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How long is UK property cycle?
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Abstract

Purpose – The purpose of this paper is to assess the duration of the UK commercial property cycles, their volatility and persistence to gauge future market direction.

Design/methodology/approach – The study employs a novel approach to dissect cycles in a form of a three-step algorithm. First, the Hodrick-Prescott de-trends the selected variables. Second, volatility (measured by the variance) screens periods of atypical fluctuations in the series. Finally, the series is regressed against its past values to assess the level of persistence. The sequential steps screen the length of the cycles in UK commercial property market to facilitate interpretation.

Findings – The estimates suggest that UK commercial property market follows an eight-year cycle. Combined modelling results indicate that the current market trend is likely to change over the coming year. The modelling suggests increasing probability of a market correction in late 2016/early 2017.

Practical implications – This updated appreciation of the UK commercial property cycle duration allows for better market timing and investment decision making.

Originality/value – The paper adds additional evidence on the contested issue of UK commercial property cycle duration.

Keywords Property, Market, Volatility, Cycles, Commercial, Filter

Paper type Research paper

1. Introduction

Over the last century, a series of downturns badly afflicted the British economy and underlined the issue of cycles (Barras, 2009). The very notion that the property market is cyclical implies that, whilst not deterministic, it has a rhythm (Jadevicius and Huston, 2014). Research either focused on investigating the cyclical hypothesis itself (Case and Shiller, 1994; Rottke and Wernecke, 2002) or on modelling its pattern to better inform investment timing decisions and help cut associated risk (Pyhrr *et al.*, 1999; Mueller, 1999, 2002). Numerous techniques were employed to screen cycle's duration. Empirically, frequency domain and simultaneous equation modelling processes dominated. In the UK, Barras (2005) identified four major commercial property market cycles:

(1) 4 to 5 year cycles directed by the classical business cycle phases;

(2) 7 to 10 year cycles related to changes in equipment investment;

(3) 20 year cycles, linked to large building and transport investments programmes; and

(4) 50 year waves, related to major technological innovations.

The current study re-examines the UK commercial property cycle duration and so contributes to market understanding. It employs a novel three-step algorithm, which tightens analysis. First, the selected series is de-trended using the Hodrick-Prescott (HP) filter. Next, volatility is computed to screen out periods of atypical fluctuations in the series. Combining both techniques generates the UK commercial property market cycles' length. Finally, volatility series are auto-regressed to gauge series persistence and future UK commercial property market direction.

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The remainder of this paper is structured as follows. Section 2 reviews the previous studies in the discipline, acknowledging property cycles research chronology, various property cycle theories and the application of econometrics to the field. Data are presented in Section 3. Section 4 introduces the methodological set-up. Section 5 presents modelling estimates. Section 6 concludes the study.

2. Literature review

Historical perspective

Academic scrutiny of property cycles extends back to Cairncross (1934) and Hoyt (1933) but whilst extensive it remains inconclusive (Reed and Wu, 2010; Grover and Grover, 2013). Initially, researchers, *inter alia*, Hoyt (1933), Newman (1935), Lewis (1965), Abramowitz (1964) and Gottlieb (1976) considered property/building cycles purely a local phenomenon, mostly independent from the wider economy. Parallel UK studies by, *inter alia*, Cairncross (1934), Shannon (1934), Bowley (1937) and Bowen (1940) identified population change as the primary driver of housing demand. For these early studies, a sudden surge in population or migration into propitious industrial locales drove property/building cycles.

Over time, cyclical understanding matured. Rather than merely a reflection of human transit, later cyclical investigations saw property market fluctuations in their wider business/economic context (RICS, 1994; Barras, 2009; Barras and Ferguson, 1985; Grebler and Burns, 1982; Wheaton, 1987; Barras, 1994; McGough and Tsolacos, 1995). A seminal study commissioned by the Royal Institution of Chartered Surveyors (RICS, 1994) jointly with the University of Aberdeen and the Investment Property Databank (IPD) confirmed significant interplay between property and economic cycles. However, spatial and other distinctive features of property muddy the waters, so economic factors are not the only drivers of real estate cycles. The built-in construction lag is one key idiosyncratic feature underpinning the property cycles.

