored Windows				
A: Office	**ME**	**MAE**	**RMSE**	**U1**	**U2**	**ME**	**MAE**	**RMSE**	**U1**	**U2**
Trend	-2.1	16.0	20.8	0.48	0.94	-5.6	14.5	18.1	0.46	0.67
Econometric	-1.6	16.5	19.8	0.51	0.90	0.4	16.5	19.0	0.50	0.71
Econ w/trends	-2.6	16.4	21.5	0.49	0.98	-7.5	15.7	19.4	0.48	0.72
Naïve	6.6	17.6	22.0	0.61	1.00	-0.9	21.6	26.9	0.91	1.00
B: Retail										
Trend	0.6	21.2	27.9	0.78	1.57	2.9	21.8	29.5	0.75	1.20
Econometric	-9.9	10.4	12.5	0.42	0.70	-7.8	9.1	11.9	0.39	0.48
Econ w/trends	-12.3	14.4	17.9	0.51	1.01	-12.7	14.8	20.0	0.53	0.81
Naïve	-6.4	13.4	17.8	0.60	1.00	0.2	18.7	24.5	0.97	1.00
C: Industrial										
Trend	-5.2	12.9	16.7	0.58	1.18	-3.5	11.3	14.4	0.50	0.77
Econometric	-4.8	12.1	15.5	0.55	1.09	-0.9	8.6	12.2	0.43	0.65
Econ w/trends	-5.5	13.7	17.5	0.59	1.23	-3.7	12.4	15.6	0.52	0.83
Naïve	0.5	10.5	14.2	0.55	1.00	2.8	14.2	18.8	0.72	1.00

Comparison based on forecasts dated 1984 Q1 to 2013 Q1 for office and industrial sectors, and 1989 Q1 to 2013 Q1 for the retail sector.

At sector level, shown in Table 2.5, the tendency for real rental growth to be below predicted growth is repeated. For the retail (rolling and anchored windows) and industrial sectors (anchored windows), the smallest error metrics are for results based on conventional econometric models. For the office sector, results are much more mixed, with the trend-based models superior when anchored windows are used, but no approach superior when rolling windows are used. These results are corroborated by the DM tests, which show a statistically significant difference at the 1% level in favour of conventional econometric models for retail (rolling and anchored windows) and industrial (anchored windows), but a significant difference at the 5% level in favour of trend-based models for the office sector (anchored windows).

2. SUSTAINABLE RENTS

Table 2.6: Forecast Accuracy for Models Based on CBRE All Property Rent Monitor Series

Panel A: Models Using Rolling Windows	ME	MAE	RMSE	Theil U1	Theil U2
Trend-based estimates	-4.2	14.7	16.7	0.47	0.83
Econometric estimates	-5.5	8.8	11.1	0.38	0.55
Econometric model using trends	-6.0	13.7	16.1	0.46	0.79
Past growth continues (naïve)	-6.9	16.0	20.3	0.79	1.00
Panel B: Models Using Anchored Windows					
Trend-based estimates	-0.3	13.2	14.5	0.41	0.70
Econometric estimates	1.0	9.4	11.8	0.42	0.57
Econometric model using trends	-5.9	11.8	13.6	0.39	0.66
Past growth continues (naïve)	-3.9	16.2	20.6	0.96	1.00

Comparison based on forecasts dated 1989 Q1 to 2014 Q1, the latter relating to outturn over 2014.1-2019.1.

Table 2.7: Forecast Accuracy for Models Based on CBRE Sector Rent Monitor Series

	Rolling Windows					Anchored Windows				
A: Office	**ME**	**MAE**	**RMSE**	**U1**	**U2**	**ME**	**MAE**	**RMSE**	**U1**	**U2**
Trend	-0.3	16.3	19.1	0.39	0.71	3.9	12.9	16.3	0.33	0.59
Econometric	-0.8	14.0	16.3	0.42	0.61	6.4	17.4	20.6	0.49	0.74
Econ w/trends	-0.3	16.5	19.3	0.39	0.72	-3.8	11.4	14.1	0.31	0.51
Naïve	-4.9	22.2	26.9	0.85	1.00	-1.5	22.3	27.6	0.99	1.00
B: Retail										
Trend	-6.1	14.1	16.5	0.55	0.90	-5.2	13.7	16.2	0.53	0.88
Econometric	-2.7	7.8	10.1	0.43	0.55	2.7	9.6	11.3	0.45	0.61
Econ w/trends	-6.6	14.4	16.9	0.56	0.91	-3.8	13.5	15.7	0.50	0.85
Naïve	-9.1	14.6	18.5	0.76	1.00	-7.8	14.3	18.5	0.88	1.00
C: Industrial										
Trend	-3.4	11.9	14.6	0.49	0.89	-2.8	10.6	13.5	0.45	0.79
Econometric	-3.3	8.8	11.4	0.43	0.70	-0.1	7.2	9.9	0.37	0.58
Econ w/trends	-3.6	12.1	14.8	0.49	0.91	-3.1	10.5	13.4	0.44	0.79
Naïve	-5.4	13.1	16.4	0.84	1.00	-6.1	14.1	16.9	0.95	1.00

Comparison based on forecasts dated 1987 Q3 to 2014 Q1 for office and industrial sectors, and 1989 Q1 to 2014 Q1 for the retail sector.

2. SUSTAINABLE RENTS

Results are presented for models applied to the CBRE dataset in Table 2.6. All models are better than use of a naïve approach when applied to this dataset. Corrections based on output from econometric models appear to provide the best forecasts. Sector results in Table 2.7 show that the conventional econometric approach is superior for retail and industrial sectors, but the trend-based and trend-input approaches perform well for offices, especially when anchored windows are used. The DM test results echo those described above for the JLL dataset.

2.6. Sustainable Rent Conclusions

The 2017 Report into long-term value identified weaknesses with the use of current rental values and forecasts of those rental values as a key factor that undermined the application of models such as Investment Value and Mortgage Lending Value for detection of under- and overpricing in commercial real estate markets. This was because available rental forecasts at that time did not assist in identifying when rental values had deviated from a sustainable level given economic conditions. A principal objective of this report was to investigate different models of sustainable rental value and to examine whether these provided adequate signals of corrections in actual rental values when applied to historical data. If so, this could have implications for how commercial real estate markets might be monitored in future by investors, lenders and policy makers.

Informed by previous research, three basic approaches for measuring sustainable rental values were investigated. The first assumed simply that real rents reverted to a long-term average level. However, this approach performed so poorly in initial testing that the results are not presented in this chapter. The second approach assumed that real rents would revert to a long-term trend. This equates to the first approach if the long-run growth rate is zero, but it can also work if real rents trend either upwards or downwards. The third approach assumed that real rents revert to a figure determined by a model of demand and supply in real estate occupier markets. The academic literature has settled on an error correction model to represent real rent determination, so this was applied here. To predict sustainable rental values, coefficients for such models were used with actual values of the input variables and with trend values for those inputs. In the latter case, this was to address concerns about whether the input variables were in equilibrium.

The approaches above were applied to data from MSCI, JLL and CBRE. JLL data was used as this has a longer history than the MSCI data, while the CBRE rent monitor is a different type of index that tracks rental values for hypothetical prime properties. In each of these datasets, office, retail and industrial sectors were studied as well as the overall ‘All Property’ series. Lower levels of disaggregation were not studied. Modelling was conducted in real terms to produce measures of sustainable rental value, but outputs were reflated into nominal terms for presentation purposes, so both nominal and real terms sustainable rental values were generated and investigated.

Overall, the analysis showed that results from use of a simple long-run trend model, along the lines of the AMV approach used for capital values in the 2017 Report, were like those from using trend-based inputs with the econometric model to make predictions of sustainable rental value. An assumed stable trend in both demand and supply would imply a stable trend in real rental values, so the similarity in results is unsurprising. However, the econometric model permits use of alternative values for inputs when predicting sustainable rents. This can include actual values for demand and supply proxies when conducting historical analysis or forecasted values when projecting a path for sustainable rental values going forwards. The analysis here showed that a conventional application of the econometric model to estimating sustainable rental values one period ahead outperformed other approaches in signalling medium-term corrections.

2. SUSTAINABLE RENTS

This outcome suggests that there is merit in exploring further an econometric approach to monitoring sustainable rental values within commercial real estate markets, as different views on future demand and supply prospects can be investigated and tested within this framework. Yet such models can only be developed further if there are improvements to property market data collection such that core information on real estate stock and supply is available on a much more frequent and consistent basis. At the time of writing, available data on floorspace permitted the econometric models to be estimated up until 2019, but such data have not been published frequently in the past. Supply has been identified consistently in academic research as a problematic area where the lack of data inhibits better modelling of real estate market conditions, yet this continues to be something where public domain data remains fragmented and weak.

Over the period studied, the various models were most successful at modelling the 1990s downturn, albeit they did not predict the scale of the upswing that preceded it. Signals of the impending fall in real rental values were given by the different models as at 1988 and 1989, and the implied corrections map well onto subsequent market movements. The rental cycle of the early 2000s is captured well by some approaches, but the models were least successful at predicting the rental value downturn that followed the GFC. This was not an occupier-led market correction, but came about as the result of the economic downturn caused by collapses in asset values, among other factors. There is some reaction to this downturn by the econometric approach, but more limited reaction by the other approaches to this market event.

All of the models used in this chapter are founded on the analysis of past relationships, including the econometric models. This makes all the models susceptible to error in the face of structural changes to real estate markets. This is best illustrated by the case of the retail sector, where the outputs from models towards the end of the period are hard to reconcile with actual rental values. Although rolling windows allow some adjustment to changing economic realities, more so than in the case of anchored windows, the models are slow to react to fundamental shifts in how property markets work. However, econometric models offer possibility of refinement if appropriate variables can be found to represent how economic drivers have changed, the difficulty being that it is then hard to back test whether such adaptations are effective.

This chapter concluded by implementing some standard tests of forecasting accuracy. These support the conclusions set out above and are generally most favourable towards the econometric models as predictors of subsequent market performance. However, forecast bias is evident in the outputs from many of the models and this results from the difficulties in predicting the rental downturn in the wake of the GFC.

The results of the chapter suggest that it is useful to estimate measures of sustainable rental value for monitoring real estate market conditions. However, sustainable rental value measures cannot predict all real estate market corrections, as some do not have their origin within occupier markets. Therefore, they should be used in conjunction with the monitoring of pricing in commercial real estate markets, and sustainable rental values can be used as an input to models of pricing. For example, they may be used to imply the rental growth rate for use within an Investment Value model or, alternatively, they can be divided by a measure of fundamental or sustainable yield to obtain a sustainable capital value. This can then be compared with actual capital values, with any divergence then capable of attribution back to either occupier or investment market conditions.

Supplementary sustainable rent coefficient tables may be found in Appendix B to this report.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

This chapter considers the literature and logic behind approaches to estimation of sustainable cap rates and sustainable capital values and sets out the results of different approaches. It includes an investigation of the extent to which trend capital values (the AMV approach) work in identifying potential downturns as well as exploring approaches to the estimation of sustainable cap rates and combining these with the sustainable rent estimates to derive sustainable capital value estimates.

The chapter starts with a discussion of literature, it then sets out the various approaches to assessing sustainable cap rates in Section 3.2. This is followed by a discussion of the cap rate results (Section 3.3). Section 3.4 discusses equilibrium methods for assessing capital values. This is followed by the capital value results and then the conclusions.

3.1. Literature and Key Concepts – Cap Rates and Values

Asset prices are expected to increase over time as a result of growth in the economy and general inflation and other fundamental factors influencing the returns to different asset classes. These fundamentals are reflected in the price of an asset as the sum of the present value of future incomes. Over the long-term, sentiment and 'irrationality' are expected to fade in importance relative to fundamental drivers. In a real estate context this means the present value of future rental income streams will rise in importance.

Very simply, the price (or value) reflects all future cash flows discounted at a given rate, such that:

Equation 3.1:

$$V_0 = \sum_{t=1}^{\infty} \frac{CF_t}{(1+r_t)^t}$$

This simple DCF valuation concept can be unpicked between the assumptions underpinning rental incomes (considered in the previous chapter) and the discount rate, which is considered further in this chapter.

Literature on Determinants Of Cap Rates

In theory, the equilibrium property price should be equal to the present value of the net operating income (NOI) discounted at the assumed constant unleveraged risk-adjusted rate r. If it is assumed that NOI is expected to grow at a constant rate g, then the equilibrium price is solely a function of expected growth rate in NOI and the property specific risk-adjusted discount rate. This is the Gordon (1962) model: P=NOI/ (r-g). From the Gordon model, the following equation can be derived:

Equation 3.2:

$$NOI/P = r-g$$

where NOI/P is the capitalization rate (yield). Clearly, the cap rate should be positively related to the discount factor r and negatively related to the NOI growth rate g. The discount factor has two components: the risk-free rate and the required risk premium.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Ambrose and Nourse (1993) argued that the cap rate should be related to the cost of capital, which includes the cost of debt (mortgage rate) and cost of equity. They proxied the mortgage interest rate and real estate equity yield by using capital market variables. By using the US commercial real estate (CRE) data, they show that cap rates are negatively related to stock earning-price ratios and positively related to expected inflation, proxied by the interest rate spread between long-term bond and short-term bond rates. Jud and Winkler (1995) tested the role of risk premium on cap rates. They show that cap rates are determined by debt and equity spreads. The debt spread is the risky debt rate less the risk-free rate, and the equity spread is the return on the equity market less the risk-free rate. The above two studies on cap rates focus only on the discount factor and did not explore rental growth expectations but highlight the cost (and availability) of credit along with sentiment and expectations in driving cap rates. This would suggest the use of long-term cyclically neutral spreads in identifying long-term sustainable values.

Sivitanides et al. (2001) investigated the relationship between cap rates, the discount rate and rental growth. In their study, the discount rate is captured by the risk-free rate component (proxied by the Treasury bond yield) and the risk premium component (from regional dummy variables). The expected nominal rental growth is captured by the expected inflation and expected real rental growth. Expected rental growth is proxied by the real rent differences and current level of real rent. The idea is that once the level of rents is controlled, rental differences should positively predict future rental growth. By examining average cap rates over 16 years (1984-2000) and across 14 US metropolitan markets using a fixed effect panel regression, they found that cap rates are positively related to the risk-free rate and negatively related to inflation and changes in rent, but the effect of changes in rent is small. Furthermore, the regional dummy variables are both individually and jointly significant. This indicates that local fundamentals do play a role in the risk premium that the investors require, and hence affect cap rates.

Chervachidze et al. (2009) improved the model for cap rates by introducing two new variables. The first is the degree of general risk aversion in the economy, proxied by the yield spread between Moody's AAA corporate bond and the 10-year Treasury bond. The second is the availability of debt in the economy, proxied by the growth of total net debt (public and private) outstanding divided by GDP. They argued that debt availability in the economy can affect ease of purchase, thus affecting the price of real estate. By examining cap rates over 1980-2007 and across 30 US metropolitan markets using fixed effect panel regression, they found that cap rates positively related to general risk aversion and negatively related to debt availability. This indicates that when there is more debt available in the economy, real estate transactions are encouraged pushing prices up, thus resulting in a lower cap rate. Chervachidze and Wheaton (2013) improved Chervachidze et al.'s (2009) work by using a better proxy for debt availability, the annual change in total debt outstanding to GDP ratio. By extending the sample to 2009, they also found that cap rates were negatively related to debt availability. Beside the debt availability variable, one notable result is that the regional dummy variables are jointly not significant, indicating that local fundamentals do not affect the cap rate. Although their results contradict the findings from Sivitanides et al. (2001) in terms of local fundamentals, this might reflect that local fundamentals became a relatively small part of the explanation of cap rates during 2001-2009 with macro fundamentals playing a larger role (e.g. credit and debt availability and reduced risk aversion).

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

The above studies assume that the risk premium of CRE is a function of a general asset risk premium, which is proxied by the yield difference between risky debt and risk-free debt and again highlights the importance of credit availability in driving cap rates. Both the general risk premium and the debt availability variables are exogenous, which creates challenges in identifying sustainable long-term values as assumptions for these variables over the long-term are needed.

Duca and Ling (2020) model the time series variation of CRE risk premia using the Real Estate Investment Survey of the Situs Real Estate Research Corporation, which includes data for the expected rental growth rate and required equity return – a direct measure of CRE risk premium. By using a Vector Error Correction Model (VECM) to model cap rate and risk premium simultaneously in both the long-run and short-run, they found that cap rates are positively related to investors' required return and negatively related to the capital availability and expected growth rate of rental income in a long-run relationship. Short-run changes in cap rates are strongly driven by a tendency for actual cap rates to move toward their long-run equilibrium. Regarding the determinants of the CRE risk premium, they found that the risk premium in both the short- and long-run is positively related to the general corporate risk premium and the stringency of capital requirements on commercial and investment banks for investing in CRE. This result indicates that financial regulation can affect risk premia and cap rate. One notable result is that the cap rate changes mainly reflect changes in the discount rate rather than changes in expected rent. This is consistent with findings from the finance literature where Campbell and Shiller (1988) found that the stock price movements mainly reflect changes in the discount factor rather than in cash flows and earnings.

In the Gordon (1962) model, the cap rate is determined by the risk-adjusted discount rate and growth rate in NOI. However, does investor sentiment play a role or are investors rational? Wheaton (1999) shows that prices or rents are typically mean-reverting. Thus, with rational expectations, when the market is at or near historical highs, investors should anticipate lower subsequent income growth. Sivitanides et al. (2001) showed that the investors in the US are not rational in the sense that long-run rental growth expectations are pro-cyclical. To capture where the market is in the cycle, a ratio of current real rent to its historical average ('rent ratio') is used as an explanatory variable. They found that cap rates are negatively related to the rent ratio. During a period of high real rents, cap rates are lower, implying that investors expect higher income growth in the future. This finding provides evidence that investors are irrational or only partially rational to the extent that they expect to sell before mean reversion occurs. Using comparable data, Chen, Hudson-Wilson and Nordby (2004) also showed a negative relationship between the rent ratio and cap rates. Hendershott and MacGregor (2005a) examine the investors' rationality using UK property capitalization rates. To capture where the market is in the cycle, they used a four-quarter average of the deviation of the log of real rent from a linear trend. By using an Error Correction Model (ECM), they showed that the cap rate is positively related to the deviation of rent from the trend; that is when the rent is above the trend, the cap rate is higher, implying that investors have expectation of mean/trend reversion in future rental income. The contrasting results between Sivitanides et al. (2001) and Hendershott and MacGregor (2005a) could be due to the differences in modeling, in the quality of data, or in differences in UK and US investor behaviour. Regarding modeling, Hendershott and MacGregor (2005a) employed a model to link the cap rate with the stock market (both the dividend price ratio and expected growth rate in real dividend). Hendershott and MacGregor (2005b) re-examine the investors' rationality in the US by using the Hendershott and MacGregor (2005a) methodology. They also claimed that they used a better and more accurate measure of the US cap rate and NOI than previous studies. Their results showed that cap rates are negatively related to the deviation of rent from the trend, implying that US investors are irrational. Furthermore, they found no relationship between the cap rate and the stock market variables that were found significant in the UK study.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Clayton et al. (2009) investigated the role of investor sentiment in CRE valuation. They employed two measures of sentiment:

- A survey of investment conditions; and
- A composite quantitative sentiment indicator combining five market indicators:
  - Commercial mortgage flows as a percentage of GDP;
  - The percentage of properties sold from the NCREIF Property Index (NPI);
  - The ratio of the transaction based (TBI) and constant liquidity versions of the NPI value index;
  - The NPI total return over the past four quarters; and
  - The most recent quarterly TBI total return.

To ensure the real estate sentiment measure is not an index of common business cycle risk factors, they regress each of the five sentiment proxies on the three-month Treasury yield, a term structure variable and a measure of economy-wide default risk. They then construct their sentiment index as the first principal component of the five residual series. By using ECM estimations, they found that cap rates are negatively related to investor sentiment in the short-run.

Chervachidze et al. (2009) employed an econometrics approach (CUSUM test) to test for structural breaks and capture investor sentiment. The idea behind the CUSUM is the following:

- Define a base model for estimation;
- Run the estimation recursively; that is, adding a vector of observations corresponding to each additional period and then re-estimation the whole model with the expanded dataset; and
- Plot the residuals from the recursive estimations.

If the plotted CUSUM series simply move around the zero mean line, there is no evidence of the model structure changing over time. If the CUSUM series moves across either of a pair of symmetric lines above and below the zero line, this would indicate statistically significant evidence of structural change. They argued that the CUSUM series can be used to measure investor sentiment. For example, when the CUSUM plot crosses the upper band, the significant positive CUSUM values indicate that the additional data from this period has cap rates that are higher than the ones predicted by the model, this could be a signal of negative investor sentiment. They found that investors began to have negative sentiment around 1991 and began to have positive sentiment during early 2000s.

These studies highlight a number of approaches to assessing sentiment and its influence on cap rates with the ECM method distinguishing the long-run and short-run drivers and the CUSUM method potentially identifying structural breaks and/or abnormal sentiment.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Previous literature on the CRE studies has assumed that the risk-free rate, which is proxied by the yield on long-term government bonds, is exogenous but, in reality, the risk-free rate can be affected by several factors. Rachel and Smith (2015) investigated the reason why the world long-term real interest rate has fallen over the past 30 years. They highlight an increase in desired savings due to demographic forces, higher inequality within countries and a preference shift towards higher savings by emerging market governments following the Asian crisis. In addition, the fall in desired investment is attributed to the decline in the relative price of capital goods, a preference shift away from public investment projects, and an increase in the spread between the risk-free rate and the return on capital. Furthermore, they showed that the shift in supply and demand for safe assets may also play a role in the downward pressure on the risk-free real rate. Particularly after the financial crisis, there was high demand and low supply in a safe asset. Bean et al. (2015) pointed out similar factors to Rachel and Smith (2015) that drove down the global real risk-free rate. In particular, they stressed the role of high savings and financial integration in China.

One criticism of the Gordon (1962) model is that the discount factor and the income growth are static, thus Campbell and Shiller (1988) developed a 'dynamic Gordon' model, which allows the discount factor and income growth to vary over time. The implication of the dynamic Gordon model on the valuation of CRE is that the cap rate should reflect fluctuations in expected returns, in rental growth rates, or in both. The gross return from holding a commercial property from t to t+1 is defined by

Equation 3.3:

$$R_{t+1} = \frac{P_{t+1} + H_{t+1}}{P_t}$$

where P_t is the price of the commercial property at the end of period t and H_{t+1} is the rent from NOI from period t to t+1. Taking logs and following the method from Campbell and Shiller (1988), the following dynamic Gordon model can be derived:

Equation 3.4:

$$h_t - p_t = -\frac{k}{1-\rho} + E_t\left[\sum_{j=0}^{\infty} \rho^j r_{t+1+j}\right] - E_t\left[\sum_{j=0}^{\infty} \rho^j \Delta h_{t+1+j}\right]$$

Where h is the log NOI, p is the log price, r is the log return and k and p are parameters derived from the linearization. It should be noted that this log-linearization is valid only if expected returns and rent growth are both stationary. Campbell et al. (2009) show that by defining the return to property as a function of an interest rate and a risk premium ($r = i + \varpi$), the dynamic Gordon model can be written as the following:

Equation 3.5:

$$h_t - p_t = -\frac{k}{1-\rho} + E_t\left[\sum_{j=0}^{\infty} \rho^j i_{t+1+j}\right] + E_t\left[\sum_{j=0}^{\infty} \rho^j \pi_{t+1+j}\right] - E_t\left[\sum_{j=0}^{\infty} \rho^j \Delta h_{t+1+j}\right]$$

One implication of the dynamic Gordon model is that the cap rate can be used to forecast expected return and expected growth in NOI. For example, Plazzi et al. (2010) showed that the cap rates have some forecasting ability of expected return and expected growth in NOI by using US CRE data. For this study, the key use of this model is that, given expected returns and long-run growth in NOI, an equilibrium cap rate can be derived. For example, Ambrose et al. (2013) applied this method for property in Amsterdam. They employed a Vector Autoregression Model (VAR) to forecast the real interest rate, risk premium and changes in real rent and derived an equilibrium rent-price ratio.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

It should be noted that, under the efficient market hypothesis, asset prices should reflect all available information (and the risk-adjusted return should be unpredictable). However, financial markets seem to be prone to periods where the price of an asset can substantially deviate from its fundamental value and the price can move substantially without new information. Furthermore, the return of an asset can be persistent, that is past winners continue to outperform and past losers continue to underperform. A substantial body of research has developed that explain such deviations in terms of herd behaviour and momentum trading[14], or herding and trader interaction (including imitative behaviour by less informed investors)[15]. This work has been extended into the actions of lenders[16]. These insights help support an analysis that examines divergence from what seem to be economically-justifiable fundamental values.

Insights from the above literature in a real estate context include:

- Ex-post fundamental values can be derived using the actual rent path subject to assumptions about the path of future rents and assumptions about the risk premium; and
- Ex-ante fundamental values can similarly be derived using assumptions about future rents and risk premia.

In addition, looking for periods of variability in prices that are not consistent with the variability in fundamentals might also be a useful guide to periods of over-valuation (this and other tests are considered further in the next chapter).

A number of industry studies are also relevant to consideration of fundamental or long-term cap rates and values. These include studies of liquidity, depreciation and lease structures. These are discussed further in the next section.

Testing Protocols and Other Considerations on Fundamental Factors

Given the data issues and that there are only two major downturns in the property market in the study period some caution is necessary in terms of over-reliance on tests based on prediction error e.g. Diebold-Mariano (even with bias correction, see Harvey, Leybourne and Newbold, 1997) or MAPE. Whether and when each method predicted the major corrections or gave a clear signal will be one metric. In addition, the economic logic and clarity about fundamental drivers of over (or under) valuation will be an additional guide.

The stability of the real discount rate is assumed in some of the literature but as noted above there has been a significant fall in real interest rates and this assumption looks questionable in the context of demographic change, monetary policy and other factors leading to changes in long-term real risk free rates.

Technological changes that reduce demand for floorspace will lead to a downward shift in occupier demand and lower sustainable rental incomes and prices (although this will be partially offset through stock adjustment). The rate of change and the extent to which demand is reduced may not be stable over time. This may be anticipated by investment markets.

[14] For example De Long et al. (1990), Jegadeesh and Titman (1993) and Chan et al. (1996), Asness et al. (2013

[15] Chiang and Zheng, (2010); Nofsinger and Sias (1999); Bikhchandani and Sharma, (2000); Banerjee, 1992; Bikhchandani, Hirshleifer and Welch, (1992); Welch, (1992); Scharfstein and Stein, (1990); Trueman, (1994); Zweibel, (1995); Prendergast and Stole, (1996)

[16] For example, Rajan (1994), Maug and Naik, (2011) and many authors examining the GFC, discussed in the subsequent chapter.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

A structural increase (decrease) in credit availability and lending will increase (decrease) investment demand and push down (up) sustainable long-term yields leading to higher (lower) capital values; however, as discussed later, credit may be largely endogenous e.g. driven by both demand and values.

Lower migration/population growth will reduce demand for space compared to historical trend growth. This would lead to lower rents than would have otherwise been expected (although again this will be partially offset through stock adjustment, albeit this latter adjustment may be slow). To the extent that this is anticipated by investment markets it will be priced into cap rates.

Planning policy and infrastructure provision changes may lead to higher construction activity for any given level of values leading to lower sustainable rental values. The increase in building density over time has provided an important mechanism to enable sustainable real rents to fall despite a growing economy with a relatively fixed supply of land.

Policy changes such as higher property transaction taxes are likely to lead to lower investment demand for any given level of rent – lower sustainable values, or higher business rates (lower rents and lower values). This is considered further in the ex-ante cap rate method (Approach 3) below.

There are distributional / disaggregation patterns that may lead to shifts in market aggregates. For example, shifts in the economy to industries with greater agglomeration economies will lead to higher demand in those locations (typically larger, more expensive cities) pushing up aggregate values. Similarly shifts in the composition of market indices to sectors with different fundamentals (e.g. the growth of residential investment) will lead to a different pattern in terms of All Property averages.

3.2. Methods for Cap Rates

Drawing on the literature and concepts above, a range of approaches were used to identify the potential sustainable cap rates:

- CR Approach 1: Historical average;
- CR Approach 2: Historical trends;
- CR Approach 3: Econometric models; and
- CR Approach 4: Ex-ante methodology.

The Gordon Growth model was also explored but was found to be unstable and, hence, the results are not presented or discussed further. These four approaches are outlined in more detail below.

CR Approach 1: Actual Cap Rate Against Historical Average

In every period, the actual cap rate is compared with historical average cap rates. Two kinds of historical average cap rate are used. One is the anchored window average, the average using all historical data up to that point. Thus, in the anchored window estimation of average, the later the time period, the more observations are included. The other method is a rolling window average, the average using a fixed number of data points. A 15 year (60 quarters) rolling window has been used, consistent with the sustainable rent models. Thus, the average cap rate at any given period is calculated by using the historical 15 years of data.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

CR Approach 2: Actual Cap Rate Against Historical Trend

In this method, a linear regression is used to estimate the trend in the historical data. This trend is taken as measure of 'sustainable' cap rate. The actual cap rate of the last period in the sample is compared to the trend cap rate. Similarly to Approach 1, the trend line is drawn by using either an anchored window or a 15 year rolling window. This approach is less justifiable than the average and to the extent there is any trend in cap rates this can be captured in a trend approach to capital values. Consequently, the results are not included.

CR Approach 3: Cap Rate Econometrics Model

This approach is based upon a simple econometric model of the cap rate. The cap rate is the dependent variable and the independent variables are the index-linked gilt (ILG) yield and four-quarter average of QoQ (quarter to quarter) real rental growth. A substantial number of other models were explored including a variety of rental growth periods to capture the impact of longer-term rental growth on expectations and nominal bonds and rental growth variables. The model used appeared to explain movements better than others.

There are a limited number of index-linked gilts in the UK and any given index-linked gilt experiences a reduction in its maturity each year of one year. It is therefore necessary to interpolate the yields of different securities of different maturities to calculate a yield curve for the real rate. The Bank of England have published their estimated yield curve since 1985. Following Rachel and Smith (2015), the real yield before 1985 is estimated by running a simple regression linking real yield to movements in UK nominal yield of 10-year gilt and RPI inflation.

In this approach, for every period, the regression is run based on historical data. A one period out-of-sample forecast of the cap rate can then be performed, designating that as the equilibrium cap rate. As with other approaches, the estimation of the regression is done on both an anchored window and a rolling window basis.

CR Approach 4: Ex-ante Cap Rate Model

This approach is based upon the observation that if prices are sustainable then long-run expected returns (ER) should be equal to long-run required returns (RR).

Hence, $RR = ER$

The long-run required return can be expressed as the Risk Free Rate (RFR) and the Risk Premium (RP) required over this risk free rate to justify investment in real estate.

$$RR = RFR + RP$$

The long-run expected return can be expressed as the cap rate or Yield (Y) and Net Rental Growth (G), noting this is net of depreciation.

$$ER = Y + G$$

To be 'sustainable' or in equilibrium: $Y + G = RFR + RP$

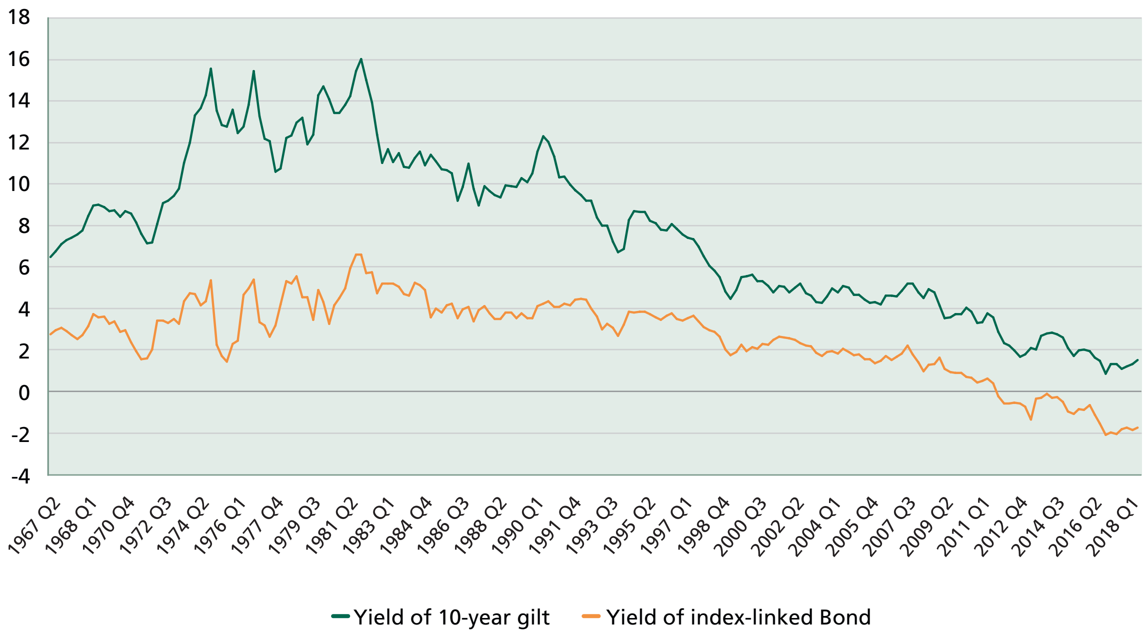
Deducting inflation from both sides gives $Y + RRG = RRFR + RP$

and $Y = RRFR + RP – RRG$ where RRG is net real rental growth and RRFR is the real risk free rate.

To derive a view of the sustainable cap rate therefore requires the real risk free rate, the sustainable risk premium and long-run net rental growth expectations.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.1: Real and Nominal UK Government Bond Yields



Real risk free rates as indicated by index-linked gilt yields have fallen from around 4% in the early 1990s to around zero in the early 2010s and in 2016 to nearer -2%. If nothing else had changed this would justify a nearly 6% fall in real yields on real estate over this period. However, there are good reasons for believing that not all of this movement in real interest rates is likely to have fed through to lower sustainable cap rates:

- Part of the fall in real risk free rates is unlikely to be sustained;
- Investor required returns are not solely driven by risk free rates and a risk premium;
- The risk premium on real estate is likely to have increased; and
- Expectations for long-run real rental growth are likely to have fallen.

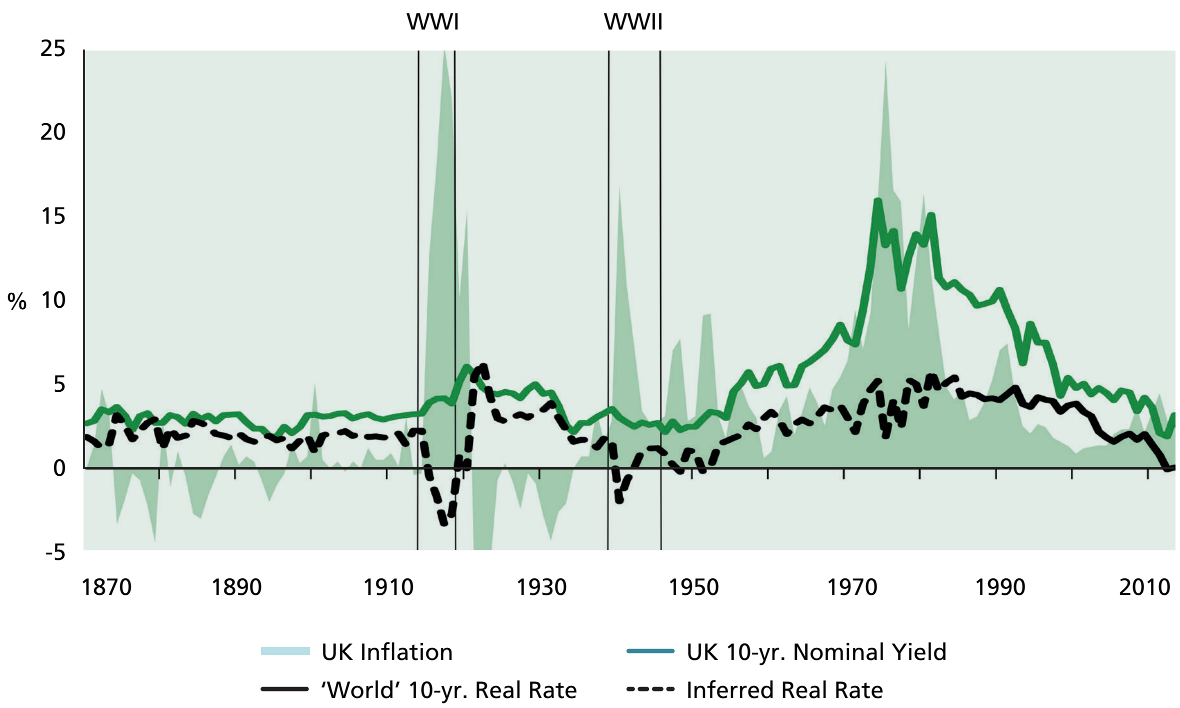
These issues are considered in turn below.

What is a sustainable real risk free rate?

First, there is the issue of whether current interest rates and bond yields are sustainable. The secular drivers of real interest rates and the implications for the sustainability of low current bond yields have been analyzed by the Bank of England (e.g. Rachel and Smith) and others (e.g. Bean et al.). These papers suggest some allowance for real and nominal risk free rates to return to more normal levels is appropriate in the analysis of sustainable required returns. The Rachel and Smith paper written in 2015 suggested that the sustainable or 'neutral' real interest rate "may settle at or slightly below 1% over the medium to long-run". The chart below shows how unusual it is for real interest rates to be negative and, consequently, it would be imprudent to assume that these rates are necessary sustainable. Hence, an alternative scenario with, for example, zero real interest rates should potentially be a part of looking at implications for values.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.2: Inflation, Bond Yields and Real Interest Rates



Source: Rachel and Smith (from King and Low 2014, Datastream, IMF, Consensus Economics)

Is the risk free rate plus risk premium sufficient to explain required returns?

Secondly, there is the question of whether the required return on capital is driven by risk free rates and a risk premium or other factors. The IPF project, *An Investigation of the Use of Hurdle Rates in the Investment Process*, identified that, for some investors, the required return moved as bond yields fell. For others, more focussed on absolute return objectives that are sticky, the required return does not move much as bond yields move, even over the medium to long-term. These investors were typically more focussed on riskier properties. This means that, for part of the market, a movement in bond yields would be expected to lead to a change in the risk premium as long-run required returns remain broadly fixed, whilst for other parts of the market the risk premium may be largely fixed (set by its underlying factors). This would suggest it might be more appropriate to view long-run required returns for the market being made up of two broad pools of investor with the overall market required return being a weighted average of the returns required by these two pools:

$$RR = w_1(RFR + RP) + w_2(O)$$

Where w_1 represents the proportion of investors with a hurdle rate driven by risk free rates and w_2 is the proportion of investors with a fixed (or real return) objective. Several assumptions are needed but this approach allows two overall measures of required return to be created – one based on a RFR + RP approach (e.g. assumes w1 = 100%) and a second approach, which integrates a higher and stickier investment objective.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Has the risk premium moved?

The risk premium can be seen as deriving from a number of components, including:

- Illiquidity risk – the premium for which will reflect both the cost and time of transactions and the expected hold period and uncertainty around this hold period;
- Credit risk – a premium to reflect the security of the contracted cashflows under the lease (reflecting both likelihood of loss and the extent of probable loss); and
- Property risk – a premium to reflect the uncertainty of cashflows beyond the existing contracted income (including both rental growth and the future path for values (rental income beyond existing leases).

Whilst IFA surveys and other reviews have suggested that the property risk premium is largely fixed there are reasons for believing that over the long-term it should have increased as bond yields have fallen.

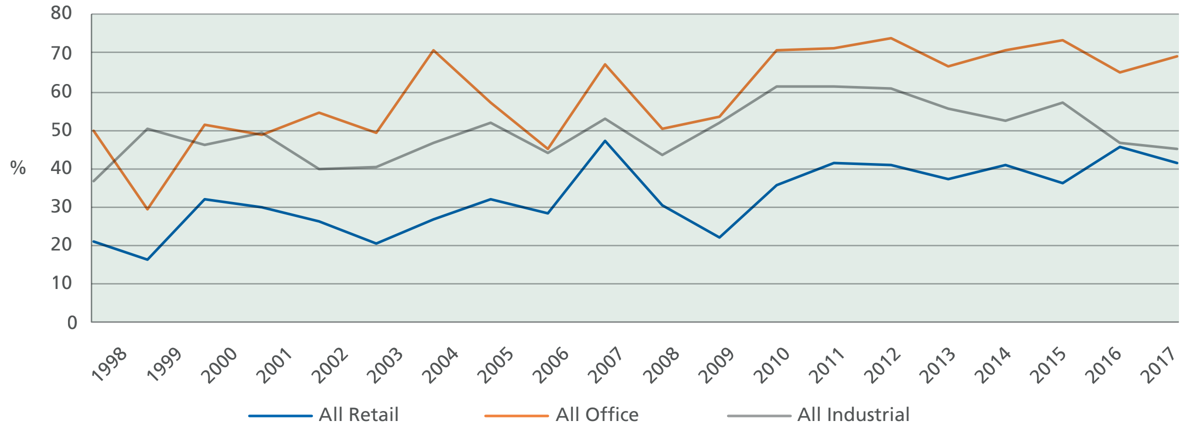
- Stamp duty has increased with the 1% rate applicable to most transactions increased to 2% in 1997, 3% in 1998, 3.5% in 1999, 4% in 2000 and, more recently, to 5% (4.5% in Scotland) on the bulk of the purchase price of commercial transactions. In addition, substantial efforts to reduce stamp duty avoidance have meant that that these rates are paid for most transactions.
- A deterioration in profitability of many retail companies and the growth of the use of Company Voluntary Arrangements in recent years means overall credit quality has fallen and for weaker credit tenants the contracted cashflow is less certain than in previous decades (CVAs were introduced in the Insolvency Act 1986 and so the importance of this latter effect should perhaps not be overstated).
- The value of the contracted cashflow (bond-like credit risk) as a proportion of the overall value of a property has generally fallen as lease lengths have fallen. The average weighted term to lease expiry (ignoring breaks) on new leases in the retail sector fell from over 15 years in the early 2000s to under 10 years in 2018, whilst office lease lengths have also shortened on average. In addition, the proportion of leases with break clauses has increased from around 20% pre-GFC to around 40% in 2017 and 2018 (MSCI UK Lease Events Review 2018).
- The retail sector in particular has seen an increase in uncertainty about value at lease expiry as a result of the growth of on-line retail sales. The increase in vacancy rate at lease expiry illustrated below suggests income on lease expiry has become more uncertain. There similarly appears to have been a drift up in vacancy rate for exercised break clauses (from 10% in the late 1990s to over 25% over the past decade) (MSCI UK Lease Events Review 2018)

Against these influences for a higher risk premium, there are arguments that the increase in risk premium should not be overestimated. Firstly, there have been continued healthy transaction flows and a growth in international investment, which has potentially improved the depth and breadth of the market, partly offsetting the impact of higher transaction costs on the illiquidity premium[17]. This international investment effect is likely to be concentrated by market and type of property. Second, whilst lease lengths have fallen and breaks have increased, the overall vacancy rate of the properties in the MSCI indices has not shown any marked trend increase and the impact on rent expectations is captured separately and should not be double counted. In addition, a substantial proportion of office and industrial properties are achieving higher rents on new lettings suggesting that the risk at the end of leases is not substantially higher than in previous decades (except for the retail sector).

[17] Note: similar arguments were being advanced in 2005 and 2006 to justify capital values.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

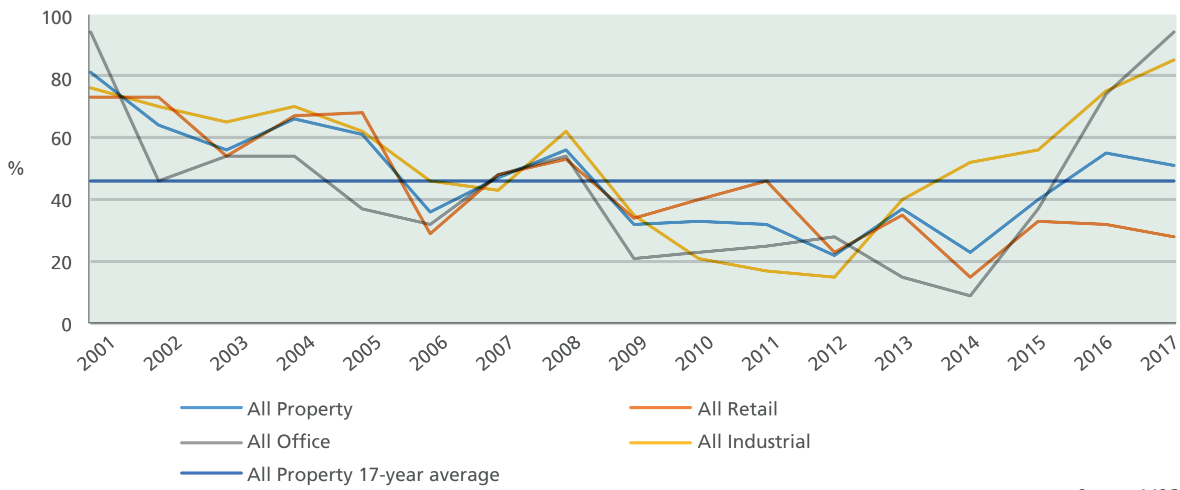
Figure 3.3: Vacancy Rate on Expired Leases by Sector, 1998-2017



Note: Tenancies Weighted by Rent Passing

Source: MSCI

Figure 3.4: Proportion of New Lettings on Higher Rents



Source: MSCI

Note: Tenancies Weighted by Rent Passing

Disaggregating the property risk premium between illiquidity, credit risks and other property risks is challenging. The IPF Liquidity in Commercial Property Markets study argued that a long-run average ex-ante risk premium for illiquidity is 3%, noting that the hidden costs associated with poor liquidity are not reflected in most investors' thinking about liquidity. Other studies, e.g. Francke (2018), have suggested that the liquidity risk premium is closer to 1% but this had a significant 'other' element to the risk premium. For the purpose of this study, an increasing liquidity risk has been assumed, reflecting the impact of rising transaction costs. In addition, it should be noted that liquidity is pro-cyclical and a lack of liquidity can amplify a modest downturn into a more severe market correction and hence a cautious assumption here is appropriate.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Most commercial property provides significant protection from loss in the event of tenant failure and hence credit risk is generally far lower than that implied by tenant credit quality. As with liquidity the pricing of credit risk is strongly pro-cyclical, with the credit risk premium increasing in downturns. An ex-ante assumption for a sustainable long-run risk premium needs to look through these cyclical movements to give a long-run position that is unaffected by cyclical sentiment.

The risk associated with the value of the property at lease expiry is markedly higher than the risk associated with the contracted rent. As with other elements, there will be substantial variation across properties but on this 'equity' like risk premium is likely to be particularly wide.

The weighting between credit or 'bond' like risk and 'equity' like risk in the estimation of an ex-ante risk premium is driven by lease length, discount rate (yield) and assumptions about growth. For example, a property with 15 year unexpired lease term, using an 8% discount rate with no growth (over 100 years) has 69% of its value in the 'bond' element whilst with a 6% discount rate this falls to 58% and at a 4% discount rate to 44%. All things being equal, the fall in overall discount rates is therefore expected to have increased the relative weight of equity risk compared to bond risk. Using the same example and shortening the unexpired lease term to 10 years reduces the share in value from fixed income to overall income from 69% to 54%. However, this assumes constant rental incomes, the fall in overall discount rates partly reflects lower inflation expectations and to the extent assumptions of growth have been reduced this will offset the impact of falling discount rates. Overall discount rates have fallen faster than the fall in income growth expectations as real yields have fallen. The overall impact of all these changes over the past few decades is roughly estimated to have reduced the bond proportion of real estate by 15-25%. Assuming a 5% differential in risk premium between 'bond' and 'equity' risk this suggests an increase of c.75-125bps on the aggregate risk premium from shortening lease length and lower yields (partly offset by lower growth expectations).

Combining these elements enables initial estimates of an aggregate market risk premium to be produced. The industrial sector risk premium has increased slightly whilst there has been a more marked increase in the office sector and an even more marked increase in the retail sector. These can then be combined with the risk free rate to derive a first estimate of the required return or discount rate that can be applied to sustainable future income (RR1). However, this ignores the stickiness in absolute and real return targets for a significant part of the investor universe and hence an alternative estimate based on combining the risk free rate plus risk premium approach with long-run average nominal and real discount rates can also be explored (RR2).

Have long-run real rental growth expectations changed?

To derive a sustainable cap rate requires a view of sustainable long-run rental income growth expectations. This growth element can be general price inflation, sustainable market real rental growth or from other effects on growth (lease structures and the translation of rental growth into NOI and the related capital expenditure). For simplicity and in alignment with MSCI's attribution methodology the focus has been on market rental growth but make adjustments to ensure sustainable and actual cap rates are consistent.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Retail	Office	Industrial	All Property	Inflation
3.6%	2.6%	2.5%	3.0%	3.8%

Table 3.1 shows how rents (ERVs) have performed on average relative to RPI inflation since 1980. Historically, retail rents have kept pace with RPI inflation whilst industrial and office rents have declined in real terms (the JLL figures for a 40-year time period show a similar pattern). However, expectations have been affected by some fundamental changes in the economy, notably technological change, which has lowered expectations of rental growth over the medium to long-term for the retail sector. The ex-ante framework assumes that long-run sustainable retail real rental growth expectations have fallen from +0.5% positive back in the 1980s to -1% negative in recent years as a result of trade diversion to online sales along with lower long-run expectations for consumer spending and sales growth. The office sector is also expected to have seen a reduction in long-run rental growth expectations compared to the 1980s as a consequence of technological changes, changes in planning stance along with more subdued economic growth expectations. Long-run expectations for the industrial sector are expected to have been broadly unchanged. These negative real rental expectations are broadly in line with the results of the sustainable rent analysis.

The above approach is based on long-run expectations of rental growth (it ignores the adjustment from actual rents to sustainable rents). It also makes no explicit assumptions about capital expenditure and other expenditure.

Table 3.2: ERV and Rent Passing Growth (% p.a.)

	ERV Index				Rent Passing Index			
	Retail	Office	Industrial	All Property	Retail	Office	Industrial	All Property
1980-1990	10.1%	9.9%	7.6%	9.4%	11.7%	10.5%	8.9%	10.5%
1990-2000	1.9%	-1.7%	-0.7%	0.0%	4.4%	4.0%	2.9%	3.9%
2000-2010	1.7%	-1.2%	0.3%	0.5%	3.7%	2.2%	1.1%	2.7%
2010-2018	0.1%	2.8%	2.0%	1.4%	0.5%	1.2%	1.6%	1.1%

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Income growth has substantially outstripped ERV growth over the past few decades, partly reflecting the impact of lease structures and reversionary potential. Additional adjustments are made where market equivalent yields (or similar) are the actual cap rates used to ensure the estimates of sustainable cap rates reflect the impact of reversionary potential and lease structures and are consistent with the actual cap rates.

For all approaches, the cap rate analysis is conducted at the All Property level, as well as at sector level (office, retail and industrial) and using three sources of property market data MSCI, JLL and CBRE data.

In general, whenever the actual cap rate is below the sustainable cap rate, a subsequent rise is anticipated, which may lead to a fall in values.

3.3. Cap Rate Results

3.3.1. MSCI Series

Figure 3.5 displays the All Property sustainable cap rate estimated based on the analysis of the MSCI data. The left hand panel of Figure 3.5 shows the results from using rolling windows to identify the period for analysis while the right hand panel show the results from using anchored window. The graphs begin at 1995 Q4 based on the fact that the first estimation window (whether rolling or anchored) runs from 1980 Q4 to 1995 Q3. Different colours in each chart then identify the time series of sustainable cap rates generated by individual methods, while actual cap rates are shown in blue. A consistent colour scheme is used throughout the charts in this chapter to aid comparison.

Figure 3.5: Sustainable Cap Rate and the MSCI Cap Rate through Time

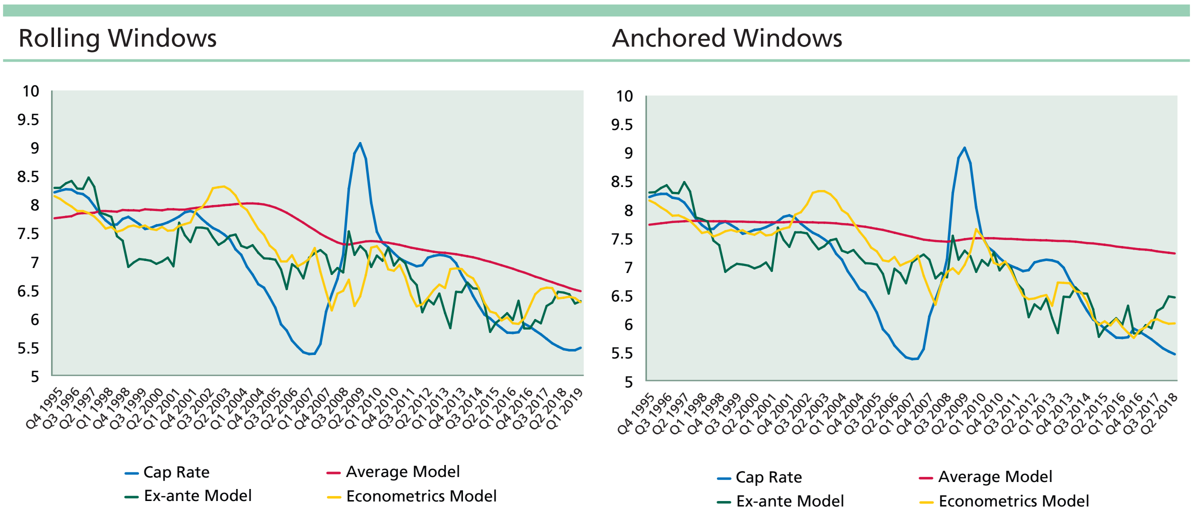


Figure 3.6 takes the actual MSCI cap rate series and divides this by each series of sustainable cap rates to identify the ratio between the two at different points. This ratio more clearly identifies suggested periods of deviations from the sustainable level.