The other factor of increasing significance is international capital flows. Increasingly, cycle studies have tended to analyse the dynamics of the property market on a global scale. For one thing, global diversification became an essential consideration for an efficient property portfolio (Chen and Mills, 2005). Researchers, *inter alia*, Case *et al.* (1999), Jackson *et al.* (2008) and Stevenson *et al.* (2014), explored concordance in global property market cycles and a possible existence of a single cross-continental property market. Despite structural market diversity and different dynamics, property commentators nevertheless queried whether geographic distance guaranteed diversification. In case of office markets in London and New York, Jackson *et al.* (2008) found significant convergence between two metropolises. Ironically, it turns out that a cross-border or trans-continental investment strategy could actually undermine diversification. An extended view presented by Stevenson *et al.* (2014) on 20 of the world's largest office markets reached the same conclusion. Their findings reported a notable concordance across a large number of markets. The risk of contagion fuelled growing demand for international property market comparative data and spurred organisations in likes of Dow Jones (2015), FTSE (2015), MSCI (2015), Knight Frank (2015), S&P (2015) to construct global property benchmarks.

Family of cycles

In parallel with empirical investigations, property cycle theory developed. Four types of cycles with varying ontologies emerged (Ball *et al.*, 1998; Barras, 2009; Jadevicius and Huston, 2014). The so called "family of cycles" (Barras, 2009), include Kitchin (1923) cycle of three to four years of duration; the Juglar (1862) cycle lasts anything from between seven to ten years; much longer the 20 year Kuznets (1930) cycle; and "Kondratieff waves" (Kondratieff and Stolper, 1935) lasting around 50 years.

Aside from varying durations, cycle mechanics differ. Changes in inventory investment drive Kitchin cycles whilst the classical business cycle influences short four to five year property cycles (Barras, 1994; RICS, 1994). Ball *et al.* (1998) suggest that the transmission mechanism operates via general economic activity which affects occupier demand and subsequently triggers deviations in commercial property rents, prices and development activity.

Fixed capital inventory changes drive seven to ten year Juglar cycles. In property, Juglar cycles are simply development cycles and include flexible multiplier-accelerator effect (Barras, 1994; Ball *et al.*, 1998). For Barras (1994) development cycles merely reflect swings in general business cycles which push (pull) property demand and its production. Often, by the time new buildings come on stream, demand has declined in line with deteriorating business sentiment. Ball *et al.* (1998) suggest that the pernicious tendency to overbuild persists, in part, because post-recession restructuring and redundancies effectively delete corporate memories.

In the building and transport sectors, long 20 year Kuznets cycles are particularly prevalent. Such cycles are also known as "long swings". In contrast to Juglar cycles, the Kuznets ones are typically speculative and usually constitute a new phase of urban development (Barras, 1994, 2009). This new phase of development accounts for the significant amount of fixed capital formation, which subsequently affects general economic growth.

Major technological changes drive long Kondratieff waves, which are around 50 years of duration (Kaiser, 1997). Schumpeter (1939) warned of their short-term destructive impact on property markets and the overall economy. In their analysis, Ball *et al.* (1998) and Barras (2009) suggest that technological advances generate a surge in economic prosperity that usually increases commercial and other property demand. As a new phase matures and markets saturate, productivity and growth declines. As the economy sinks into recession (or depression), it drags the property market with it. Contrary to previous technological waves, the current internet retail revolution is restructuring retail markets by shrinking demand for conventional retail space.

Econometric scrutiny

Econometric research into property market cycles splits into two fields: confirmation of existence or analysis of fundamental drivers. Ball *et al.* (1998), for example, noted that cycles could be spurious artefacts of data analysis. Alternatively, cycles could the result of institutional and policy changes or a consequence of random shocks. To investigate these alternatives, researchers used formal statistical analysis to investigate a range of factors.

Barras (1987, p. 1) investigated "urban development cycles" in Britain and their links with technological changes. He found long swings of 20-30 years' duration punctuated by shorter cycles generally, two shorter cycles superimposed on dominant long swings causing pronounced building cycles. Compared to other investment classes, building activity is particularly prone to cyclical fluctuations.

In their 1985 article, Barras and Ferguson dissected the chronology of five major building sectors in the UK: private industrial, private commercial, private housing, public housing and other public building. The authors used spectral analysis to assess series turning points and detected four/five year "demand cycles" associated with general business cycle and longer around nine years "supply cycles" in UK property market.

Building on their empirical foundations, Barras and Ferguson (1987a, b) developed a theoretical dynamic model of property cycles. The theoretical framework was operationalized with ARIMA and error correction (ECM) algorithms. Estimates suggested the UK commercial property market experienced nine year major building cycles, transmitted via shorter four/five year business cycles.