Figure 3.5 and 3.6 show that the actual cap rate can deviate from the sustainable level for a number of years. The cap rates were well below the sustainable level prior to the 2007-2009 downturn.

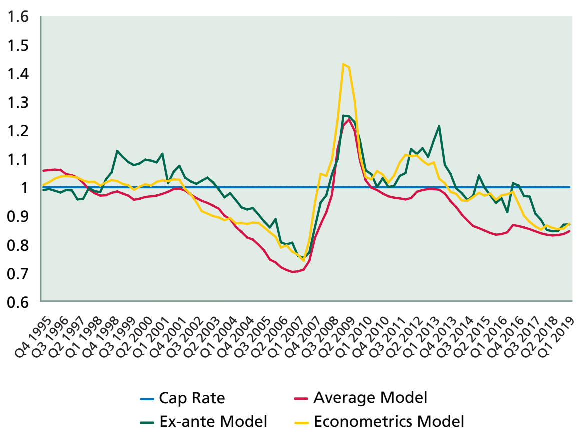
3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.7 shows the percentage corrections required to restore cap rates to sustainable levels. This presumes no other market development and shocks to fundamental drivers. There is no prediction as to how long a correction might take, but the figures are benchmarked to the outturn for the MSCI cap rates over the following five years. The blue series tracks the changes of cap rates from each date to a date five years later. This can be compared to the implied correction from the results of different models. The implied corrections predict well prior to the 2007-2009 downturn, since they signal the increase of cap rate well prior to 2007.

Analysis of property sectors is presented in Appendix C. The pattern for all three sectors is similar to the pattern of All Property.

Figure 3.6: Ratio of MSCI Cap Rate to Sustainable Cap Rate

Rolling Windows



Anchored Windows

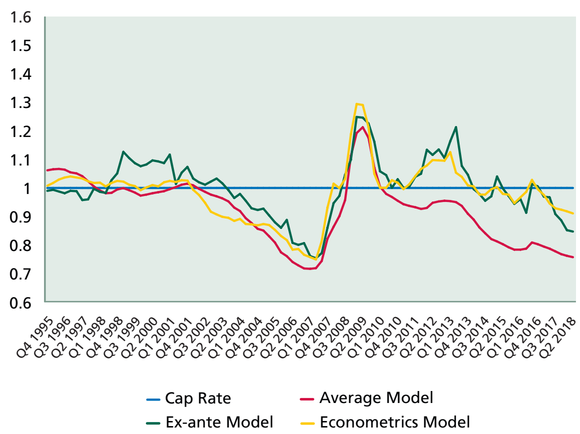
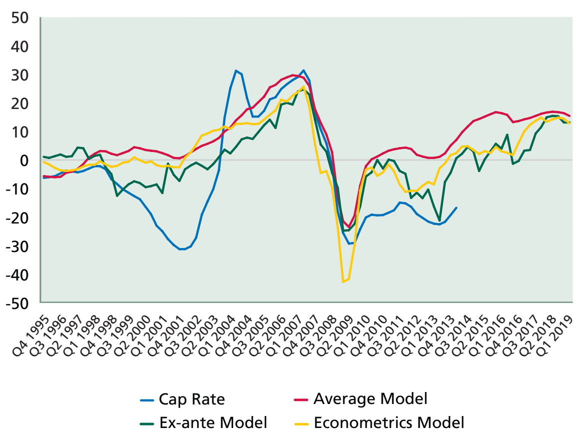
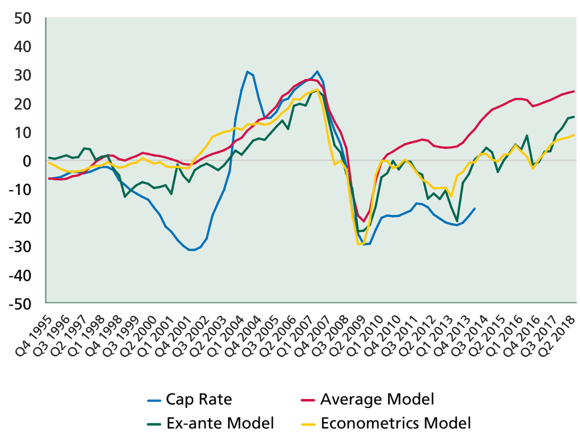


Figure 3.7: Implied Correction in Cap Rate vs. Subsequent Five Year Outturn in the MSCI Series

Rolling Windows



Anchored Windows



3.3.2. JLL series

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.8-3.10 show sustainable cap rates, ratio and implied corrections for models estimated using the JLL All Property data on the same basis. The derived cap rate series begins in 1977 Q2, using 15 years estimation window would miss the 1990-1992 downturn. In order to get the prediction of that correction, the first estimation is based on a 10-year window (1977 Q2 – 1987 Q2). For the rolling window analysis, the estimation is a ten year anchored window before 1982 Q3. From 1982 Q3, the estimation of rolling window will be fixed at 15 years. The results indicate that the cap rates were well below the sustainable level prior to the 2007-2009 downturn but not before the 1990-1992 downturn. The implied corrections predict well prior to the 2007-2009 downturn, since they signal the increase of cap rate well prior to 2007.

Analysis of property sectors is presented in Appendix C. The results show that the pattern for all three sectors is similar to the pattern of All Property.

Figure 3.8: Sustainable Cap Rate and the JLL Cap Rate through Time

Rolling Windows | Anchored Windows

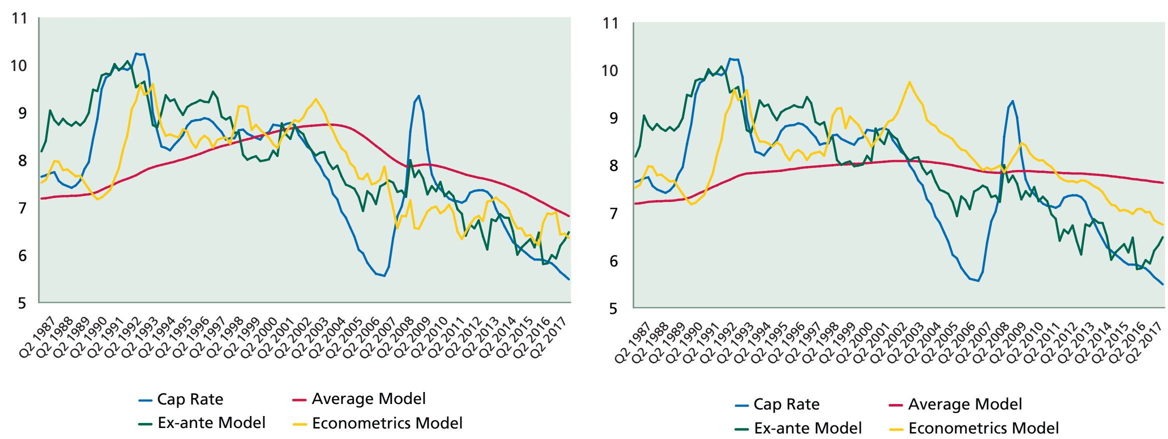
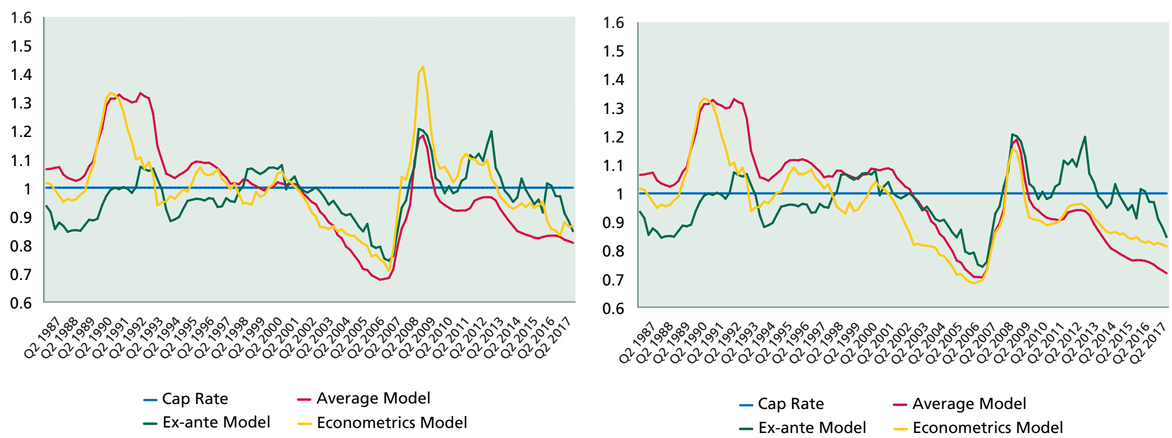


Figure 3.9: Ratio of JLL Cap Rate to Sustainable Cap Rate

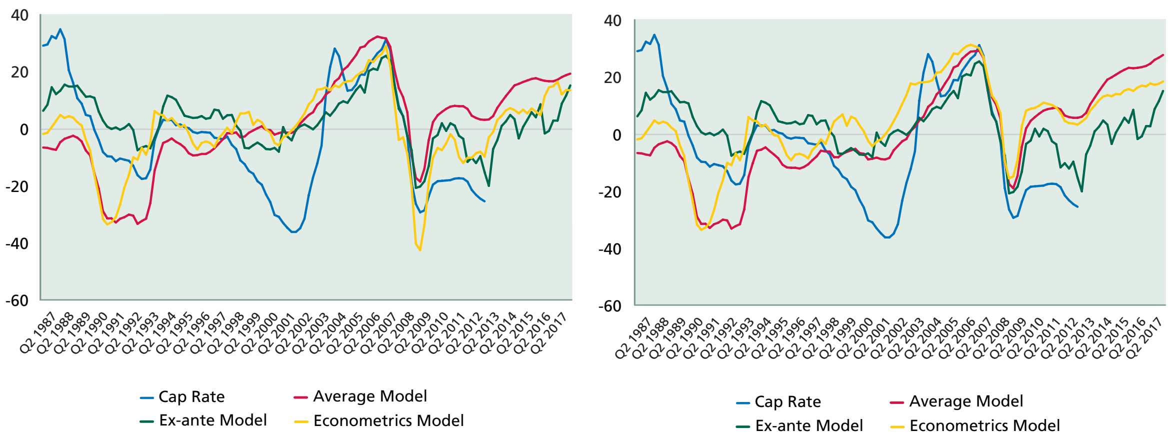
Rolling Windows | Anchored Windows



3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.10: Implied Correction in Cap Rate vs. Subsequent Five Year Outturn in JLL Series

Rolling Windows | Anchored Windows

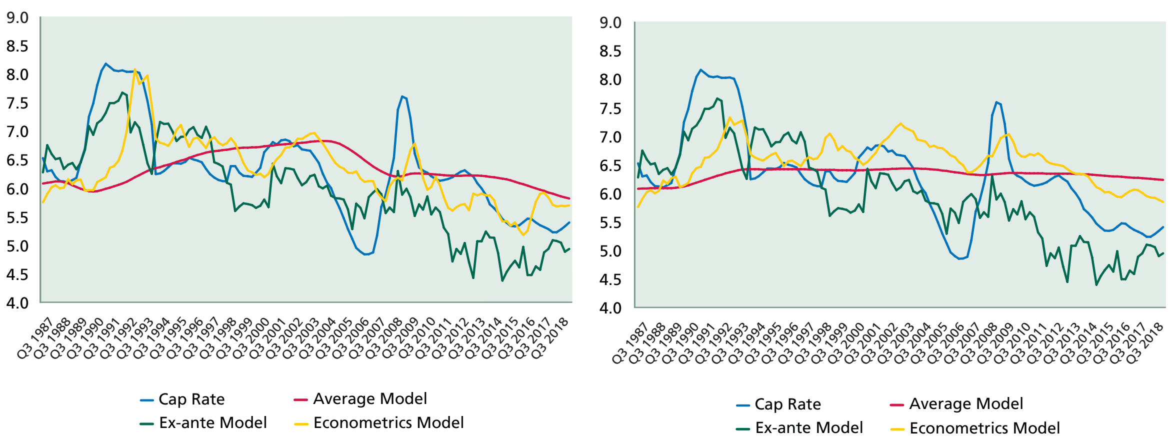


3.3.3. CBRE Series

Figure 3.11-3.13 show sustainable cap rates, ratio and implied corrections for models estimated using the CBRE All Property data. The cap rate series begins in the 1970s and the first estimation window for this dataset runs from 1972 Q3 to 1987 Q2. The results indicate that cap rates were well below the sustainable level prior to the 2007-2009 downturn but not before the 1990-1992 downturn. The implied corrections signal the 2007-2009 downturn several years beforehand. The appendices contain sector estimates, which show a similar picture.

Figure 3.11: Sustainable Cap Rate and the CBRE Cap Rate through Time

Rolling Windows | Anchored Windows



3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.12: Ratio of CBRE Cap Rate to Sustainable Cap Rate

Rolling Windows | Anchored Windows

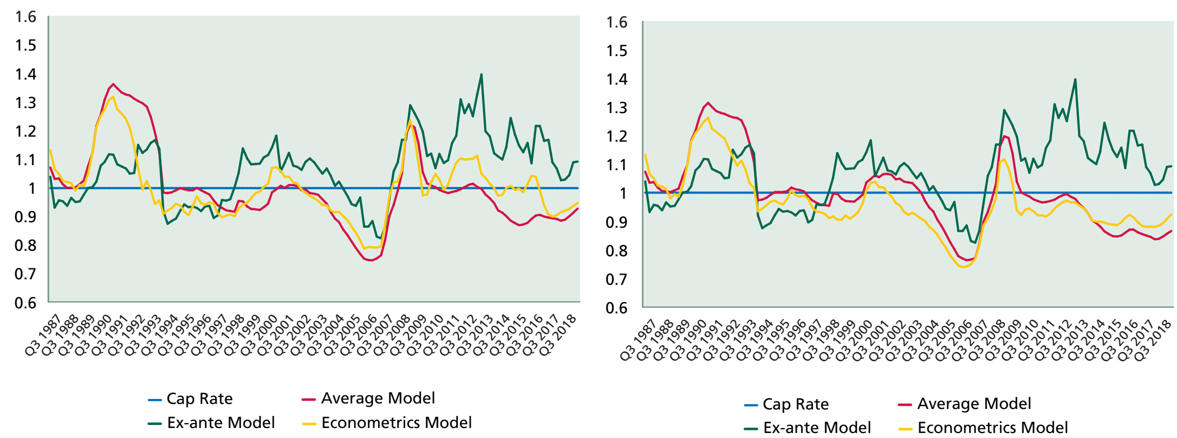
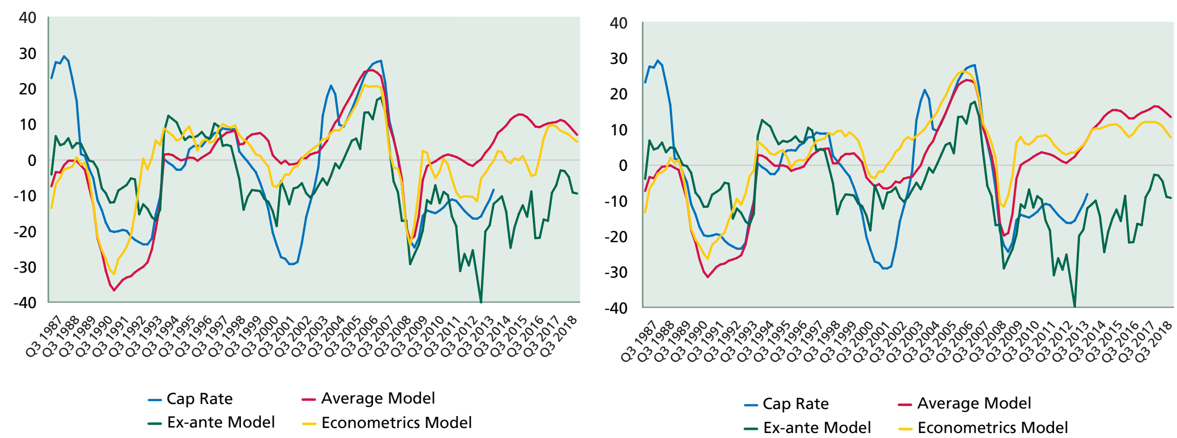


Figure 3.13: Implied Correction in Cap Rate vs. Subsequent Five Year Outturn in the CBRE Series

Rolling Windows | Anchored Windows



3.3.4. Statistical Testing of Implied Correction Forecasts

In this section, the corrections implied by the difference between sustainable cap rate and the actual cap rate are examined further. They are treated as forecasts of subsequent cap rate changes and benchmarked against the changes of the actual cap rate over the following five years. As in the sustainable rent chapter, four metrics are used to evaluate the quality of the forecast: mean error (ME), mean absolute error (MAE), root mean squared error (RMSE) and Theil U1. Without a naïve model for the cap rate, Theil's U2 is not used.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Table 3.3 presents tests in relation to the MSCI All Property cap rate, comparing the implied corrections from models of these series with the subsequent actual outturn in changes of cap rate. The mean errors are negative for both rolling window and anchored window models, indicating that the actual changes in cap rates were lower on average than predicted changes in cap rates based on corrections to sustainable cap rates. MAE, RMSE and Theil U1 give a consistent ranking whereby the ex-ante model produced the smallest errors on average, followed by the econometrics approach and then the average approaches. The appendices contain sector level results of MSCI dataset. For all three sectors, the same pattern occurs as at the All Property level, with the smallest errors for results based on econometric models.

Table 3.3: Forecast Accuracy for Models Based on MSCI All Property Cap Rate

Panel A: Models Using Rolling Windows	ME	MAE	RMSE	Theil U1
Reversion to average	-11.5	13.1	16.5	0.51
Reversion to ex-ante	-5	10.1	12.5	0.42
Correction to econometric estimate	-6.5	11.8	14.6	0.46
Panel B: Models Using Anchored Windows				
Reversion to average	-11.2	13.4	17.1	0.51
Reversion to ex-ante	-5	10.1	12.5	0.42
Correction to econometric estimate	-7.6	11.4	14.5	0.49

Table 3.4 presents results for JLL All Property data. There is a tendency for the actual changes of cap rates to be lower on average than the predicted changes in cap rates based on corrections to sustainable cap rates. The results show that the ex-ante model produced the smallest errors on average for both rolling and anchored windows. The econometric estimate produced smaller errors than the average model for rolling windows, but the econometric estimate produced the largest errors for anchored windows. The appendices contain sector level results of the JLL dataset, the pattern is similar to the results for All Property.

Table 3.4: Forecast Accuracy for Models Based on JLL All Property Cap Rate

Panel A: Models Using Rolling Windows	ME	MAE	RMSE	Theil U1
Reversion to average	-2.7	16.5	19.5	0.55
Reversion to ex-ante	-6.8	11.4	14	0.48
Correction to econometric estimate	-2.3	12.7	16.4	0.5
Panel B: Models Using Anchored Windows				
Reversion to average	-0.2	15.5	18.4	0.51
Reversion to ex-ante	-6.8	11.4	14	0.48
Correction to econometric estimate	-6.8	15.8	19.5	0.58

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Table 3.5 presents results for CBRE All Property data. The actual changes in cap rates were lower on average than predicted changes in cap rates based on corrections to sustainable cap rates estimated by average and econometrics model. The actual changes in cap rates were higher on average than predicted changes in cap rates based on corrections to sustainable cap rates estimated by the ex-ante model. The results show that the ex-ante model produced the smallest errors on average for both rolling and anchored windows. For the rolling windows, the econometrics approach performed similar to the average model. For the anchored windows, the econometric estimate produced larger errors than the average model. The appendices contain sector level results of the CBRE dataset, the pattern is similar to the results for All Property.

Table 3.5: Forecast Accuracy for Models Based on CBRE All Property Cap Rate

Panel A: Models Using Rolling Windows	ME	MAE	RMSE	Theil U1
Reversion to average	-1.6	10.1	13.2	0.43
Reversion to ex-ante	2.2	9.6	11.7	0.39
Correction to econometric estimate	-2.3	9.9	13	0.48
Panel B: Models Using Anchored Windows				
Reversion to average	-1	9.5	12.4	0.42
Reversion to ex-ante	2.2	9.6	11.7	0.39
Correction to econometric estimate	-5.6	11.6	14.7	0.53

3.4. Equilibrium Capital Value Methods

The results from the sustainable rental analysis suggest that econometric estimates are preferred. The cap rate analysis suggests that the econometric or ex-ante approaches are preferred. Consequently both of these sustainable cap rate results are combined with the sustainable rent estimates to produce sustainable or equilibrium capital value estimates. In addition, the AMV approach to capital values is also used for comparison. Consequently, the focus is on three approaches to the estimation of sustainable capital values:

- Adjusted market value (a trend-based model);
- Econometric estimation of sustainable rents and econometric estimation of sustainable cap rates; and
- Econometric estimation of sustainable rents and econometric estimation of sustainable cap rates.

CV Approach 1: Adjusted Market Value (AMV)

This steps for this approach involve:

- Calculating real capital values using an inflation deflator;
- Take the logarithm of the real capital value;
- Estimating a regression of the logarithm of real capital value on time recursively. At each pass, an in-sample forecast of the last period logarithm of real capital value is generated;
- Take the exponential of the predicted logarithm of real capital value to get predicted real capital value;
- A market adjustment factor (MA) is defined as the percentage deviation of the actual real capital value from the predicted (trend) real capital value; and
- The equilibrium capital value is equal to the actual nominal capital value times (1-MA).

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

CV Approach 2: Econometrics Model for Equilibrium Rent + Econometrics Model for Cap Rate

In this approach the econometrics approach is used to estimate the equilibrium or sustainable rent as outlined in the previous chapter. Rent depends on the supply and demand of the property. Two kinds of estimation are employed: a rolling window and an anchored window. Based on the estimated coefficient, the next quarter's rent is predicted, designated equilibrium rent. Similarly, the cap rate model in previous section is used to estimate the equilibrium cap rate.

The approach to get equilibrium capital value involves:

- Hypothetical capital value = actual rent / actual cap rate;
- Predicted capital value = predicted rent / predicted cap rate. This step is conducted via the econometrics models. The rolling window equilibrium capital value is calculated by using the rolling window estimated equilibrium rent divided by the rolling window estimated equilibrium cap rate. The anchored window equilibrium capital value is calculated by using the anchored window estimated equilibrium rent divided by the anchored window estimated equilibrium cap rate;
- Calculate adjustment factor = (hypothetical capital value / predict capital value) -1; and
- Equilibrium capital value = actual capital value * (1- adjustment factor).

As discussed in the sustainable rent chapter for the estimation of equilibrium rent for office, the supply variable is the stock of office and the demand variable is real GDP. For the estimation of equilibrium rent for retail, the supply variable is the stock of retail and the demand variable is the log of real household consumption. For the estimation of equilibrium rent for industrial, the supply variable is the stock of industrial and the demand variable is real GDP.

CV Approach 3: Econometrics Model for Equilibrium Rent + Ex-Ante Cap Rate

This approach uses the econometrics-based equilibrium or sustainable rent and the ex-ante view of sustainable cap rates in a similar way to CV Approach 2.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

3.5. Equilibrium Capital Value Results

This section sets outs the results from three approaches:

- CV Approach 1: Adjusted market value (AMV);
- CV Approach 2: Econometrics model for equilibrium rent + Econometrics model for cap rate; and
- CV Approach 3: Econometrics model for equilibrium rent + Ex-ante cap rate.

3.5.1. CV Approach 1: Adjusted Market Value (AMV)

Figure 3.14: Actual Capital Value vs. Equilibrium Capital Value for MSCI All Property

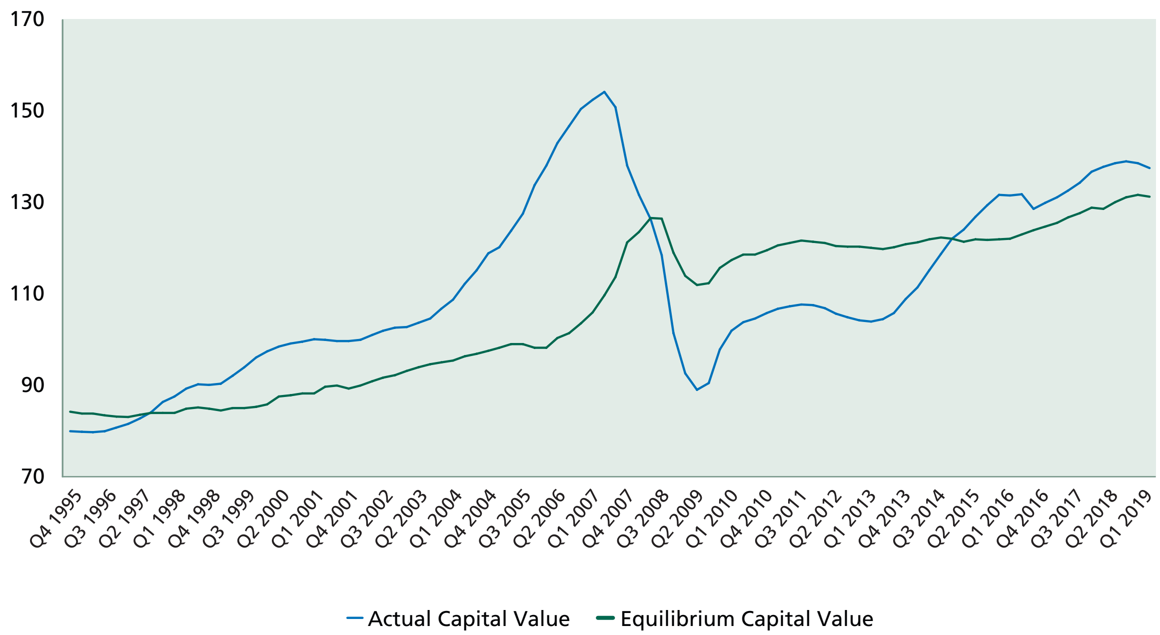


Figure 3.14 displays the actual capital value index against the equilibrium capital value based on AMV model by using the MSCI data. Only an anchored window is used.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.15: Deviation of Actual Capital Value from Equilibrium Capital Value for MSCI All Property

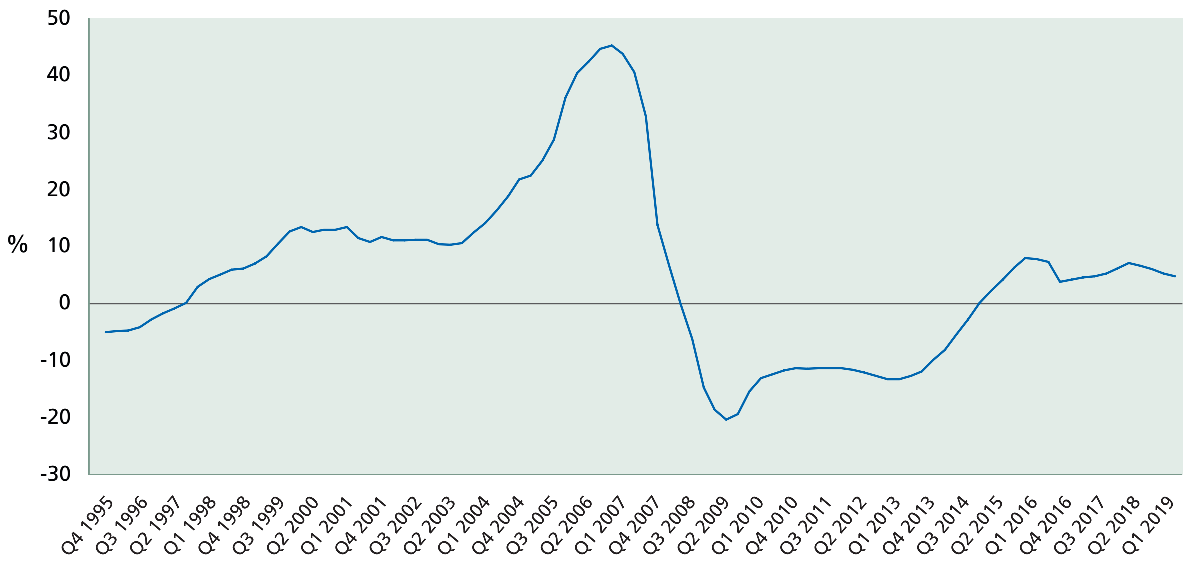
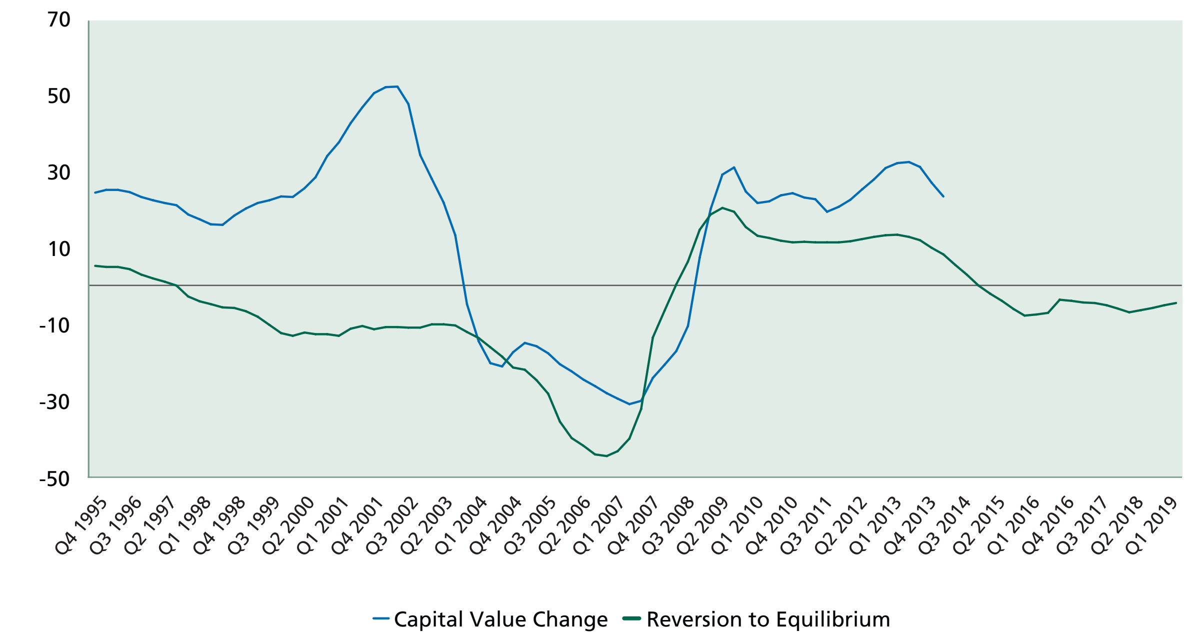


Figure 3.15 extends the comparison by displaying the percentage of deviation of the actual capital value from the equilibrium capital value. The percentage of deviation allows us to track the magnitude of deviation over time. The results indicate that the actual capital value is over-valued by more than 40% prior to the 2007-2009 downturn.

Figure 3.16: Implied Correction in Capital Value vs. Subsequent Five Year Outturn in the MSCI All Property



3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

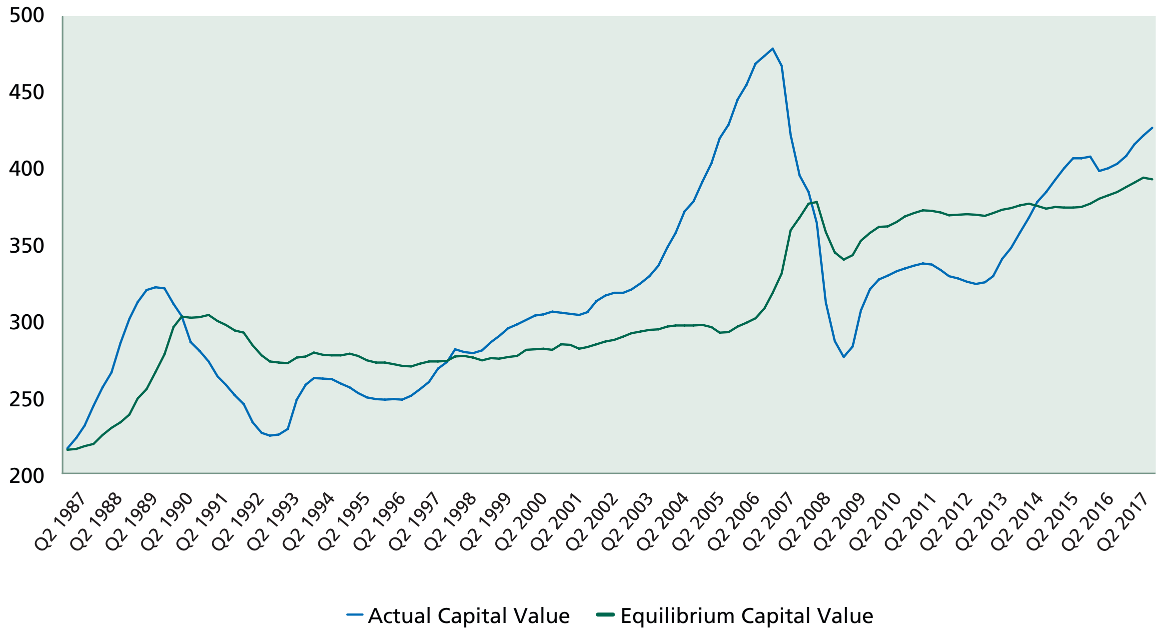
Figure 3.16 shows the corrections required to restore capital value to equilibrium levels based on the AMV model. The blue series tracks the changes of capital value from each date to a date five years later. This can be compared to the implied correction from the results of different models. The implied corrections successfully predict the downturn of the capital value in 2007-2009 downturn. Overall, the model successfully predicts the property crisis in 2007-2009.

Analysis of property sectors is presented in Appendix C. For all three sectors, the actual capital values were well above the equilibrium capital values prior to the 2007-2009 downturn. The model successfully predicts the property crisis in 2007-2009 for all three sectors.

Figures 3.17-3.19 show equilibrium capital value, percentage deviation and implied corrections for the AMV model (all based on anchored windows) using the JLL All Property data. The actual capital value is above AMV by around 30% prior to 1990-1992 downturn and by more than 50% prior to the 2007-2009 downturn. The model successfully predicts the two property crises in 1990-1992 and 2007-2009.

Analysis of property sectors is presented in Appendix C. For the office and industrial sectors, the model successfully predicts the two property crises in 1990-1992 and 2007-2009. For the retail sector, the actual capital value is over-valued by around 10% prior to 1990-1992 downturn and over-valued by more than around 30% prior to the 2007-2009 downturn. While the model successfully predicts the property crisis in 2007-2009, it fails to predict the 1990-1992 crisis if a 20% over-valuation is chosen as an indicator of crises.

Figure 3.17: Actual Capital Value vs. Equilibrium Capital Value for JLL All Property



3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.18: Deviation of Actual Capital Value from Equilibrium Capital Value for JLL All Property

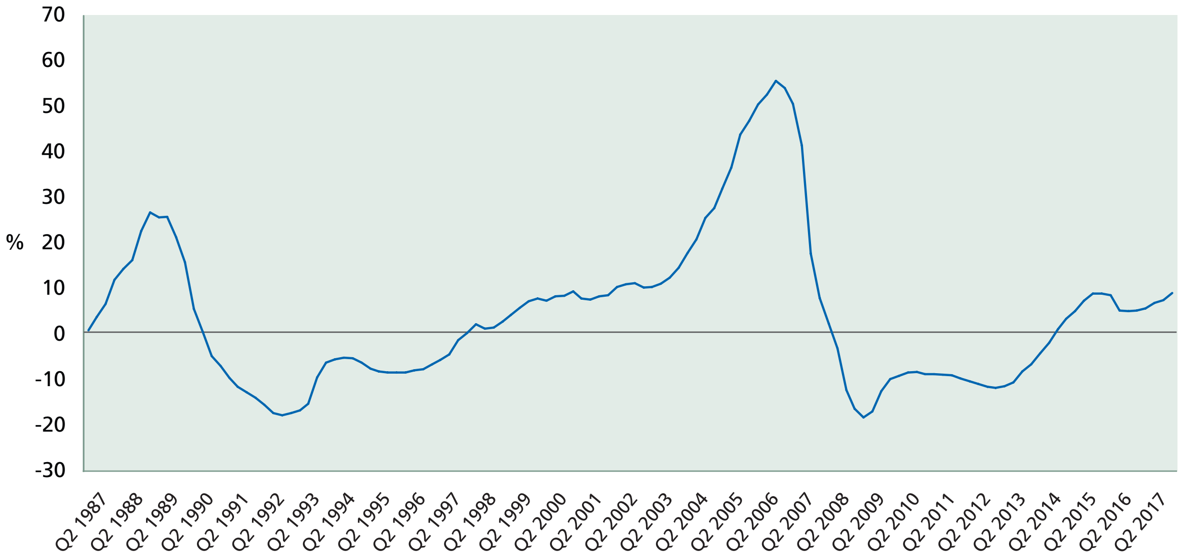
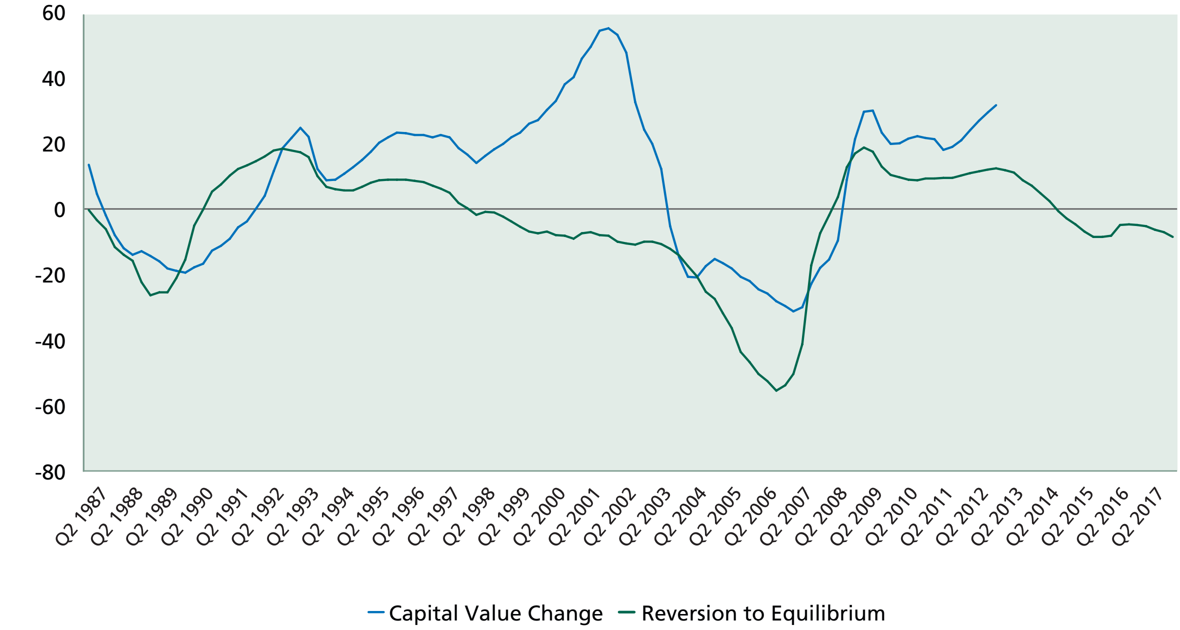


Figure 3.19: Implied Correction in Capital Value vs. Subsequent Five Year Outturn in JLL All Property

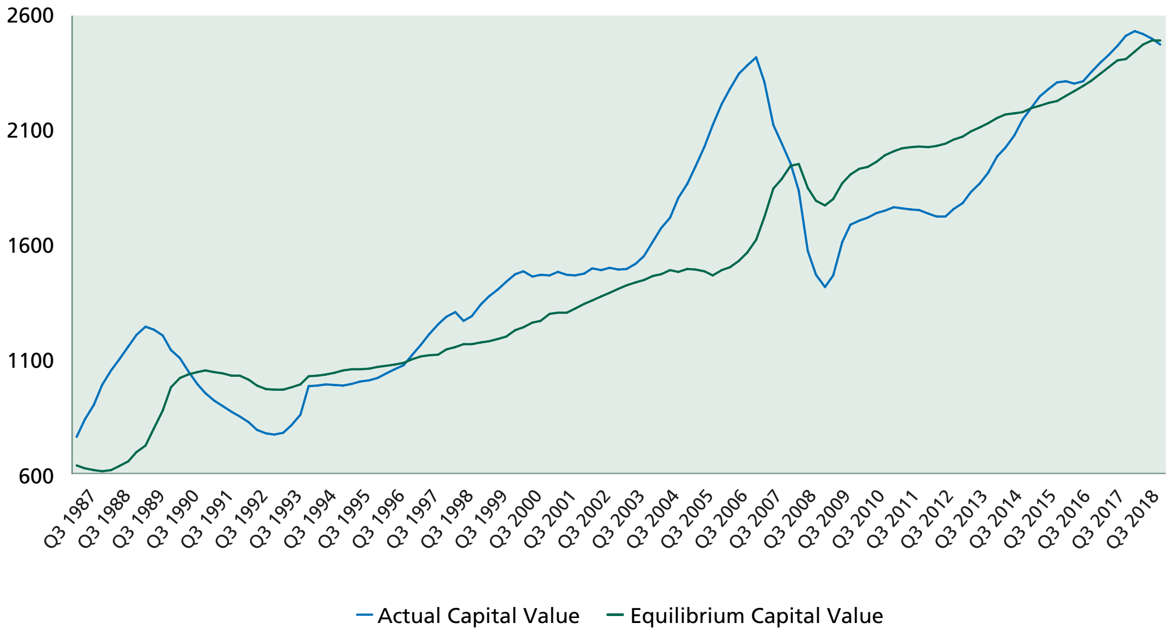


3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figures 3.20-3.22 show equilibrium capital value, percentage of deviation and implied corrections for the AMV model using the CBRE All Property data. The actual capital value is over-valued more than 70% prior to 1990-1992 downturn and over-valued around 50% prior to the 2007-2009 downturn. The model successfully predicts the two property crises in 1990-1992 and 2007-2009.

Analysis of property sectors is presented in Appendix C. For all three sectors, the actual capital values were well above the equilibrium capital values prior to 1990-1992 and 2007-2009 downturn. The model successfully predicts the property crises in 1990-1992 and 2007-2009 for all three sectors.

Figure 3.20: Actual Capital Value vs. Equilibrium Capital Value for CBRE All Property



3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.21: Deviation of Actual Capital Value from Equilibrium Capital Value for CBRE All Property

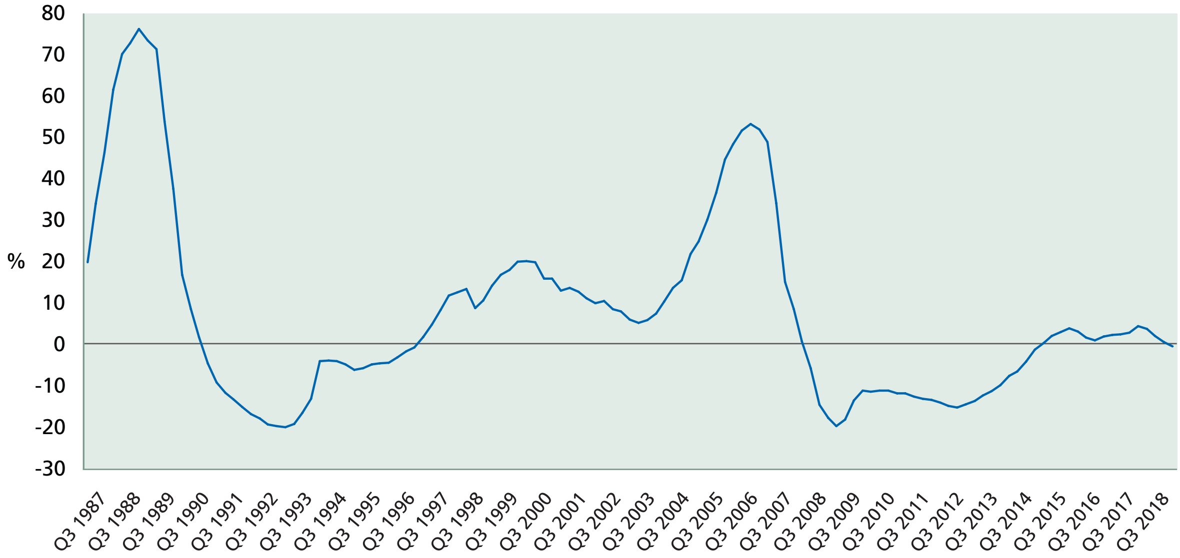
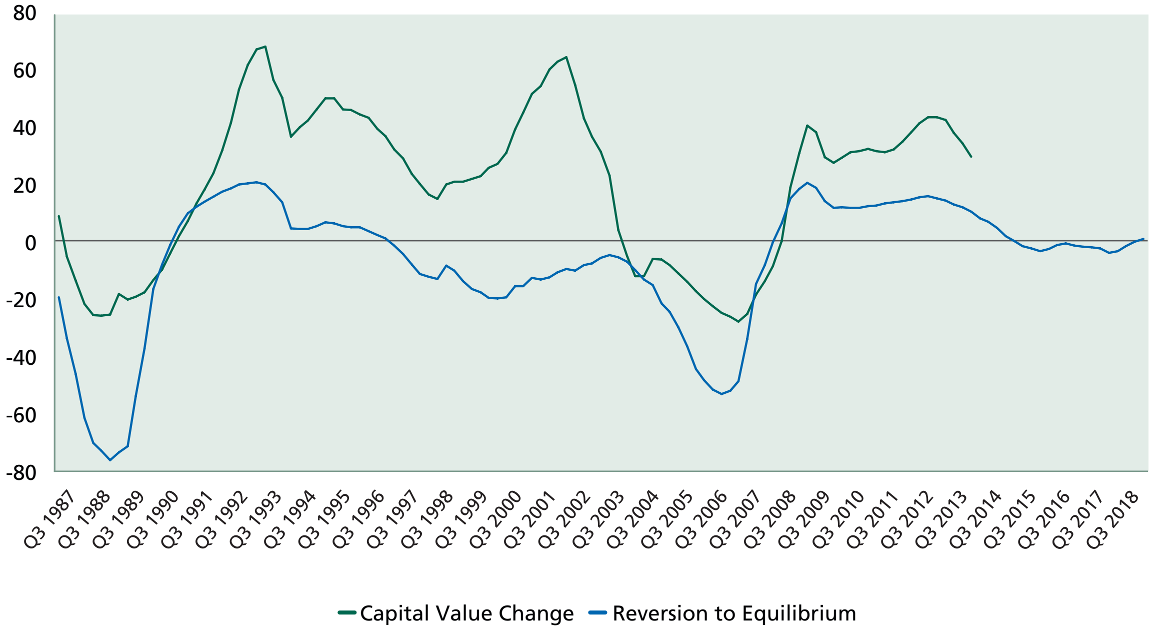


Figure 3.22: Implied Correction in Capital Value vs. Subsequent Five Year Outturn in the CBRE All Property



3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

3.5.2. CV Approach 2: Econometrics Models for Equilibrium Rents and Cap Rate

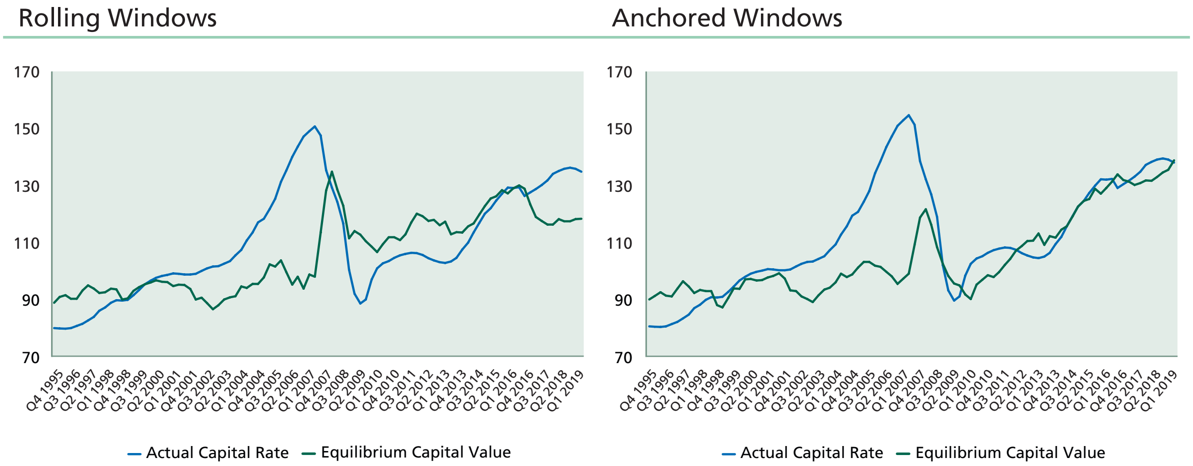
This method combines the econometric estimation of equilibrium rents with the econometric estimation of sustainable rents. Figure 3.23 displays the actual capital value index against the equilibrium capital value based on the model by using the MSCI data. The left hand panel of Figure 3.23 shows the results from using rolling windows to identify the period for analysis while the right hand panel show the results from using an anchored window.

Figure 3.24 extends the comparison by displaying the percentage of deviation of the actual capital value from the equilibrium capital value. The percentage of deviation allows us to track the magnitude of deviation over time. Both rolling and anchored windows show an over-valuation of more than 30% prior to the 2007-2009 downturn.

Figure 3.25 shows the corrections required to restore capital value to equilibrium levels based on the model. The blue series shows the change in capital value from each date to a date five years later. This can be compared to the implied correction from the results of different models. The implied corrections successfully predict the downturn of the capital value in 2007-2009 downturn. Overall, the model successfully predicts the property crisis in 2007-2009.

Analysis of property sectors is presented in Appendix C. For all three sectors, the actual capital values were well above the equilibrium capital values prior to the 2007-2009 downturn. The model therefore successfully predicts the property crisis in 2007-9 for all three sectors.

Figure 3.23: Actual Capital Value vs. Equilibrium Capital Value for MSCI All Property



3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.24: Deviation of Actual Capital Value from Equilibrium Capital Value for MSCI All Property

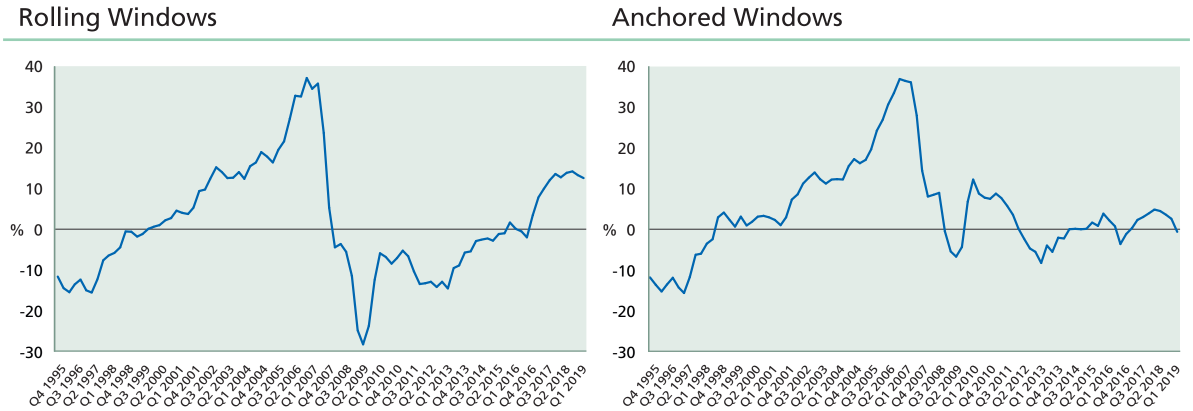
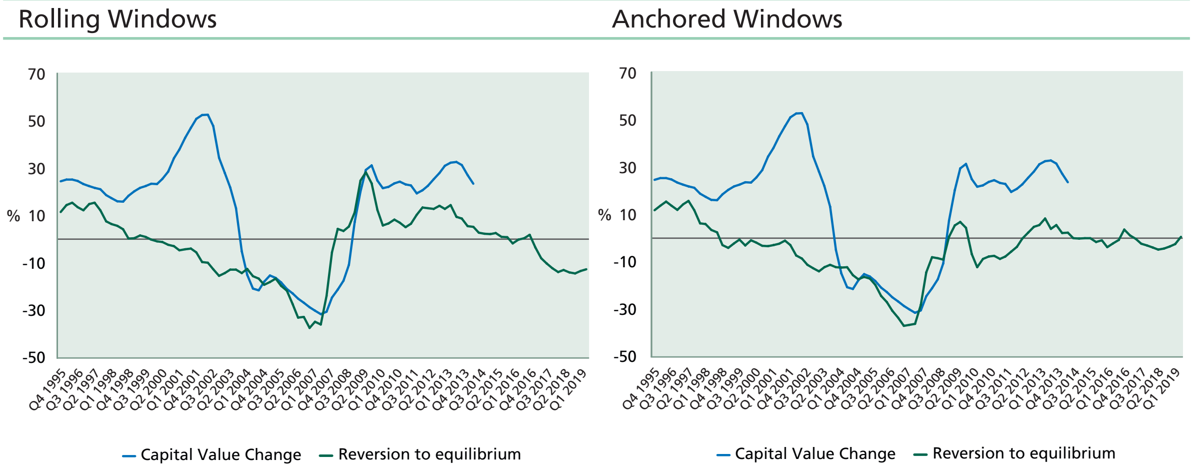


Figure 3.25: Implied Correction in Capital Value vs. Subsequent Five Year Outturn in the MSCI All Property Index



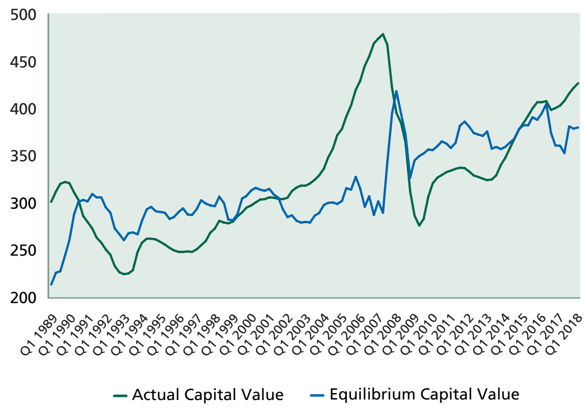
Figures 3.26-3.28 show equilibrium capital value, percentage of deviation and implied corrections using the JLL All Property data. Both rolling and anchored windows show that the actual capital value is over-valued by around 30% prior to 1990-1992 downturn and over-valued by more than 40% prior to the 2007-2009 downturn. The model therefore successfully predicts the two property crises in 1990-1992 and 2007-2009.

Analysis of property sectors is presented in Appendix C. For the office and industrial sectors, the model successfully predicts the two property crises in 1990-1992 and 2007-2009. For the retail sector, both rolling and anchored windows show that the actual capital value is over-valued by under 20% prior to 1990-1992 downturn and over-valued by more than 40% prior to the 2007-2009 downturn. While the model successfully predicts the property crisis in 2007-2009, it fails to predict the 1990-1992 crisis if choosing a 20% over-valuation as an indicator of a potential crisis.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.26: Actual Capital Value vs. Equilibrium Capital Value for JLL All Property

Rolling Windows



Anchored Windows

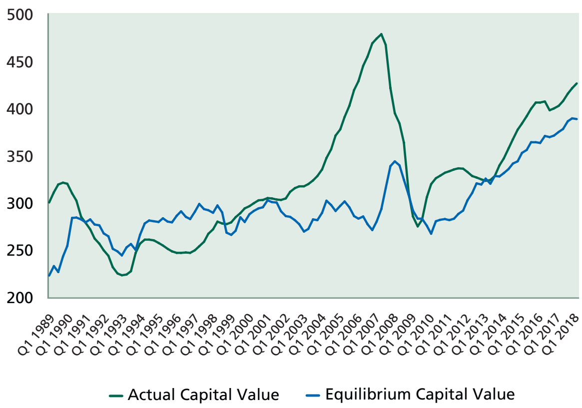
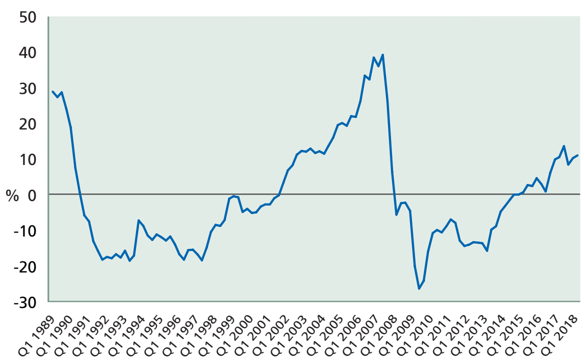


Figure 3.27: Deviation of Actual Capital Value from Equilibrium Capital Value for JLL All Property

Rolling Windows



Anchored Windows

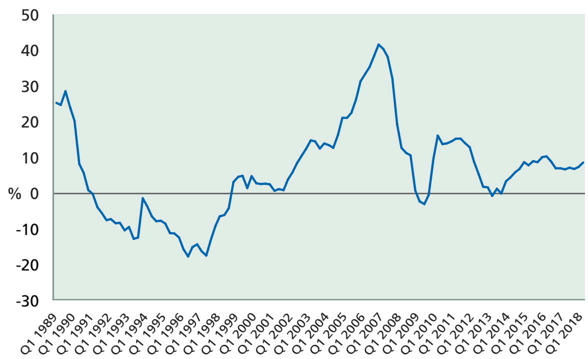
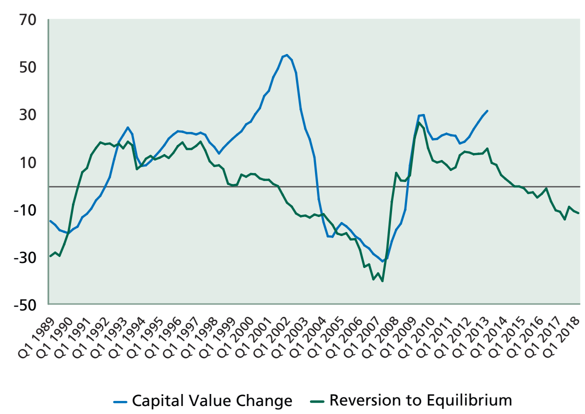
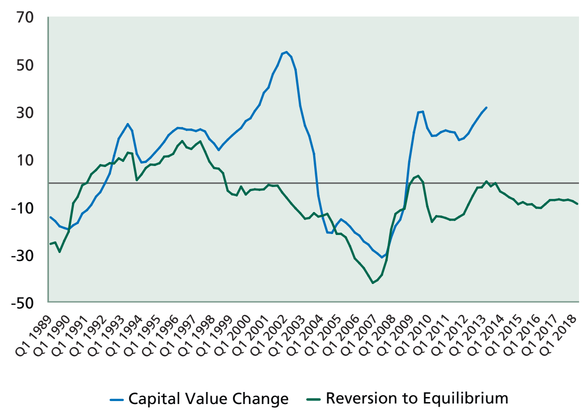


Figure 3.28: Implied Correction in Capital Value vs. Subsequent Five Year Outturn in JLL All Property

Rolling Windows



Anchored Windows



3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figures 3.29-3.31 show equilibrium capital value, percentage of deviation and implied corrections using the CBRE All Property data. Both rolling and anchored windows show that the actual capital value is over-valued around 20% prior to 1990-1992 downturn and over-valued more than 30% prior to the 2007-2009 downturn. The model successfully predicts the two property crises in 1990-1992 and 2007-2009.

Analysis of property sectors is presented in Appendix C. For all three sectors, the actual capital values were well above the equilibrium capital values prior to the 2007-2009 downturn. The model successfully predicts the property crisis in 2007-2009 for all three sectors.

Figure 3.29: Actual Capital Value vs. Equilibrium Capital Value for CBRE All Property

Rolling Windows | Anchored Windows

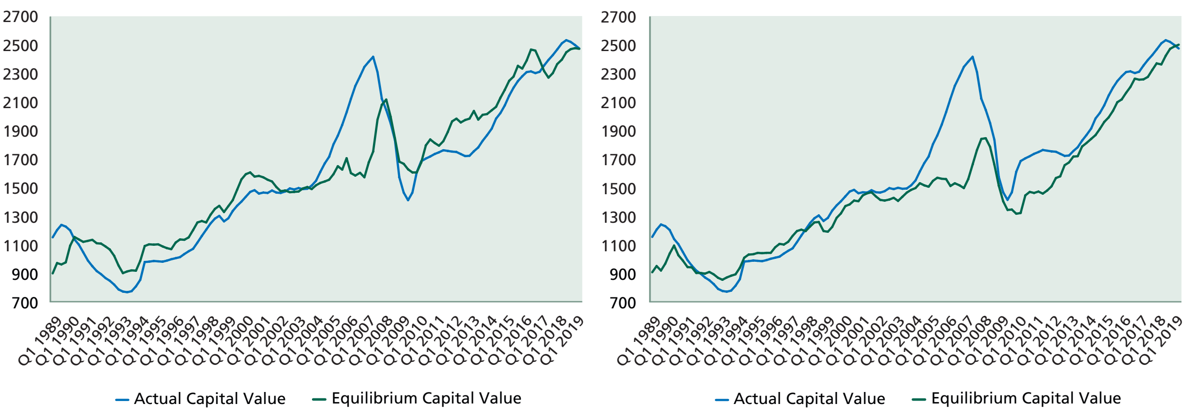
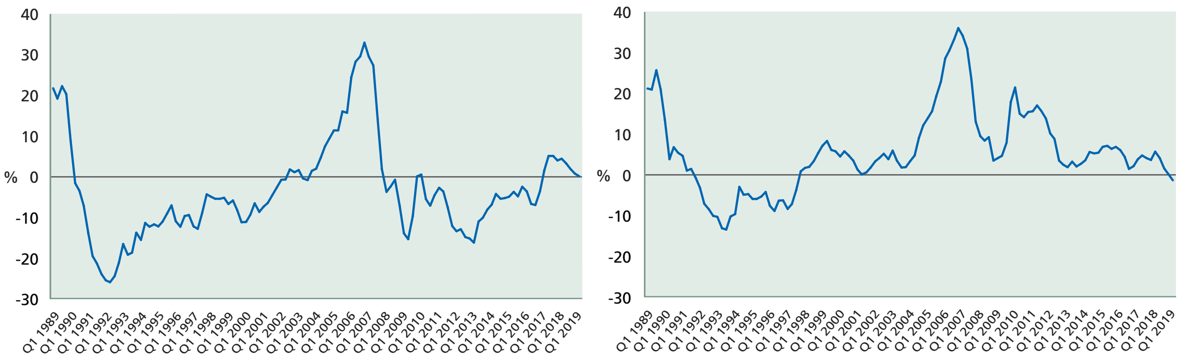


Figure 3.30: Deviation of Actual Capital Value from Equilibrium Capital Value for CBRE All Property

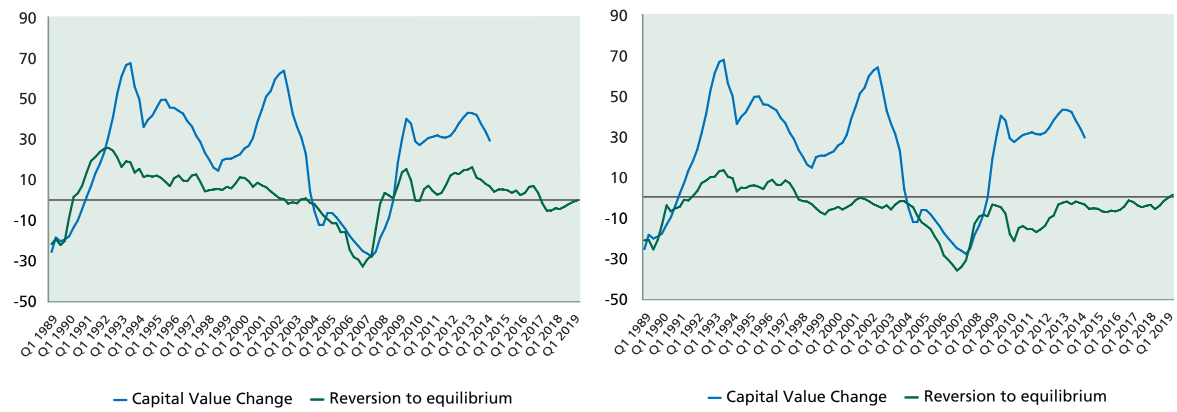
Rolling Windows | Anchored Windows



3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.31: Implied Correction in Capital Value vs. Subsequent Five Year Outturn in the CBRE All Property

Rolling Windows | Anchored Windows



3.5.3. CV Approach 3: Econometrics Models for Equilibrium Rents and Ex-ante Cap Rate

This method combines the econometric estimation of equilibrium rents with the ex-ante cap rate as explained in Section 3.2. Using sticky required returns was explored, as opposed to a RFR+RP approach, and the results for this are included in Appendix C, as this approach did not produce significantly better or different results.

Figure 3.32: Actual Capital Value vs. Equilibrium Capital Value for MSCI All Property

Rolling Windows | Anchored Windows

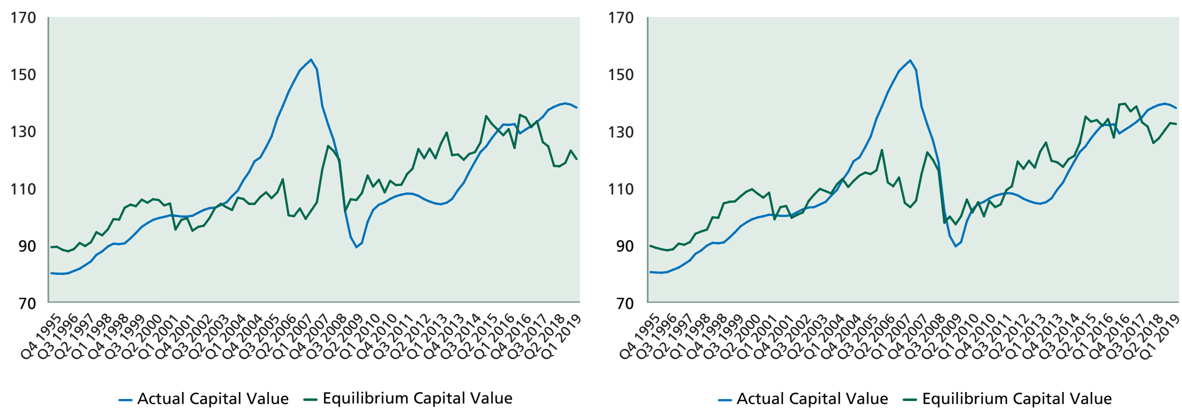


Figure 3.32 displays the actual capital value index against the equilibrium capital value based on this model using MSCI data. The left hand side of Figure 3.32 shows the results from using rolling windows to identify the period for analysis while the right hand side show the results from using anchored window.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.33: Deviation of Actual Capital Value from Equilibrium Capital Value for MSCI All Property

Rolling Windows | Anchored Windows

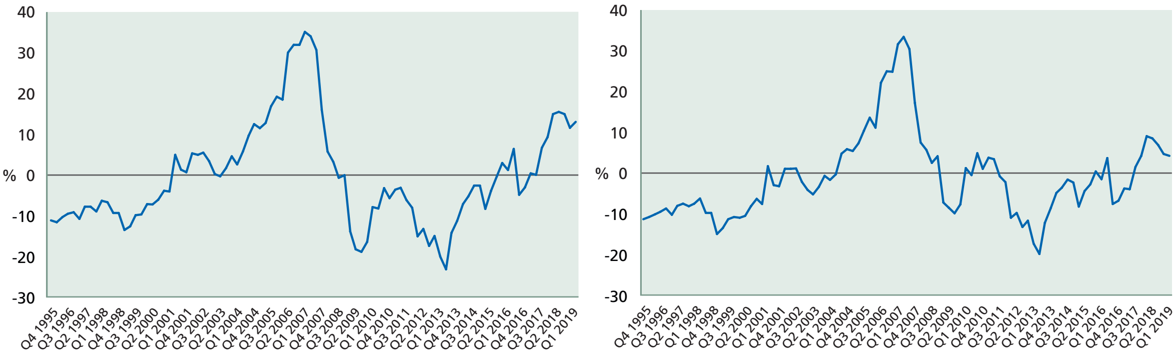


Figure 3.33 extends the comparison by displaying the percentage deviation of the actual capital value from the equilibrium capital value. Both rolling and anchored windows show an over-valuation of more than 30% prior to the 2007-2009 downturn.

Figure 3.34: Implied Correction in Capital Value vs. Subsequent Five Year Outturn in the MSCI All Property

Rolling Windows | Anchored Windows

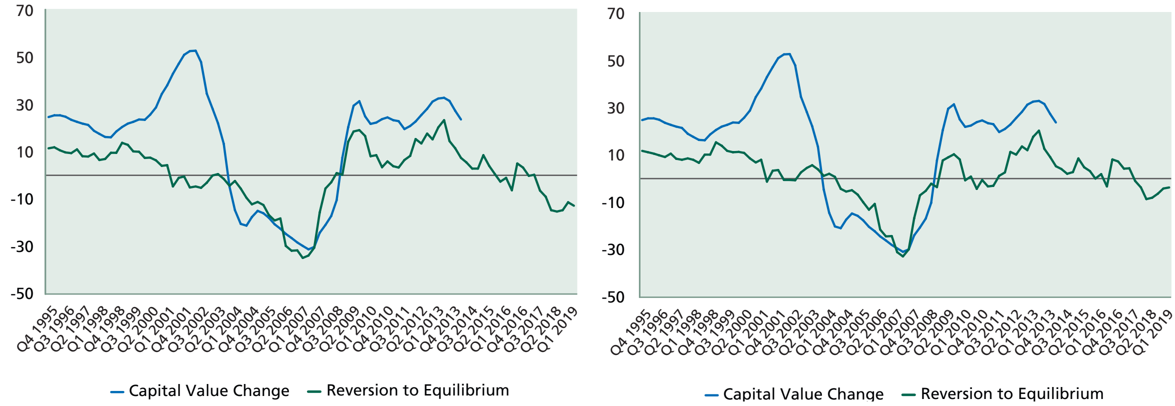


Figure 3.34 shows the corrections required to restore the capital value to equilibrium levels based on the model. The blue series shows the change in capital value from each date to a date five years later. This can be compared to the implied correction from the results of different models. The implied corrections successfully predict the 2007-2009 downturn in capital values.

Analysis of property sectors is presented in Appendix C. The actual capital values were well above the equilibrium capital values prior to the 2007-2009 downturn indicating the model successfully predicts the property crisis in 2007-2009 for all three sectors.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.35: Actual Capital Value vs. Equilibrium Capital Value for JLL All Property

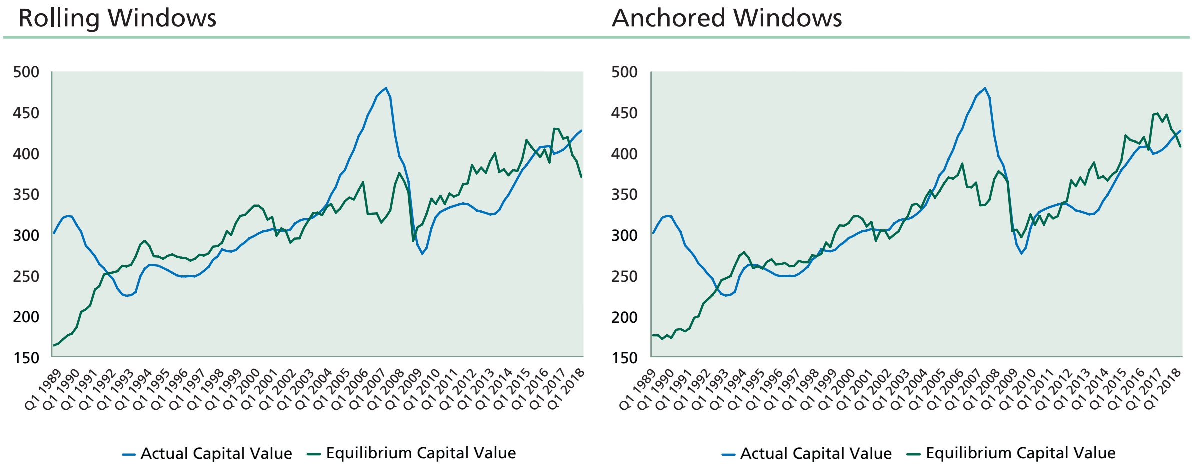


Figure 3.36: Deviation of Actual Capital Value from Equilibrium Capital Value for JLL All Property

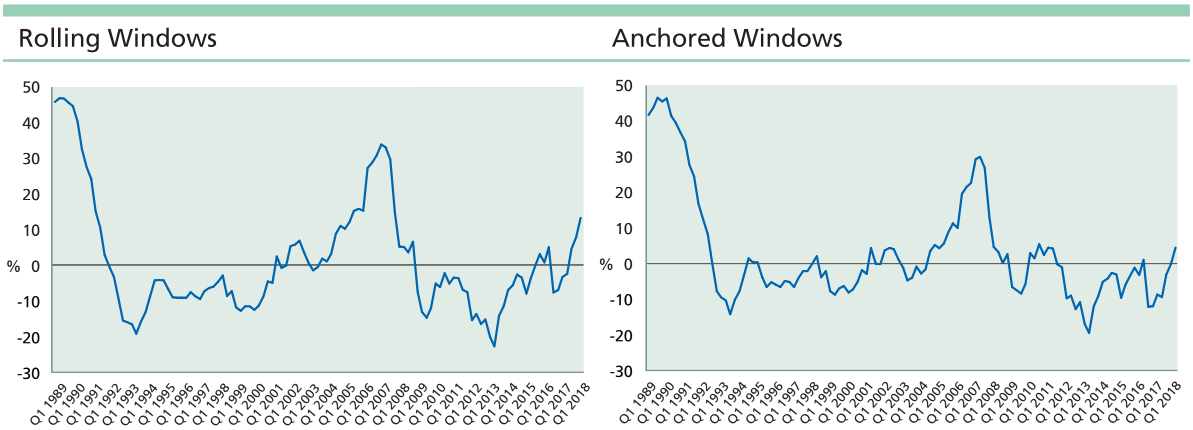
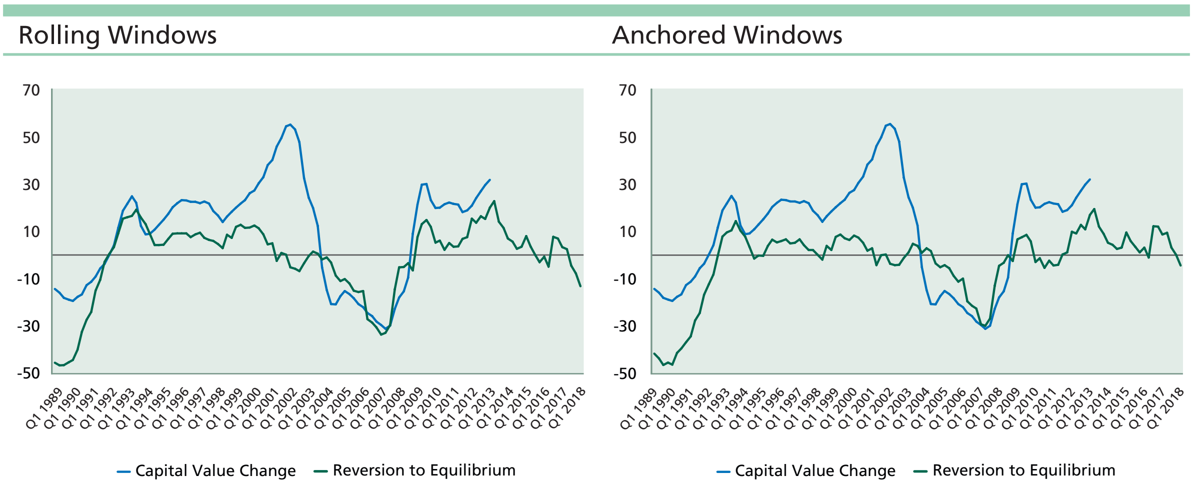


Figure 3.37: Implied Value Correction vs. Subsequent Five Year Outturn in the JLL All Property



3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

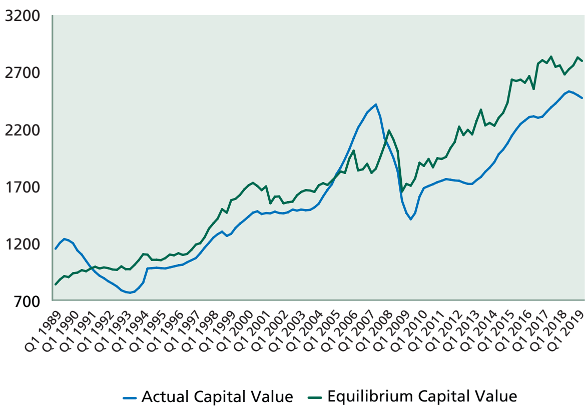
Figures 3.35-3.37 show equilibrium capital value, percentage of deviation and implied corrections using the JLL All Property data. For both rolling window and anchored window estimations, the actual capital value is over-valued by more than 40% prior to 1990-1992 downturn and over-valued by around 30% prior to the 2007-2009 downturn. The model successfully predicts the two property crises in 1990-1992 and 2007-2009.

Analysis of property sectors is presented in Appendix C. For all three sectors, the model successfully predicts the two property crises in 1990-1992 and 2007-2009.

Figures 3.38-3.40 show equilibrium capital value, percentage of deviation and implied corrections using the CBRE All Property data. For both rolling window and anchored window estimations, the actual capital value is over-valued by more than 20% prior to 1990-1992 downturn and over-valued by around 20% prior to the 2007-2009 downturn. The model successfully predicts the two property crises in 1990-1992 and 2007-2009.

Figure 3.38: Actual Capital Value vs. Equilibrium Capital Value for CBRE All Property

Rolling Windows



Anchored Windows

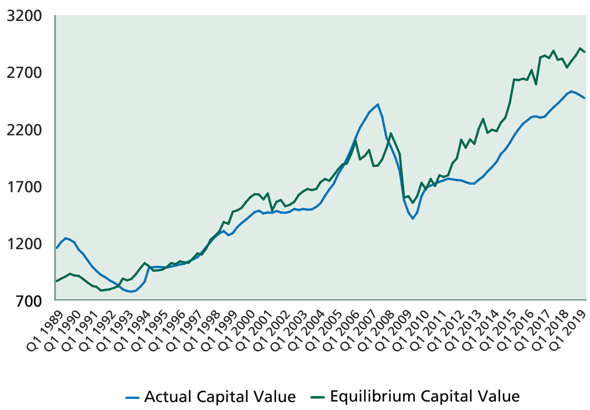
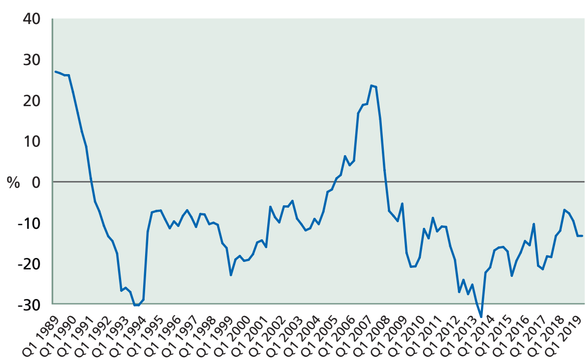
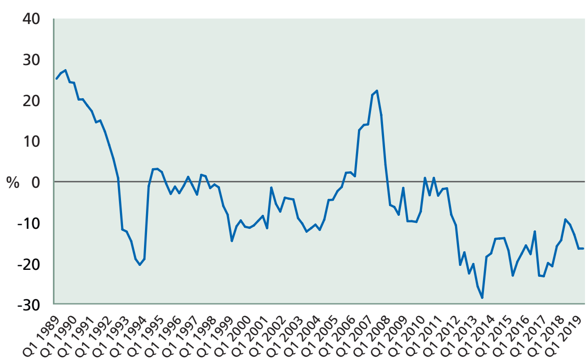


Figure 3.39: Deviation of Actual Capital Value from Equilibrium Capital Value for CBRE All Property

Rolling windows



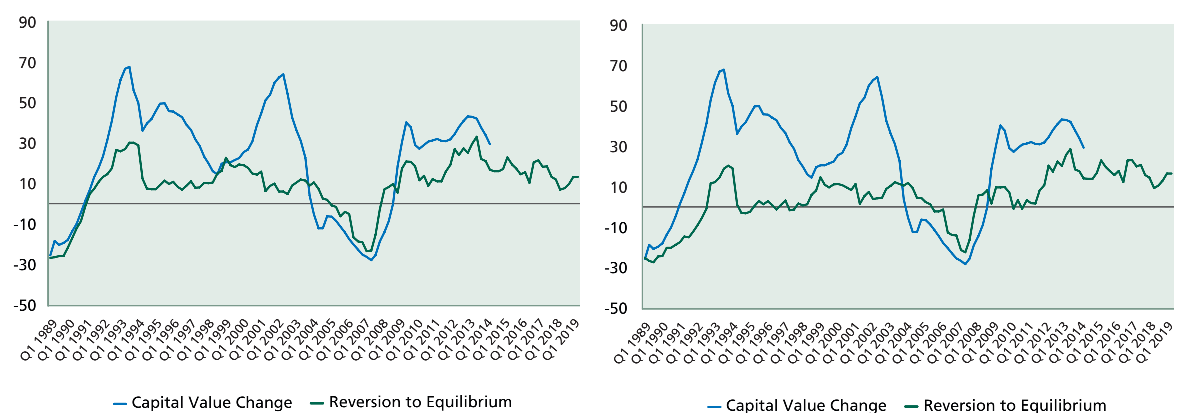
Anchored windows



3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Figure 3.40: Implied Correction in Capital Value vs. Subsequent Five Year Outturn in the CBRE All Property

Rolling Windows | Anchored Windows



Analysis of property sectors is presented in Appendix C. For the office and retail sectors, the model successfully predicts the two property crises in 1990-1992 and 2007-2009. For the industrial sector the actual capital value is over-valued by more than 20% prior to 1990-1992 downturn but there is not a clear signal (>20% over-valuation) prior to the 2007-2009 downturn.

3.6. Statistical Testing of Implied Correction Forecasts and Conclusions

In this section, the corrections implied by the difference between equilibrium capital value and the actual capital value are examined further. They are treated as forecasts of subsequent capital value changes and benchmarked against the changes of the actual capital value over the following five years. As for sustainable rents, four metrics are used to evaluate the quality of the forecast: mean error (ME), mean absolute error (MAE), root mean squared error (RMSE) and Theil U1. As with cap rates, since there is no naïve model for the capital value, Theil's U2 is not used.

Table 3.6 presents tests in relation to the MSCI All Property capital value, comparing the implied corrections from models of these series with the subsequent actual outturn in changes of capital value. The mean errors are positive for both rolling window and anchored window models, indicating that the actual changes in capital values were higher on average than predicted changes in capital values based on corrections to equilibrium capital values. For both rolling and anchored windows, ex-ante Approach 1 produced the smallest errors on average. Panel B shows that there is little to choose between the anchored AMV and econometric approaches in terms of prediction, although the latter generates lower error metrics.

The appendices contain sector level results for the MSCI dataset. Ex-ante Approach 1 produced the smallest error across all the sectors and estimation windows. In the case of anchored windows, the econometrics model performed as well as the AMV model across all three sectors.

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Table 3.6: Forecast Accuracy for Models Based on MSCI All Property Capital Value

Panel A: Models Using Rolling Windows	ME	MAE	RMSE	Theil U1
AMV	NA	NA	NA	NA
Econometrics model	15.0	17.9	23.6	0.58
Ex-ante required return (1)	12.7	15.6	20.3	0.51
Ex-ante sticky required return (2)	23.0	23.8	27.7	0.64
Panel B: Models Using Anchored Windows				
AMV	19.6	21.6	26.7	0.62
Econometrics model	19.5	20.9	25.8	0.66
Ex-ante required return (1)	12.5	17.0	20.6	0.55
Ex-ante sticky required return (2)	22.8	24.0	28.0	0.68

Table 3.7 presents results for JLL All Property data. The mean errors are positive for both rolling window and anchored window models, indicating that the actual changes in capital values were higher on average than predicted changes in capital values based on corrections to equilibrium capital values. For both rolling and anchored windows, econometrics model and ex-ante Approach 1 performed equally well. In the case of anchored windows, AMV performed slight better than econometrics model and ex-ante Approach 1.

The appendices contain sector level results of JLL dataset. In the case of rolling windows, econometrics model performed equally well as ex-ante Approach 1 for office. Ex-ante Approach 1 performed the best for the retail sector, whereas econometrics model performed the best for the industrial sector. In the case of anchored windows, AMV model performed equally well as ex-ante Approach 1 and slightly better than the econometrics model for office and industrial sectors. For the industrial sector, ex-ante Approach 1 performed the best, followed by econometrics model, AMV and ex-ante Approach 2.

Table 3.7: Forecast Accuracy for Models Based on JLL All Property Capital Value

Panel A: Models Using Rolling Windows	ME	MAE	RMSE	Theil U1
AMV	NA	NA	NA	NA
Econometrics model	8.7	14.1	19.9	0.51
Ex-ante required return (1)	12.2	14.7	19.5	0.49
Ex-ante sticky required return (2)	21.9	22.5	26.5	0.61
Panel B: Models Using Anchored Windows				
AMV	13.3	17.3	22.5	0.55
Econometrics model	16.1	18.5	24.1	0.62
Ex-ante required return (1)	14.6	18.6	21.9	0.56
Ex-ante sticky required return (2)	24.6	25.8	29.5	0.68

3. SUSTAINABLE CAP RATES AND CAPITAL VALUES

Table 3.8 presents results for CBRE All Property data. The mean errors are positive for both rolling window and anchored window models, indicating that the actual changes in capital values were higher on average than predicted changes in capital values based on corrections to equilibrium capital values. For both rolling and anchored windows, ex-ante Approach 1 produced the smallest errors on average. Panel B shows that there is little to choose between the anchored AMV and econometric approaches in terms of prediction, although the latter generates higher error metrics. The appendices contain sector level results of JLL dataset. For the office sector, ex-ante Approach 1 performed the best in both rolling and anchored windows. In the case of anchored windows, econometrics model performed better than AMV. For the retail sector, while ex-ante Approach 1 performed the best in the rolling window, AMV model performed the best in the anchored window. For the industrial sector, ex-ante Approach 1 performed the best in both rolling and anchored windows. In the case of anchored windows, econometrics model performed worse than AMV.

Table 3.8: Forecast Accuracy for Models Based on CBRE All Property Capital Value

Panel A: Models Using Rolling Windows	ME	MAE	RMSE	Theil U1
AMV	NA	NA	NA	NA
Econometrics model	18.3	21.6	26.3	0.57
Ex-ante required return (1)	13.7	17.7	22.3	0.44
Ex-ante sticky required return (2)	25.4	26.5	31	0.66
Panel B: Models Using Anchored Windows				
AMV	28.5	29.2	34.0	0.60
Econometrics model	28.3	29.2	34.3	0.75
Ex-ante required return (1)	19.7	24.4	28.4	0.60
Ex-ante sticky required return (2)	32.2	33.3	38.6	0.79

The results presented here suggest that the combination of econometrics sustainable rent and ex-ante Approach 1 perform the best. Furthermore, an econometric approach combining sustainable rent analysis and estimation of appropriate capitalisation rates performs at least as well as the AMV model in providing warning signals of the 1990-1992 and 2007-2009 market corrections, often produces smaller error metrics and has the critical advantages of being able to disaggregate impacts (is any excess value in the market driven by occupier markets, investment markets or both?) and having an underlying economic logic and rationale, which makes it more adaptable to changes in market drivers and structural change. This needs to be set against the requirement for greater computational effort: however, the techniques and methods required should be well within the compass of a professional investment fund. Other potential warning signals of corrections or excess value are considered next.

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

4.1. Introduction

This section moves away from direct assessment of fundamental versus market values, yields and rents to investigate whether there are other indicators that might indicate future substantial falls (or increases) in values in the direct, private property market. The principal focus here is on leverage. The aftermath of the Global Financial Crisis reawakened interest in the interaction of debt and asset values as highly-geared investment vehicles failed and financial institutions (and regulators) struggled to unravel portfolios of non-performing loans and debt-related securities and derivatives. This new focus was mirrored in financial research, which began to move beyond simplistic corporate finance models predicated on efficient markets to recognise the interaction between financial and asset markets and the possibility of mispricing of risk in debt markets. Of particular importance in the context of this report is research on credit and asset prices, which can reinforce one another in both the upward and downward phases of market cycles[18]. Excess credit with rising prices leads to buying pressure, forcing prices higher, competition amongst lenders may lead to erosion of underwriting standards, relaxation of covenants and, critically, higher LTVs, increasing leverage ratios and enabling optimistic investors to expand their portfolios. Thus credit and asset cycles reinforce, pushing prices of the assets above their equilibrium level. In reversal, tightening credit may create refinancing issues for investors (particularly for finite life funds or those with liability shocks) forcing sales into a falling market, which lowers the value of the retained portfolio, reinforcing refinancing issues and leading to covenant breaches and non-performing loans. This might imply, then, that an indicator of increasing leverage might provide advance warning of a potential reversal in growth trajectory. This possibility is examined in the next section.

Consideration is also given to whether signals from the listed market might be informative in the context of property value cycles. The current state of research on the relationship between private and public real estate markets suggests that the two forms of investment are strongly linked, even though prices in the listed sector are subject to wider equity market volatility possibly unrelated to economic drivers in private property markets. Removing the impact of leverage from REIT and property company prices and correcting for lagging and appraisal-smoothing effects in the indices of private real estate market performance reveals a strong fundamental linkage between the two markets, as would be logically expected[19]. These studies also demonstrate that there are strong systematic risk factors common to both equity and real estate markets that can be masked by the use of valuation-based indicators. Given this linkage, is it possible that price discovery occurs such that the equity prices in the listed sector identify potential over-pricing of assets before this is recognised in the underlying real estate market (and the associated lending market)? To explore this, Section 3 examines evidence from discounts to net asset value.

The final section considers some other potential indicators, which, while they have not been formally analysed in this project, might be considered alongside those set out in the report in future research, briefly examining the potential for leading indicator analysis and more recent work from the US that looks at implied income growth assumptions from listed asset prices. To some extent, these measures are already embedded in the equilibrium rent and cap-rate/yield analysis discussed extensively above. The potential for the use of sentiment indicators is also considered briefly, although there are few candidates for practical usage in a UK context.

[18] For example, Adrian & Shin (2010), Brunnermeier (2009), Brunnermeier & Pedersen (2009), Geankopolos (2010).
[19] For example, Hoesli & Oikarinen (2012), Oikarinen et al. (2011), Yavas & Yildirim (2011).

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

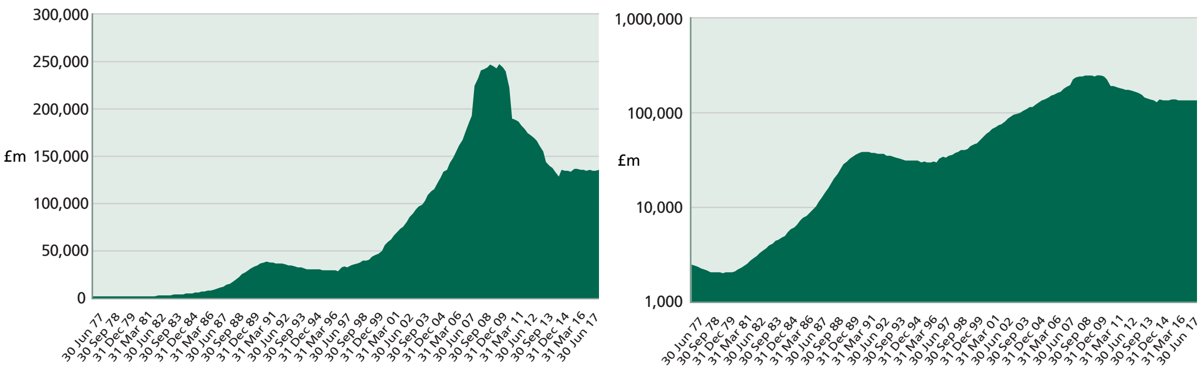
4.2. Corporate Real Estate Lending and Value Cycles

Figure 4.1 shows Bank of England figures for nominal debt outstanding secured on commercial real estate[20] for the period 1977-2018 (panel A, linear scale shows the extent of the capital value of debt in the more recent crisis, while panel B, log scaled, demonstrates the relative speed of the build-up of debt before the 1990 market correction). It should be noted that the series has been subject to compositional changes (notably the inclusion of lending to housing associations in the period preceding the financial crisis). Nonetheless, the build-up of debt before the GFC is clear, as is the earlier increase in lending before the 1990 property market downturn. Figure 4.2 shows quarterly change in debt outstanding over the same period, revealing short periods of deleveraging in the aftermath of the 2007 GFC and earlier 1990 property market downturns, with long periods of debt build up preceding the market falls, more pronounced in the earlier cycle, albeit from a lower base. It should be noted that the falls in debt outstanding after the GFC appear lagged (overall debt only begins to reduce from 2009). In part this may reflect continued use of lending arrangements entered into before the downturn; in part to bank forbearance of covenant breaches and loan restructures to reduce bad debt provisioning; in small part it may be attributed to the compositional changes. The same effect is observed in the earlier crisis: debt outstanding falls from Q3 1991, while the JLL capital value series begins to fall in Q1 1990[21].

Figure 4.1: Debt Outstanding to UK Commercial Real Estate 1977-2018

Panel A: Linear Scale

Panel B Logarithmic Scale

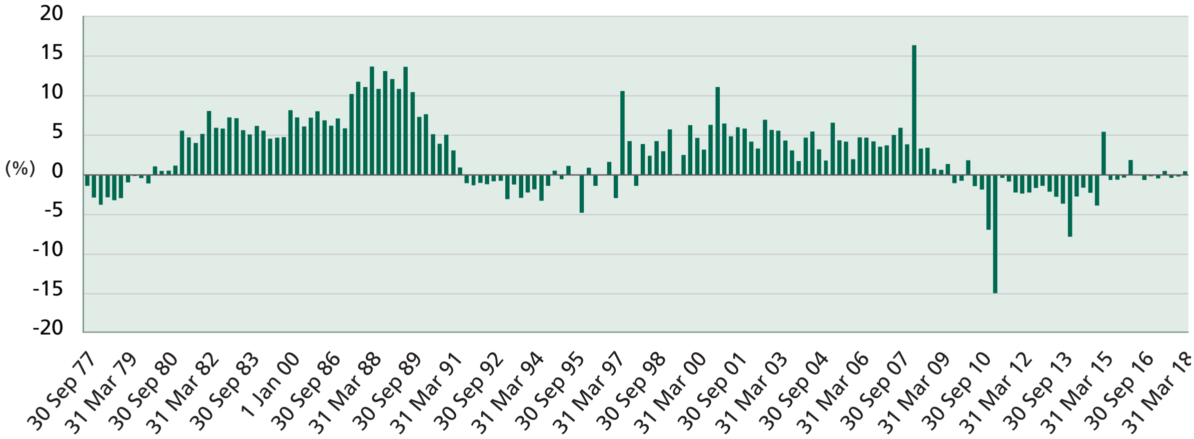


Source: Adapted from Bank of England statistics.

[20] For example, Adrian & Shin (2010), Brunnermeier (2009), Brunnermeier & Pedersen (2009), Geankopolos (2010).
[21] For example, Hoes

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

Figure 4.2: Quarterly Change in Corporate Real Estate Debt 1977-2018



Source: ibid

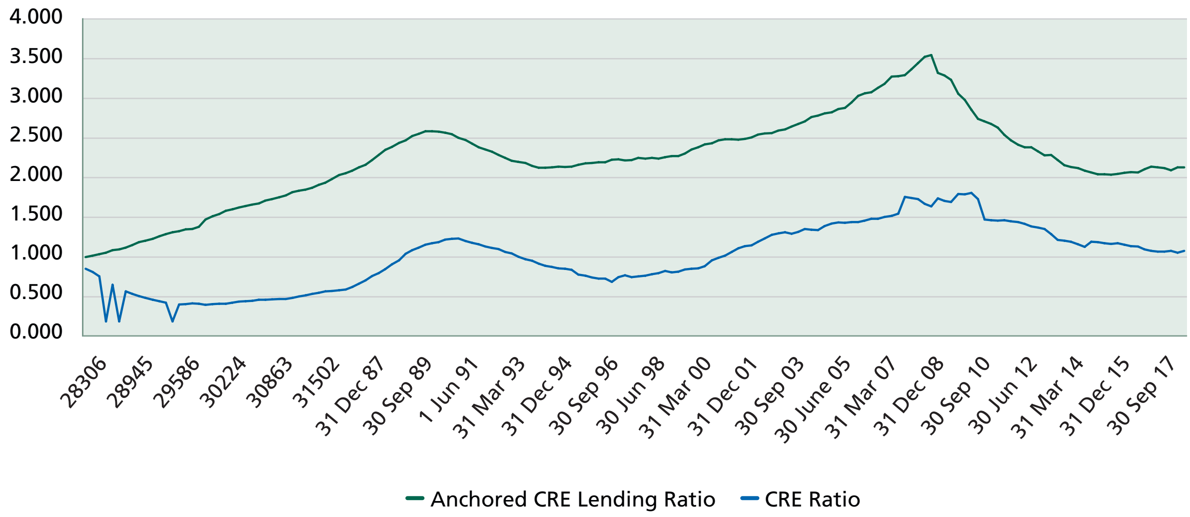
On its own, the nominal volume of lending is a relatively crude indicator of leverage. There are many ways in which the raw lending figures could be adjusted. The nominal figures are unadjusted for inflation: it would be possible to focus on real prices, adjusted using the GDP deflator, CPI or other inflation index. If the focus is on leverage in the sector, then it would also be possible to adjust the series for the increase in commercial real estate asset values although this would then create potential endogeneity and identification problems if the adjusted series is then mapped onto value falls measured by the same real estate value series. One could also seek to adjust the debt outstanding to reflect changes in the total quantity of stock (using the authors' new CRE stock indicator) to fine tune estimates of leverage. Another possibility would be to investigate whether excess lending to the sector has influenced the future price trajectory. Two measures are used for this: first, net new lending to real estate is compared to total net private sector lending (on an M4 basis)[22] to see if the share of real estate is above or below its historic average. More simply, change in CRE debt outstanding is compared to its historical average (strictly, this should be an anchored or trailing window average to be consistent with the valuation-based work earlier in the report). If real estate lending has increased relative to historical averages or as a share of total lending, does this presage market adjustments?

Figure 4.3 shows the share of CRE lending as a ratio of the average share. The CRE Ratio variable plots the share relative to the average over the whole of the data period, while the anchored ratio variable calculates the ratio based on the average share to that data point (in the spirit of much of the investment value analysis above). As an indicator, the latter is more robust since it does not assume any knowledge of future events, although the former allows for historical analyses. The series are strongly correlated ($\rho = 0.866$) and both show peaks around the commercial real estate market downturn. Once again, the lending indicator peaks after real estate prices had begun falling in the more recent GFC cycle, while the peak in the earlier cycle is more coincident with the onset of capital value falls.

[22] Bank of England LPQBF36 series

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

Figure 4.3: CRE Lending Share Relative to Historical Average Share, 1977-2018



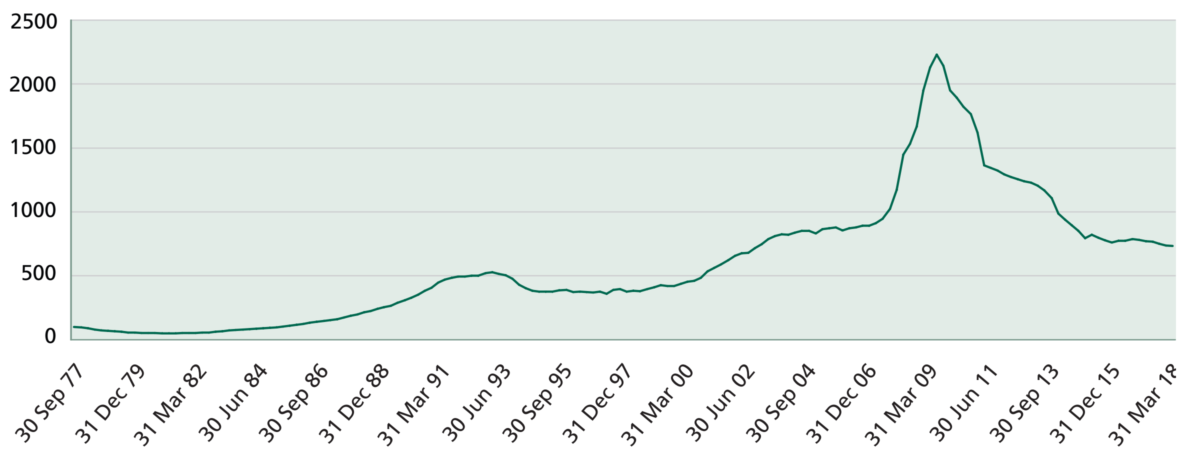
Source: Adapted from Bank of England data.

Examination of the lending indices deflated for inflation show relatively little difference in shape or trend when compared to the nominal indices, despite the fall in inflation over the analysis period; in real terms peak lending coincides with the onset of the two major real estate market corrections, with the latter correction beginning just before peak lending. An indicator of leverage level in the real estate sector is also estimated, by creating a series that compounded growth in capital values with growth in stock (using the same figures as in the equilibrium rent and value models discussed above) and comparing that to the CRE lending figures. Since there is not a robust or usable proxy for the overall value of the stock nor any a priori way of assessing what neutral leverage is, then the scaling of this variable is, to an extent, arbitrary. It is set to June 1977 =100 and the change in leverage measured from that point. Figure 4.4 shows the created series. It indicates a general upward trend in leverage over the period[23]. Within that trend, there is a dramatic increase in leverage in the 2006 to 2009 period. It should be noted that the leverage ratio will increase if debt is held constant but values fall (since the share of debt outstanding increases relative to asset values), which helps explain why the leverage indicator increases into the GFC – but casts doubt on its value as an early warning signal for investors, analysts and regulators.

[23] The authors do not have a way of knowing whether June 1977 was a particular low point in real estate lending: the falls in aggregate debt shown on the left side of Figure 4.2 may give some indication that it was.

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

Figure 4.4: Change in Leverage 1977-2018



Source: Estimated from Bank of England, ONS and JLL series.

These indicators of credit and leverage are mapped against real estate capital value change. Given the availability of quarterly data for the debt figures, the longest consistent series is the JLL capital value series and, so, this is employed in the subsequent analysis. In the period where the JLL and MSCI quarterly series overlap, there is a 0.969 correlation between the JLL and MSCI capital growth series and a 0.971 correlation between JLL and the estimated MSCI asset value growth series. Given this strong correlation, it seems sensible to use the longer, consistent time series. It would be possible to extend MSCI back using the monthly index, but there would be concerns given the extreme autocorrelation in monthly capital value changes[24].

While one can examine changes in lending and leverage and in capital values on a period-by-period basis, introducing leads and lags as appropriate, the main focus of discussion has been on large corrections in value, since it is these that lead to financial distress and poor investment performance, rather than short-run volatility. Following the principles applied elsewhere in the report, a five-year window is examined following the debt or leverage observation, a time period relevant for the refinancing of loans and for the performance of finite-life funds. The main analyses consider two metrics: the worst performance over the five-year window (that is, dividing the minimum capital value index observation by the initial observation); and the maximum fall over the period (which sets all positive values of the worst performance indicator to zero).

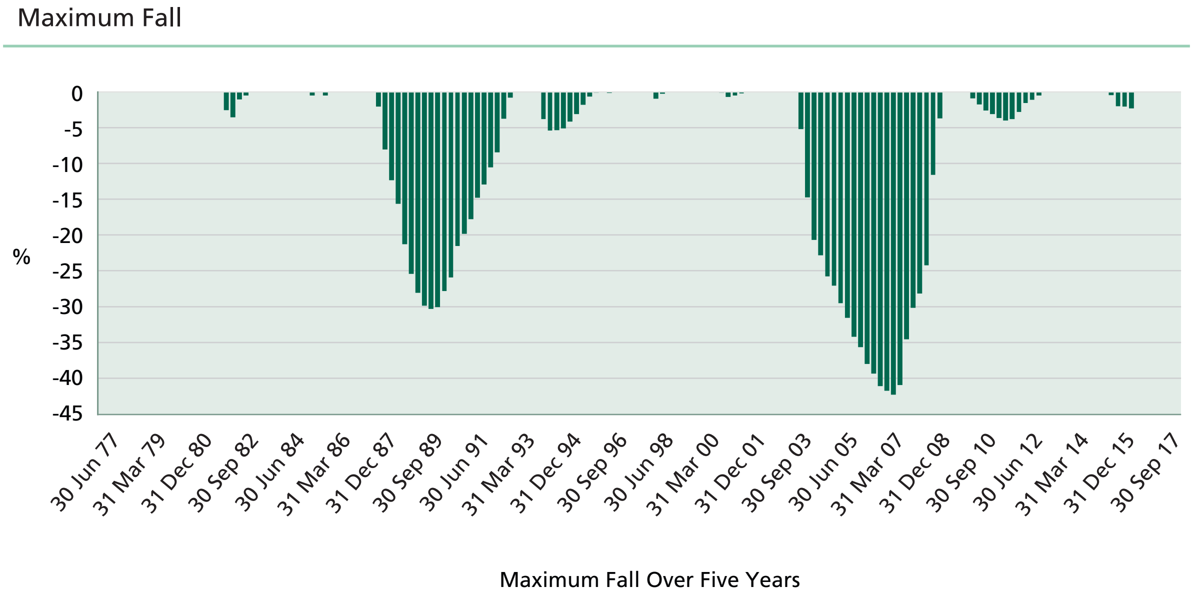
Let $WF_0 = \min(CV_1 \text{ to } CV_{20})/CV_0 - 1$ $MF0 = WF_0$ if $WF_0 < 0$, $MF_0 = 0$ otherwise.

The analysis focuses on the maximum fall metric, shown in Figure 4.5.

[24] With a first order autocorrelation coefficient in excess of 0.88.

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

Figure 4.5: Maximum Fall in Trailing Five Year Window



Source: Estimated from JLL quarterly capital value growth figures.

As expected, there are only two substantial periods of value falls over the analysis period: from 1988 to 1992 and from 2004 to 2008. As noted in the review of the 2017 Report, this presents a problem in generating 'success measures' since these periods of large falls are persistent (such that a correlated leverage indicator that is 'successful' in time period one is likely to be successful in time period two, three and onwards, overstating the accuracy of the measure, particularly as, essentially, only two observations are being dealt with). To identify a significant event, it is necessary to set a threshold maximum fall, with results sensitive to that. Setting the threshold to 15%, there are 30 quarters where there is a 15% or more fall in capital values in the subsequent five years[25].

Looking first at correlations between value and lending, cross-correlations suggest that capital value increases weakly lead increases in lending. The contemporaneous correlation is just 0.03; with δJLL lagged two years, the correlation increases to close to 0.30. By contrast, with lending lagged, coefficients remain insignificant. Testing this more formally, Granger Causality tests with different lag lengths reveal few significant leads or lags (with eleven quarters of lags included, δJLL is seen to lead change in lending at the 0.05 significance level, but the results are unstable as lag length is altered). In part this results from the noise and volatility of quarterly observations: annualising the capital value and lending changes suggests that capital value change Granger causes CRE lending change (at between the 0.05 to 0.01 significance level depending on lag length), but not vice versa. Results for the deflated series removing inflation as measured by the GDP deflator are broadly similar. Clearly, if lending follows capital value growth, this produces problems for the reliability of any indicator variable derived from the debt statistics. Nonetheless, given there may be asymmetric effects, Table 4.1 examines the correlation between a selection of indicator variables and the maximum fall and worst performance series.

[25] For a starting LTV of 70%, a fall of 15% implies a shift to a LTV of 82% assuming no amortisation or growth prior to the fall. Whether that shift breaches covenants or would result in lender action will be contextual. Clearly there is some relationship between maximum LTV and price rises, with evidence from the DeMontfort (now Cass) surveys showing increases in LTV and LTC across the first half of the 2000s.

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

Table 4.1 Debt Indicators and Subsequent CRE Value Moves

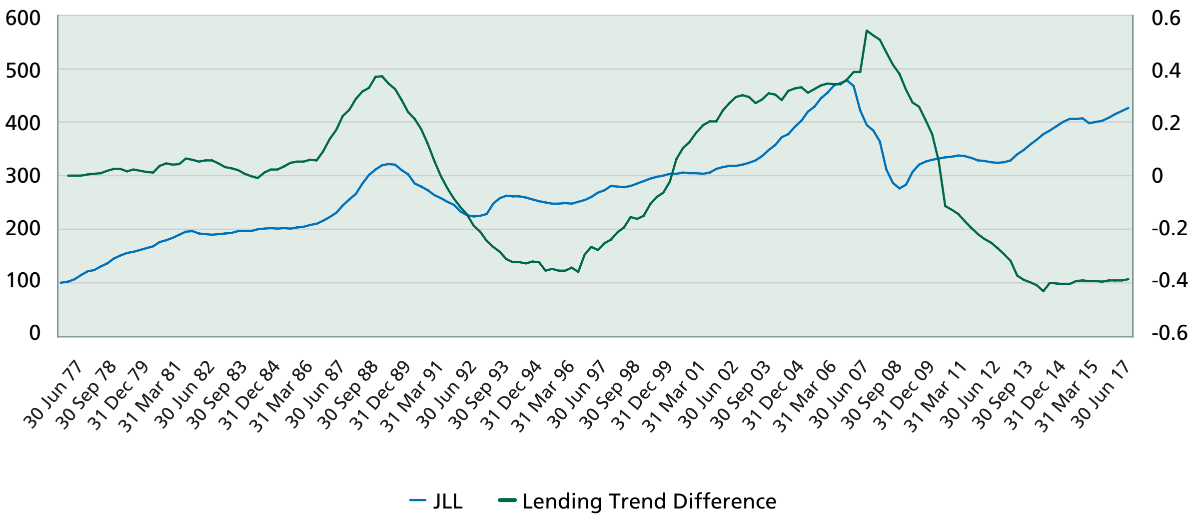
	Poorest Performance Over Trailing Five Years	Maximum Fall Over Trailing Five Years
Leverage Ratio Change	-0.144	0.056
Deviation from Linear Lending Trend	-0.599**	-0.747**
Ratio of CRE Lending to M4 Business Lending	-0.468**	-0.451**
Deviation from Mean CRE Share of Lending	-0.589**	-0.646**
Change in Inflation Adjusted Lending	-0.325**	-0.374**
Change in Lending Adjusted for Value Growth	-0.362**	-0.322**
Deviation from (arithmetic) Average Lending Growth	0.09	-0.06

** Statistically significant at the 0.01 level

While the coefficients shown are, in many instances, statistically significant, the explanatory power is relatively weak and it is important to emphasise the persistence of the strong negative capital value performance in the two downturn periods, which may distort the results. The strongest performing indicator appears to be deviation from long-term lending trend: this appears to explain around 55% of variation in the maximum fall indicator. However, as Figure 4.6 makes clear, while there is a clear historical relationship between trend difference and capital value, the relationship breaks down in the aftermath of the Global Financial Crisis as lending falls far below trend. This is a valuable example of the insensitivity of trend models such as Adjusted Market Value to structural breaks and regime changes. The graph also suggests, once again, that capital value change seems to lead lending behaviour. Changes in commercial real estate's share of aggregate private sector lending also appears to be a potential indicator of subsequent value adjustments (again with the caveat that only two significant periods of persistent poor real estate performance are being dealt with), explaining around 42% of variation in the maximum fall variable.

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

Figure 4.6: Capital Value Growth and Deviation from Trend Lending



In the spirit of the 2017 Report's analysis of AMV and IV (but mindful of the critique in the authors' review of that work, see Appendix A), Table 4.2 examines the 'success rate' of three of the indicators: corporate real estate lending share, an indicator that compares the share of CRE lending to its average (anchored to the starting date of the series) and deviation from trend lending. Thresholds are set for these three variables based on their distributions and compared to the maximum fall variable with threshold set to -15%. As can be seen, the lending share and trend lending measures have relatively high success rates (a function in large measure of the persistent large falls in the two down cycles) but also generate false positives and false negatives. While Deviation from Trend Lending appears to perform well, the evidence from Figure 4.6 needs to be taken into account: there is no way of testing whether it would be a robust indicator of a future downward adjustment in value. It must be noted that these results are sensitive to the choice of threshold value (particularly in relation to the false positive and false negative proportions) but that there is no objective way of setting those thresholds.

Table 4.2: 'Success' Rates from Indicators

	Maximum Five Year Value Fall	CRE Lending Share	Anchored CRE Lending Share Ratio	Deviation from Trend Lending
Threshold Value	-15%	7.1%	2.5	30%
Count	30	37	47	28
Success		18	26	23
Positive		60.0%	86.7%	82.1%
False Positive		51.4%	44.7%	17.9%
False Negative		40.0%	13.3%	6.7%

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

It should be noted that, while there is no access to robust lending statistics to extend the analysis back to the early 1970s banking and real estate crisis, reviews of that incidence clearly illustrate the interplay between debt and property asset values. A recent review by the World Economic Forum of that literature[26] highlights the importance of the flow of debt capital from the lightly-regulated secondary banks to the real estate sector, leading to average real capital value increases of more than 10% per annum in the build-up to the crisis: imposition of rent controls and taxes on development profits but, most of all, interest rate shocks following the 1973 oil crisis brought about a sharp reversal with real estate failures causing a banking crisis and necessitating Bank of England intervention (nominal values fell some 22% in 1974 before recovering – but that masks much larger real falls in value given the high inflation at the time – in real terms, values fell 43% from 1973-1976). The study emphasises the interactions and feedback loops between the banking and real estate sectors, confirming both academic and industry discussion of that crisis[27].

In summary, given the results presented above, it is evident that there is a relationship between lending to commercial real estate and capital values, but that relationship is dynamic and bidirectional. There is evidence that changes in lending trail increases in capital values (beyond that relating to escrow lags), a positive relationship linked both to the role of LTV but also market (over-) confidence. The results, however, also indicate that in the period before a market correction, a build-up of real estate debt is observed, both in aggregate and in relation to past patterns of lending, such that 'excess' debt is related to subsequent price falls – a negative relationship. If this were a robust relationship, it could imply myopic borrowing and lending practices and suggest that the overall real estate sector's ability to time the market in terms of leverage is limited. While these findings are broadly consistent with research literature on real estate leverage, they should be treated with considerable caution. The authors reiterate that there are only two substantial periods of downward price correction and it would be unwise to overemphasise results based on those two events alone. Nonetheless, the findings suggest that lending and leverage levels may be a useful warning signal for market participants, alongside the other indicators discussed in this report: real increases in lending, increases in commercial real estate's share of overall lending and evidence of higher leverage in the sector should be viewed with concern.

4.3. Evidence from Listed Real Estate: Property Company Prices and Discounts to Net Asset Value

Real estate as an asset class is unusual in that it is priced in private and public markets, with the existence of real estate investment trusts and property markets priced on equity markets. Conventional finance argues that public market pricing is more efficient, given liquidity, transparency and a dominance of professional investors giving rise to the possibility of price discovery effects. This needs to be set against overall equity market influences on listed real estate prices (exacerbated by the growth of passive investment strategies and tracker funds, such that high proportions of equities may be held by non-specialist equity investors making portfolio decisions) and by the impact of leverage on price volatility. There is clear evidence that listed real estate prices move before private market performance indices, with the lead generally found to be around six months. However, much of that lead results from valuation smoothing and lagging effects (which would include escrow lags as a result of exchange prices being agreed well in advance of completion). Adjusting for both

[26] World Economic Forum (2015)
[27] Barras, 1984, Reid, 1982, Scott, 1996.

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

appraisal and leverage effects, the research literature has reached broad consensus that public and private prices are formed in a single marketplace and exhibit a common long-run trend (Hoesli and Oikarinen, 2012).

Given this, might there be valuable information about future price corrections when the two markets appear to diverge? One measure of that would be the discount or premium to Net Asset Value (NAV). If public markets react to pricing information more rapidly than do the valuations that form most commercial real estate indices, then this would be reflected in a deviation from NAV-based pricing. Specifically, if public markets perceived a downward correction in the future, then this should be reflected in a discount to NAV. In UK context[28], we this should be more precisely stated as "reflected in an increase in the discount to NAV" since, on average, UK REITs and property companies have traded at a substantial discount to NAV, generating many explanatory studies. In this section, then, whether there are valuable signals from variations in NAV discounts is examined.

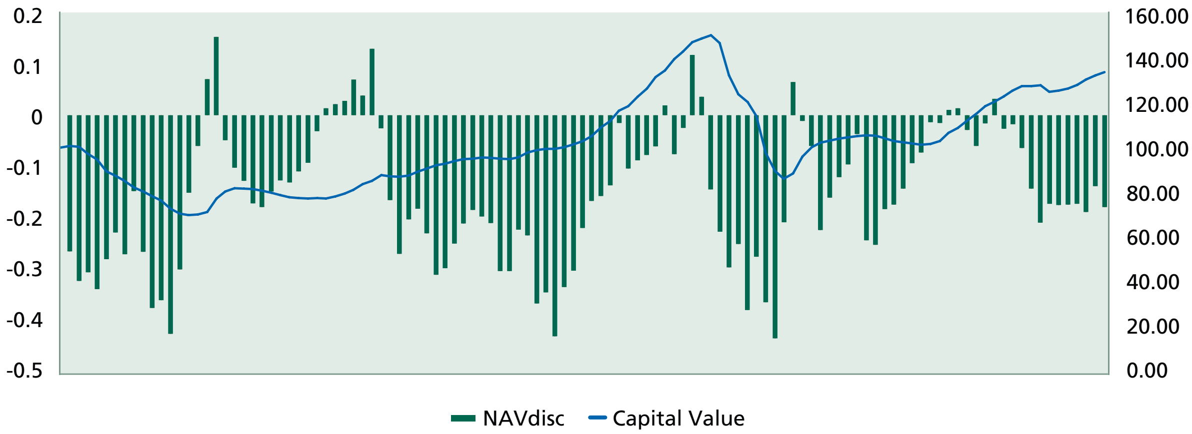
The NAV discount figures are from EPRA and are adjusted for price movements. Unfortunately, with the data set starting in 1989, it is not possible to observe the lead-in to the 1990 price correction. These are set against commercial real estate asset value movements (for consistency with the leverage results, again the JLL series is used, although the results are robust to use of MSCI). Over the analysis period, the mean discount was 15.4% (median 16.7%) and ranged between a discount of 43% and a premium of 15%. Figure 4.7 shows quarterly discount/premium set against the JLL capital value index (with the NAV discount axis set at the average discount over the period). It is immediately evident that NAV discount did not predict the downturn linked to the Global Financial Crisis – the market was trading at premiums in the quarters leading to the peak of the market. Similarly, the switch to above average discounts and small premiums is broadly contemporaneous with the post-GFC recovery phase. From this, it suggests that there is limited predictive data from variations in NAV for major market corrections, both downwards and upwards.

Figure 4.8 confirms this in large measure. Panel A shows NAV discount/premium set against the subsequent six month change in value. There is a positive correlation, but the explanatory power is very low (less than 5% of the variation in the future change is explained by NAV discount). Panel B shows discount/premium against the value change in the previous period. The correlation is higher and statistically significant although, again, the explanatory power is low (R2 of around 14%). This could be taken as implying that (despite public market price performance leading the valuation-based private market performance metrics) NAV discount is, to an extent, backward looking and myopic.

[28] In passing, it should be noted that there are few US studies on this topic, since US GAAP accounting processes, in contrast to IFRS, do not have to mark REIT values to market but retain at historic cost. As a result, NAV premia and discounts must be estimated by analysts such as Green Street Advisors or SNL, introducing noise and uncertainty into models.

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

Figure 4.7: NAV Discount and Capital Value Change



Source: Adapted from EPRA and JLL. Note that the NAV discount axis (right scale) is set to -15%, the long-run average over the analysis period.

Figure 4.8: NAV Discount and Capital Value Change

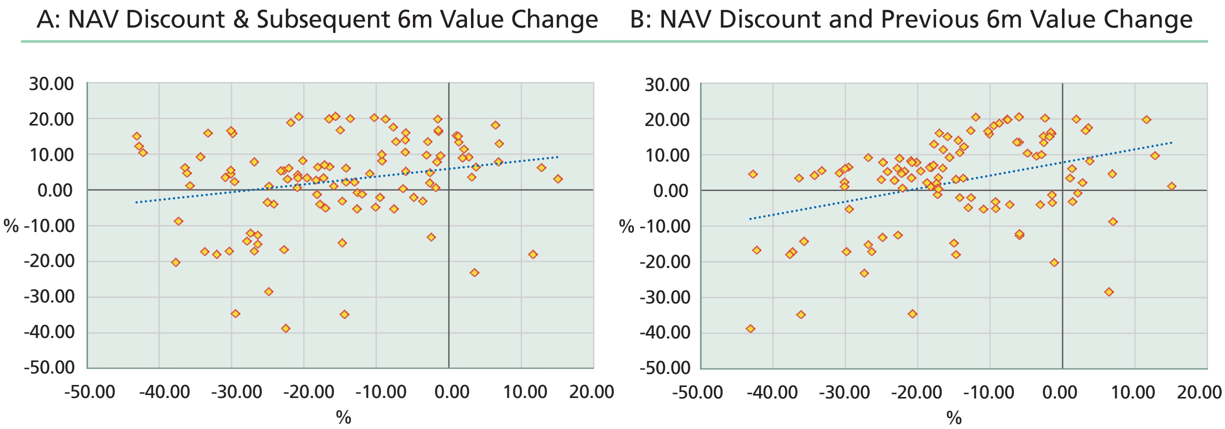


Table 4.3 confirms this analysis, showing the correlation between NAV discount and capital value change. First, the strongest correlation is contemporaneous and, as observed, there is a stronger correlation between lagged performance than future performance. Given the focus of this report, the two final columns may be most relevant: they show NAV discount correlation with the worst performance over the following five years and the maximum fall over the following five years, defined as in the leverage section, above. The correlations, other than for the contemporaneous value, are statistically indistinguishable from zero.

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

Table 4.3 Discount to NAV and Capital Value Change

Contemp.	Six Months After	One Year After	Six Month Lag	One Year Lag	Five Year Low	Maximum Five Year Fall
0.605	0.227	0.076	0.369	0.090	0.080	0.041

One other approach drawing on REIT and property company performance that might be considered is that adopted by Van Nieuwerburgh (2019) for US REITs, which seeks to decompose the price-dividend ratio into risk free, risk premium and expected growth components, using similar underlying models to those discussed in relation to private real estate yields in this report, for example using the Campbell-Shiller approach. Van Niewerburgh argues that, even allowing for low interest rates and dampened growth expectations, US REIT prices over the last five or more years reflect extremely high growth expectations, inconsistent with any prior period of sustained net rental growth. For the present project, however, there is no mechanism to test whether (well) above average embedded income growth assumptions presage a market correction.

4.4. Other Potential Leading Indicators

While resources have precluded detailed analysis of all other potential measures or indicators, for completeness, a range of possible leading indicators that might signal a change in pricing trajectory should be noted. Indeed, many so-called leading indicators from the literature are, in practice, driver factors in pricing and return models and, as such, have largely been considered in the modelling and analytic sections above. With these reservations, existing research in this field is reviewed. As in preceding sections, it is important to distinguish between short-run signals (which may not be helpful in identifying periods when values are substantially above equilibrium levels) and those which provide an indicator of a turning point or correction in the market.

In work linked to the REIT income growth assessment discussed at the end of the previous section, Van Niewerburgh worked with NGKF on an "early warning prototype model" for the World Economic Forum (2016), which combined implied growth from REITs, bond yields, inflation, employment and consumer confidence to produce an indicator of a shift in cap rate for US metro commercial real estate markets, seeking to identify market peak and, hence, turning points and downturns. The model (combining a logit and hazards approach) appeared to have some success in predicting turns but not in all markets and not with particularly long lead times – the most successful approaches being one quarter or four quarter warnings (which, given that the cap rate data is appraisal-based and hence probably lagged, must be a concern). The downturn probabilities seem to have been estimated over the whole analysis period, rather than on a step-ahead basis, which also raises some concerns about the predictive power of the model. There are strong similarities here in approach to the analytic work carried out in the current research project with the exception of including sentiment indicators and an expected income growth projection derived from REIT markets (which Van Niewerburgh's subsequent work seems to question as a robust indicator of actual growth).

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

Krystalogianni et al. (2004) examined the use of leading indicators to identify turning points in UK commercial real estate, using IPD (MSCI) capital values as their target index. The approach uses a classic business cycles phasing approach (identifying peaks and troughs with a rolling three-month moving average) and a composite leading indicators set up. Individual probit analyses identify possible variables for inclusion (with retail sales, private to total credit ratio and money supply having some predictive power, albeit relatively short leads); multivariate probits similarly had relatively weak predictive power and short leads (M4 having the longest lead). While the models outperform a naïve constant probability method, it is worth noting that they generate false positives. Tsolacos (2012) adopts a similar approach for office rents for London, Paris and Frankfurt, using an EU composite economic sentiment indicator (combining business and consumer survey data). It seems that this has some predictive power around two quarters in advance, but also generates false negatives. It is not clear how sensitive tests are to the amount of correction required to generate an 'event', nor what probability of an event threshold is set to generate a 'warning'. Marcato and Nanda (2016) also examine sentiment indicators in a US context: the indicators are tilted towards the housing market and do not significantly improve forecast ability when added to a multivariate modelling approach.

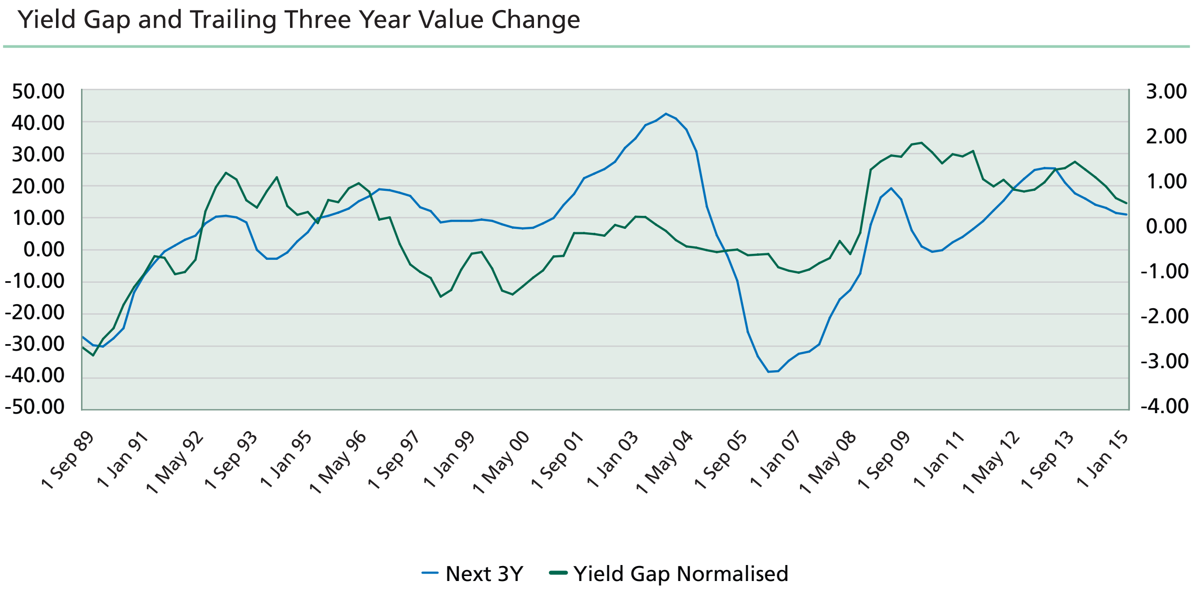
By contrast, Ling et al. (2014) use a VAR approach to argue that US real estate sentiment indicators are positively linked to subsequent private real estate returns and that mispricing can persist for long periods. They use one direct measure of sentiment based on survey information and an indirect measure based on a component analysis of a range of 'sentiment indicators', which include NAV discount/premia, turnover rates, IPOs and equity issuance and retail investor capital flows into mutual funds. Since these proxies may (should) contain the influence of market fundamentals, they seek to strip that out in their analysis as a robustness test. Short-run models suggest sentiment influences returns with up to a two quarter lag; a longer-run model shows sentiment effects persisting for up to two years (there is, of course, persistence in the sentiment indices). As noted with some of the other research reviewed, the models necessarily include all observations in the analysis period, rather than using a step ahead approach, which will tend to overstate the ability of the models to predict changes ex ante. Ling et al.'s models do include fundamental economic variables as controls such that the sentiment indicators are attempting to capture and explain deviation from the expected or 'rational' value.

Other indicators mentioned in the literature as indicators of future recessions (and hence with possible predictive power for real estate market corrections) include the yield gap and business profitability. The former might operate through the discount rate channel, given the long nature of real estate leases; the latter linked both to investment and to rental growth. However, both appear to be at best noisy indicators of real estate value movements. For example, Figure 4.9 shows the relationship between the yield gap (measured as the difference between one-year and 15-year UK gilt yields, normalised to zero mean and unit standard deviation over the period) and the trailing three year change in values as measured by the JLL capital value series. While a positive correlation is evident, it clearly fails to provide a strong signal of the 2007-2009 major market correction linked to the Global Financial Crisis (although it seems to give clearer signals for the subsequent recovery. Correlations do appear to be significant: +0.38 for trailing six month returns, 0.43 for trailing one year returns, +0.46 for trailing three year returns and (despite the GFC result) +0.54 for the maximum fall in

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

value over the following five years. Caution is needed though not to over-interpret such series. For example, that 0.54 correlation implies that just 29% of the variation in value falls over the next five years are explained by yield gap shifts. At best then, this might form part of a set of warning indicators.

Figure 4.9: UK Yield Gap and Capital Value Movement



Source: Adapted from JLL and Bank of England Yield Curve statistics.

It might be useful to explore further the extent to which available leading indicators and sentiment surveys helped predict turning points and market corrections. The range and robustness of surveys and indicators specific to commercial real estate in the UK is limited, with surveys either having relatively short time series (as with the IPF consensus forecast utilised in the 2017 Report) or methodological issues (or, often, both). More general economic indicators could be used, but to some extent are already subsumed in the econometric modelling's use of lag structures. In passing, Bond and Mitchell (2011) are also noted, who argue that IPD (MSCI) derivatives contracts provided a better forward indicator than the IPF consensus forecast. Aside from measurement issues, this is a troubling result since derivative prices should not forecast price movements if fairly and efficiently priced, suggesting that there were problems both with the underlying index and with pricing processes in the nascent market. However, the rapid decline in the liquidity of the property derivatives market in the aftermath of the GFC largely precludes any further analysis of derivatives as an indicator.

In summary, while there is some evidence that sentiment indicators and leading indicators do have a positive relationship with subsequent price movements, more substantial work is required before they could be included as a valuable forward indicator of price corrections, since most sentiment measures carry, embedded within them, market fundamentals; and typically the signals that are given tend to be relatively short-run. Nonetheless, the Ling et al. results for the US does suggest that there may be some long-run information – if, and only if, it were possible to strip out the market fundamentals from any measures that were sufficiently robust and available over long time horizons.

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

4.5. Technical and Other 'Bubble' Indicators

The finance literature has considered a number of other approaches to identify when prices are over-valued or there is a bubble. The starting point of a DCF valuation as a basis for identifying periods of over or under-valuation was outlined by Blanchard and Watson (1982) – under the assumption of no rational bubble and no-arbitrage, the price of a financial asset is the sum of the present value of future incomes. Implied in this model is the growth of future cashflows, which is expected to reflect underlying fundamentals (economic growth etc.). In this model, new information on growth prospects will be factored into cashflows and prices and the real discount rate is assumed to be stable or relatively stable. Asset prices may deviate from a rational view of fundamentals as a result of buyers believing they can sell the asset at an even higher price in the future – this will lead to the price of an asset exceeding its fundamental value, a 'rational' bubble is present. This rational bubble can also be seen as a speculative bubble or irrational exuberance – in that it is not sustainable. In a more extreme version, buyers are not reflecting future cashflows in a rational way in what they are prepared to pay – an irrational bubble – with the lack of arbitraging opportunities meaning that prices are driven by these irrational buyers. However, most studies on identification of bubbles and fundamental value assume that bubbles are largely rational – driven by the expectation that the price an asset will be sold for is higher than the price today and, in terms of identification of long-term value fundamentals, it is not a material consideration.

The implication of this approach is that sentiment has a large part to play in cycles and that the underlying fundamentals should support a long-term view of pricing. It also raises the issue that any method seeking to identify long-term value needs to be able to look through distortions/cyclical influences from sentiment and credit conditions etc.

To identify fundamental values and periods when values are differing from fundamentals a number of methods have been outlined in the finance literature. Shiller (1981) in highlighting the problems of a rational (or efficient) markets view of the world sought to identify a test by which would indicate that prices were moving by more than could be justified by new information. He proposed a variance bounds test for equities in which using the observed values of dividends, the variance of the fundamental value can be constructed. There is seen to be a potential bubble or misalignment of prices with fundamentals if the variance of the asset price exceeds the bound imposed by the variance of the fundamental value. In these circumstances, this may indicate there is a 'rational' bubble.

West (1987) proposed a two-step test, which requires a detailed specification of an underlying equilibrium model of asset prices. Under the equilibrium model in the absence of bubbles, if dividends follow an autoregressive (AR) process, which means that the current period dividend is correlated with dividends in previous periods, the stream of dividends can be constructed if the correlations are known. Given the discount rate, the relationship between the market fundamental stock price and the dividends can be derived. Essentially, one can construct the stream of dividends and hence estimate the market fundamental value of equities. This is referred as the 'constructed' relationship between stock prices and dividends. The actual relationship can be directly estimated by regressing the stock prices on dividends. However, this two-step method has been criticised as being heavily dependent on the specification of the equilibrium model, the rejection of 'fair value' may be due to the misspecification of the equilibrium model rather than the existence of substantial over-valuation or dividends.

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

Without the needs to specify the equilibrium model, Campbell and Shiller (1987) proposed a method to detect the gap between the asset price and the fundamental value. Asset price and fundamental value will diverge as over-valuation builds (during the bubble-formation process). The essence of the test is to identify trends in the fundamental values and asset price and to see if these are stationary e.g. if the trend growth rates are stable over time. If these are not then there is potentially a period of substantial over-valuation or bubble building.

In more technical terms, unit root tests are used to determine whether a time series variable is stationary. If it is stationary, it has a constant mean (the mean does not change over time) and the values do not have a trend. If there is a period of excessive valuation there are two possible cases:

- The fundamental value is stationary but the asset price is non-stationary. In this case, the fundamental value has no trend but the asset price follows a trend, the asset price and the fundamental value diverge. Thus, there might be a bubble or substantial over-valuation.
- Both the asset price and fundamental value are non-stationary and they are not co-integrated. In this case, both asset price and fundamental value follows a trend. In order to verify that they are following the same trend, a co-integration test is needed as a second step. If they follow the same trend, then they are co-integrated and there is no evidence of bubble. If they follow different trend, then the asset price and the fundamental value discrepant, there might be bubble exists.

One drawback of the unit root and co-integration test is that they are not able to capture the explosive bubbles/excessive valuations when there are periodically collapsing bubbles/excessive under-valuations in the sample, since, if the price rises and falls in the sample, it might look like there is no trend. Thus, when both explosive and collapsing behaviour is present in the sample period, the asset price may look stationary. Evans (1991) examined the power of unit root test and co-integration test and confirmed that the power of those two tests is substantially decreased when collapsing bubbles are present in the sample.

To overcome this issue Phillips, Wu and Yu (PWY, hereinafter, 2011) proposed a method called sup Dickey-Fuller (DF) test. Since over-valuations (bubbles) are associated with an explosive upward trend, what really needs to be tested is whether the data follows an upward trend. Thus, PWY use a right tailed augmented Dickey-Fuller (ADF) test, which set the alternative hypothesis differently. In the right tailed ADF test, the alternative hypothesis is that the data follows an upward trend. Thus, if the null hypothesis of the right tailed ADF test is rejected, it may be concluded that the data follows an upward trend. Furthermore, since stationarity cannot be accurately detected when both explosive and collapsing behaviour present in the sample, PWY improved the conventional ADF test by running ADF tests several times on subsamples. In particular, PWY adopted a method called forward recursion. The method chooses an initial subsample including the first observation of the full sample, then adds one more observation at each pass. For example, if there are 100 observations in the sample, the first pass could be the first 20 observations, the second pass would be the first 21 observations and so on.

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

PWY showed that the sup-DF test significantly improves power compare with the conventional unit root test and co-integration test. Another advantage of sup-DF test is that it can provide real time estimates of the origination date and the termination date of a bubble.

One limitation of the PWY methodology is that it is designed to analyse a single bubble episode, when there could be more than one bubble episode in the sample period. PSY showed that PWY method cannot consistently estimate the origination date and the termination date of the periods of over-valuation. To overcome the weakness of PWY, Phillips, Shi and Yu (PSY, hereafter, 2015) proposed an alternative approach named the supsup DF test. The method is also based on the idea of repeatedly implementing a right-tailed DF test. However, rather than fixing the starting point of each DF test as the first observation of the full sample, PSY vary the starting point and the ending point of the sample over a feasible range of flexible windows[29]. The results showed that the estimates of the origination date and the termination date of all periods of over-valuation are consistent. Thus, by running ADF test on different subsamples, the PSY method can capture the origination date and termination date of multiple periods of over-valuation.

Property data typically lacks the frequency and independence of equities data for the variance bounds and right-tailed DF tests but the PSY method (the sup sup Augmented Dickey Fuller test – based on repeated implementation of a right-tailed DF test) appears to offer the most potential and will also be applied to the real price as an indicator of bubble formation and potential value falls.

The PSY (2015) method was applied to real capital values (RPI deflated) to examine if it can detect bubbles. Whenever the blue line (test statistics) breaks the orange line (critical value), it shows a potential bubble.

Figure 4.10 displays the PSY test results by using the MSCI All Property data. While the test shows a clear signal of bubble prior to the 2007-2009 downturn, some false signals are shown, but the false signals only last for a short period.

Figure 4.11-4.13 show the PSY test results at sector level using the MSCI sector level data. In general, the results at the sector level are slightly less reliable except for retail where fewer false signals are shown.

Figure 4.10: PSY (2015) Test – MSCI All Property

GSADF Test

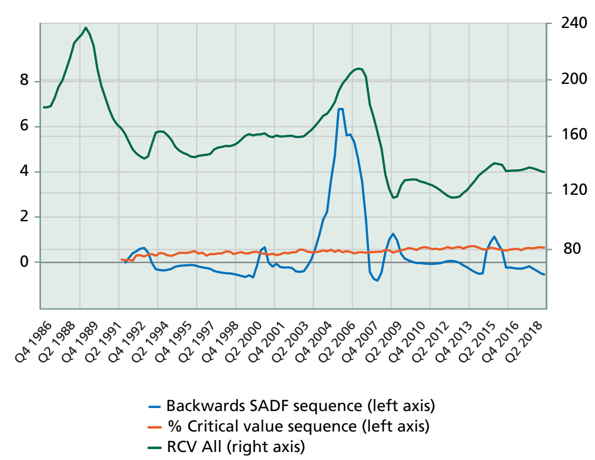
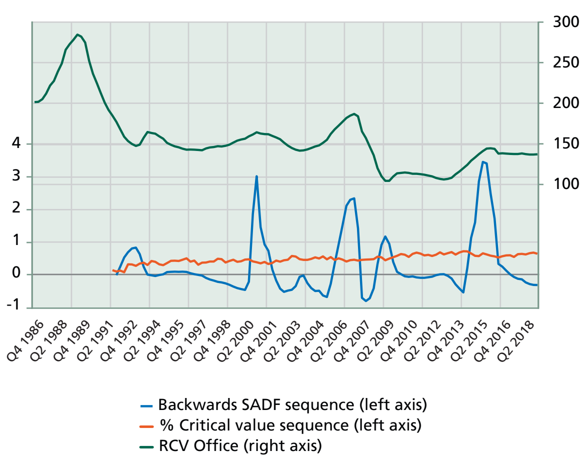


Figure 4.11: PSY (2015) Test – MSCI Office

GSADF Test



[29] Note the similarity to the rolling and anchored windows in the earlier rent and capital value chapters.

4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

Figure 4.12: PSY (2015) Test – MSCI Retail

GSADF Test

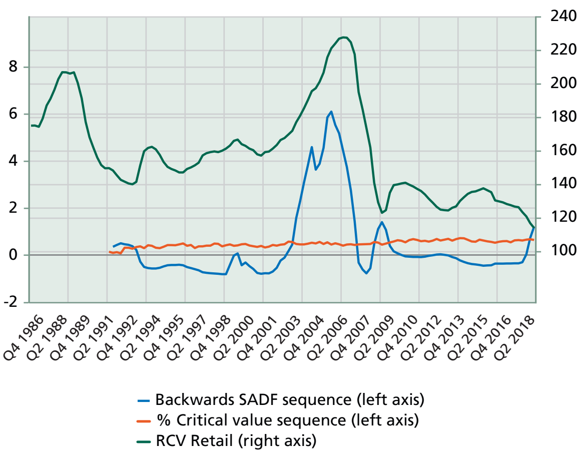
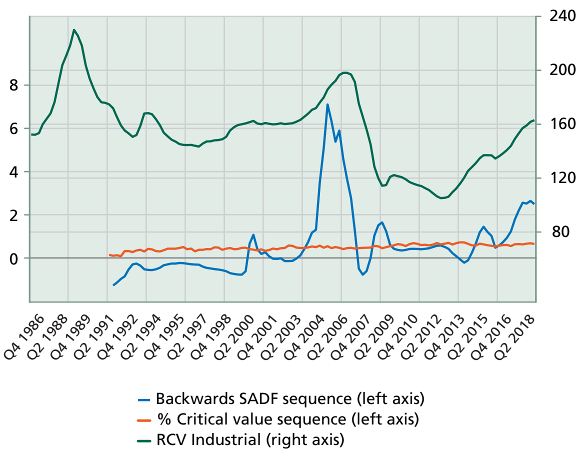


Figure 4.13: PSY (2015) Test – MSCI Industrial

GSADF Test



JLL Series

Figure 4.14 displays the PSY test results using the JLL All Property data. While the test shows a clear signal of a bubble prior to the 1990-1992 and 2007-2009 downturns, two false signals are shown, but the false signals only last for a short period.

Figure 4.15-4.17 show the PSY test results using the JLL sector level data. The test performs very well for the retail sector, both 1990-1992 and 2007-2009 downturns are predicted with only one false signal around 2009. The results for office and industrial are less reliable.

Figure 4.14: PSY (2015) Test – JLL All Property

GSADF Test

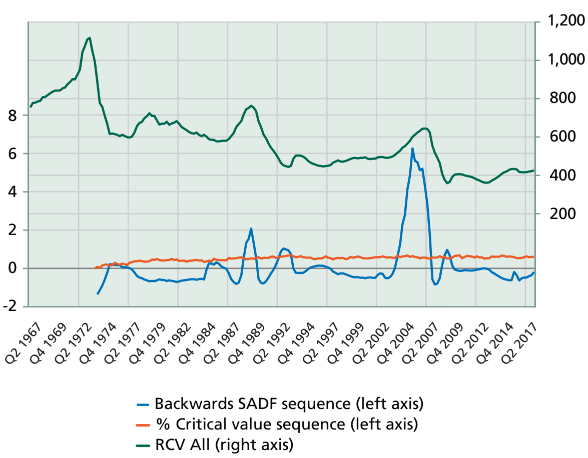
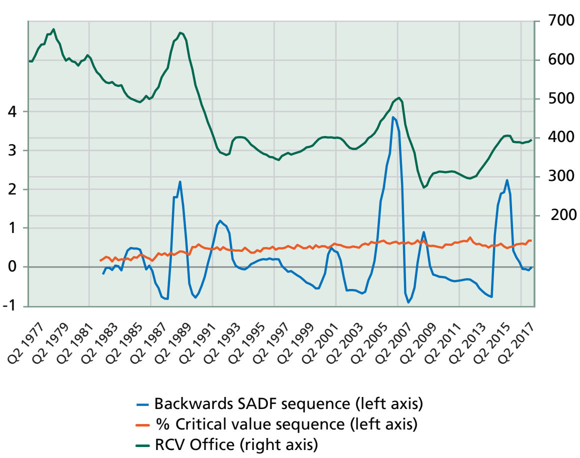


Figure 4.15: PSY (2015) Test – JLL Office

GSADF Test



4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

Figure 4.16: PSY (2015) Test – JLL Retail

GSADF Test

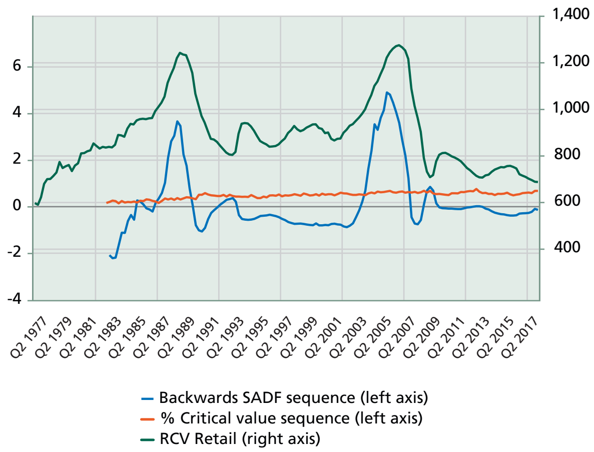
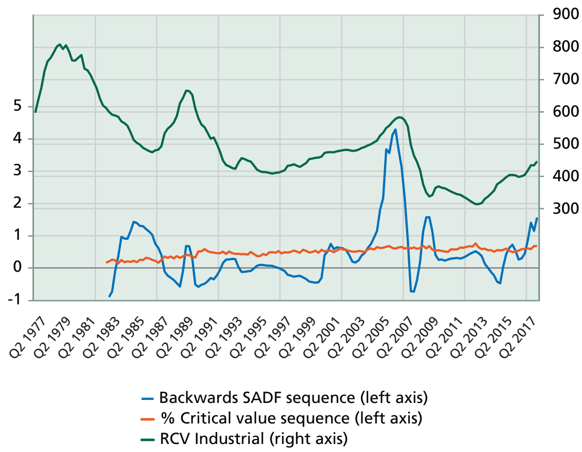


Figure 4.17: PSY (2015) Test – JLL Industriall

GSADF Test



CBRE Series

Figure 4.18 displays the PSY test results using the CBRE All Property data. The test performs very well, both 1990-1992 and 2007-2009 downturns are predicted with only one minor false signal around 2000.

Figure 4.19-4.21 show the PSY test results by using the CBRE sector level data. The test performs very well for the office and retail sectors, both 1990-1992 and 2007-2009 downturns are predicted with only one false signal around 2000. The result for the industrial sector is less reliable.

Figure 4.18: PSY (2015) Test – CBRE All Property

GSADF Test

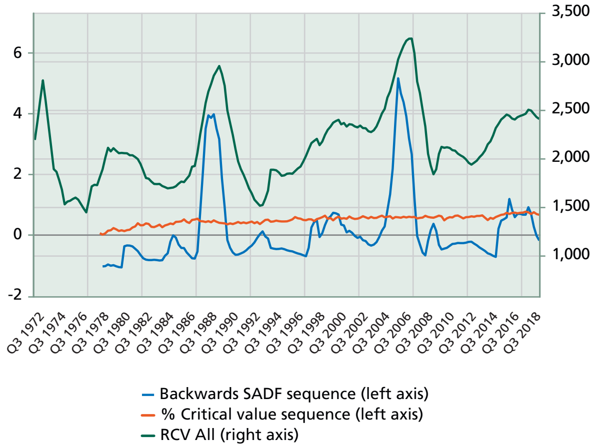
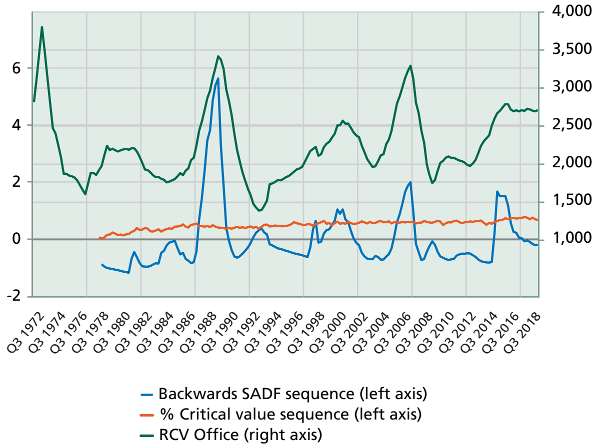


Figure 4.19: PSY (2015) Test – CBRE Office

GSADF Test



4. LEVERAGE AND OTHER POTENTIAL INDICATORS OF OVER-HEATED MARKETS

Figure 4.20: PSY (2015) Test – CBRE Retail

GSADF Test

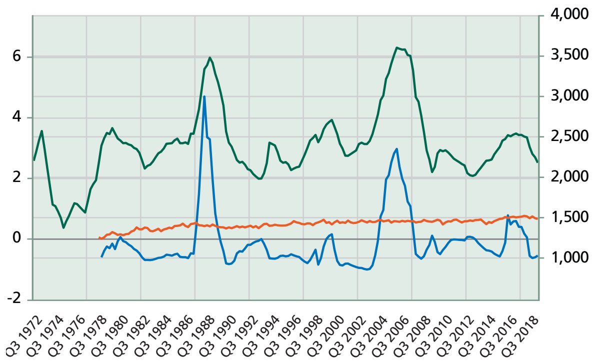
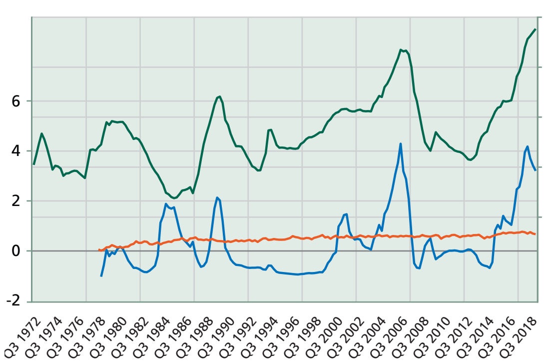


Figure 4.21: PSY (2015) Test – CBRE Industrial

GSADF Test



4.6. Conclusions on Leverage and Other Potential Indicators

The approaches identified here show some promise in alerting the market to conditions that might proceed a correction, but all seem to be, at best, noisy signals and could not be used in isolation. Leverage is clearly important due to its impact on volatility and, hence, on the risks of exacerbating cyclical upturns and downturns. However, as research post-GFC indicates, there are strong feedback effects between credit and asset markets. Rising asset prices tend to fuel increases in leverage, with the rising values of buildings being used as collateral for lending. When allied to capital gluts in credit markets (and, possibly, relaxation of underwriting standards and covenant protection from competitive pressures) there is a risk of asset bubbles or divergence from fundamental pricing. Thus leverage statistics should be an important component of any warning system of market overheating[31]. The analysis above does not identify an ideal indicator but those based on rising levels of commercial real estate lending, either as a share of overall lending or over long-run real trend, show some promise. Since the asset-credit cycle is, in part, driven by market sentiment, sentiment indicators might be a useful additional leading indicator of the risk of price corrections, provided that those indicators were asset class specific, robust and not too closely driven by the market fundamentals already embedded in the econometric modelling of value. Although there is persuasive research on the close relationship between public and private market prices once leverage and valuation effects are adjusted, there was no strong evidence that changes to NAV discounts provided a helpful signal of future corrections. Finally, the PSY method appears to sometimes provide a useful indicator that the market may be deviating from fundamentals.

[31] Similarly, excessive credit restriction could have harmful effects, particularly on the supply side of the real estate market and on market liquidity.

5. CONCLUSIONS AND RECOMMENDATIONS

This study has explored whether there is an approach to identifying longer-term fundamental value that can be used as reference point for lending-related decisions. It has reviewed a range of potential indicators that may signal the market has an increased risk of a downturn. The research has been constrained by data availability, both of property market data and data on the demand and supply drivers of occupier and investment markets. The study has managed to fill some of these gaps, notably real estate stock (supply) estimates and it has provided a review and comparison of a number of property market data sources.

The PIA Long-Term Value Working Group produced a report in 2017, highlighting the use of a simple long-run trend in real capital values (AMV) as a promising reference point for long-term value as well as exploring other approaches. This 2017 Report provided a very useful foundation for this study and the research team are very grateful for the co-operation of those involved. All approaches to estimating fundamental value are constrained by data and any conclusions are subject to the caveat that there have been only three major downturns in the last 50 years and only two in the period for which there is sufficient data to be able to test different approaches and models.

The study has analysed occupier markets and explored a range of approaches to the estimation of sustainable long-term real rental values. The models examined were generally successful in identifying downturns in real rental values in the 1990s and early 2000s, but they were less successful at predicting the rental downturn that followed the GFC. There is evidence of a late reaction to this downturn in the econometric model, with other approaches struggling to identify it. The GFC downturn was not driven by occupier markets in the same way as the earlier cycles and this finding is therefore not surprising. **Overall, the econometric modelling of sustainable rental values is the preferred approach, but improvements to input data (or a method to estimate these) are required to implement this approach on an ongoing basis, particularly for data on the property stock.**

Measures of sustainable rental value are useful for monitoring real estate market conditions. However, sustainable rental value measures cannot predict all real estate market corrections, as some have their origin within investment rather than occupier markets. Therefore, they should be used in conjunction with the monitoring of pricing in commercial real estate markets and other measures as well as being used as an input to models of sustainable capital values.

Models of capitalisation rates have also been explored to see if sustainable capitalisation rates can be identified. The models tested generally identify that yields (cap rates) were below sustainable levels well ahead of the GFC. **The preferred model for cap rates, given the desire for economic logic, is the econometric approach but the ex-ante cap rate is helpful as a framework for exploring the impact of changes in fundamentals on sustainable cap rates.**

The cap rate and rent models can then be brought together to derive estimates of sustainable or longer run equilibrium capital values. These equilibrium values can be compared with actual values to examine if they provide early warning of a potential correction. These approaches work well in that a movement of real values substantially above estimates of long-term equilibrium value are associated with a substantial correction in subsequent periods – all these approaches successfully predict the two property crises in

5. CONCLUSIONS AND RECOMMENDATIONS

1990-1992 and 2007-2009. The sector results are also generally good, working well for the offices and industrial sectors and for the retail sector before the 2007-2009 downturn but both the trend and the econometric cap rate model give only a weak signal before the early 1990s downturn for the retail sector. **The preferred capital value model is based on the econometric estimation of sustainable rents and the econometric estimation of sustainable cap rates. The econometric sustainable rent and ex-ante cap rate approach is also useful.**

All models will struggle in the face of major structural changes to real estate markets that may lead to a move to a new equilibrium, such as that the retail sector appears to be experiencing currently. Re-estimation of sustainable rents to allow for the greater impact of online sales and CVAs etc. may help to adjust for this once more data becomes available. However, it will be hard to back test whether adaptations are effective.

Leverage is not a good leading indicator but plays a powerful role in cycles and hence **real increases in lending, increases in commercial real estate's share of overall lending and evidence of higher leverage in the sector should be viewed with some concern.**

Technical analysis of real capital value performance, based on **the PSY method, appears useful as a leading indicator of downturns** whilst recognising that this will not always be reliable.

Analysis has been undertaken at the All Property level and at main sector level. Further disaggregation is problematic because of the lack of underlying information and data makes a comparison of methods impossible. A number of indicators and approaches have been reviewed in the context of international markets and generally support the conclusions above

This study has not been aimed at estimating whether the market is over-heated currently, nor at addressing the issues of how structural change should be reflected in estimates going forward. However, Table 5.1 provides estimates for the various approaches using MSCI data as at end March 2019, the last date for which full estimates of supply and, hence, sustainable rent are available.

Table 5.1 Indicators at End March 2019 (MSCI Data)

	All Property	Office	Retail	Industrial
Rent v Sustainable Rent – Rolling	-2%	-1%	-5%	12%
Capital Value – AMV	5%	25%	-14%	39%
Capital Value – Econometric – Rolling	13%	12%	3%	37%
Capital Value – Ex-ante – Rolling	13%	-2%	20%	23%
PSY Indicator – Above Critical Value	No	No	Yes	Yes

5. CONCLUSIONS AND RECOMMENDATIONS

The rent indicator suggests that in aggregate occupier markets are not over-heated. In aggregate the indicators do not suggest real estate is substantially over-valued but as noted earlier this is subject to no structural changes having a substantial adverse impact on investor or occupier demand (or supply). The ex-ante approach includes some assumptions around long-run growth and risk and consequently has different results for the retail sector from econometric and AMV approaches suggesting some risks remain in that sector. The technical indicator (PSY) also suggests risks are high in that sector. In the industrial sector, there also appear to be heightened risks of some correction with actual values above sustainable values and the technical indicator also suggesting risks are elevated. Again, to reiterate this is based on past relationships and does not take account of any positive structural changes affecting the industrial sector from an investor or occupier perspective.

The focus of this study has been on looking at history to explore methodologies for determining long-term value in real estate markets and what appear to be useful indicators for identifying when the risk of a significant correction is high.

In summary, the authors recommend:

- The use of sustainable rents to monitor if there appears to be over-heating in occupier markets.
- The use of sustainable cap rates to monitor if there appears to be over-heating in investment markets.
- The use of sustainable capital value estimates based on econometric modelling of cap rates and econometric modelling of sustainable rents to monitor values.
- The ex-ante estimation of cap rates (potentially with some scenario analysis) to monitor if investment markets appear to be over-heating.
- Monitoring of leverage to check whether these is significant growth in real terms, an increase in the share of commercial real estate lending in the total or generally higher leverage (higher LTV lending).
- Monitoring of technical indicators of bubble risks (PSY).
- Consideration of structural change risks that may lead to a fall in values not picked up by any of the above methods.

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