Together with other researchers, Wheaton *et al.* (1997) turned their attention to the Greater London office market and developed a structural econometric model. To estimate and forecast prices, the researchers used a series of endogenous and exogenous variables over 1970-1995 period. Interestingly, as their model-simulation suggested, London office market is normally non-cyclical, unanticipated economic shocks notwithstanding. Wheaton *et al.* (1997) result is somewhat at odds with an earlier RICS (1994) UK study that fed endogenous and exogenous variables into a spectral analysis, looking at commercial property cycles. Visual and statistical data analysis identified short four/five year property cycles, closely linked with cycles in the general economy.

Other studies confirmed the close links between UK office and industrial property and GDP, manufacturing and business output. Retail property in particular seems to be synchronised with changes in GDP, consumer expenditure and non-food retail sales. McGough and Tsolacos (1995) examined amplitude, persistence, pro-cyclicality and counter-cyclicality of the UK commercial property cycles. Using the HP technique, they smoothed the selected series. Then, the authors examined a set of macro-variables to analyse office space demand and its relationship with the real economy.

Still in the UK, Scott and Judge (2000) used the medium of unobserved structural components to explore commercial property cycles. To screen cycles, researchers employed the MSCI (formerly IPD) property returns index over the period 1956 to 1996 (original IPD series were combined with proxy series to extended original index by two decades). Their econometric analysis found the UK commercial property market has a regular cyclical pattern of about eight years in duration. Interestingly, although Scott and Judge's methodology and data differed completely from the Wilson and Okunev (1999) approach, both studies arrived at a similar conclusion, i.e. UK property market follows an eight-year cycle.

In 2009, Barras re-examined the importance of cycles and their effect on property market and the general economy. He found ambiguous impacts so that, at a micro-level, building investment catalyses growth but, at the macro-level, it can also destabilise industry. When his simultaneous equation model was applied to City of London office market, Barras isolated building cycles of around 20 years.

Turning to overseas cyclical investigations, Wilson and Okunev (1999) employed spectral analysis technique to assess real estate market cycles for the USA, UK and Australia. Cycle length varies from around seven years in the USA, to eight years in the UK and three years in Australia.

The above discussion confirms that cycles, in general, exhibit regularity, uniformity and predictability. However, aspects of property market cycles remain unresolved. The danger is an over-simplification of the concept and failure to recognise real estate's diversity and complexity. Notwithstanding heterogeneity, at the most basic level, business dynamics drives property cycles. Cyclical fluctuation in business activity regulates demand for and production of space to undertake or disengage from economic activity (Ball *et al.*, 1998; Barras, 1994, 2009).

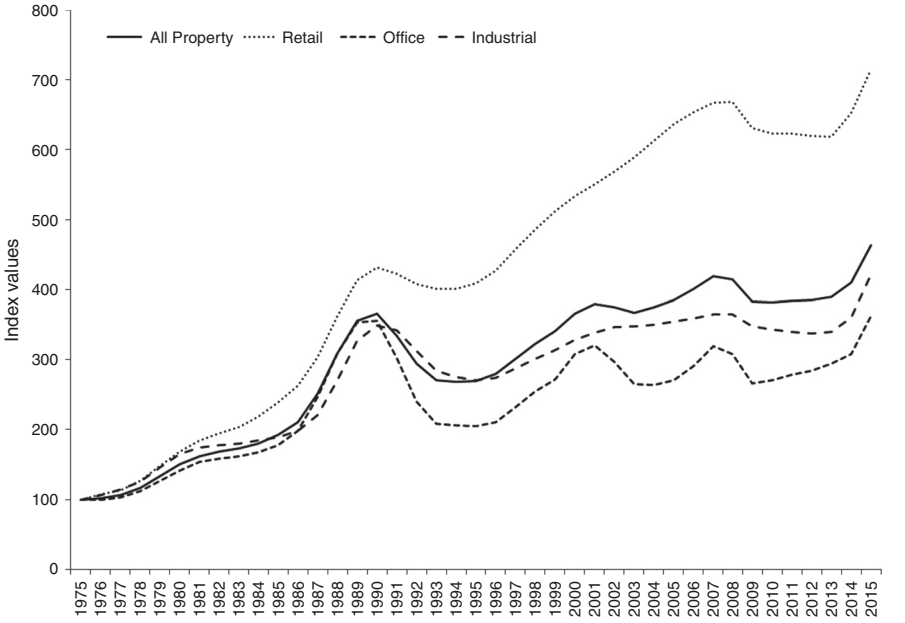
Despite the diverse spectrum of cycle literature, two key UK property cycles emerge. The first is a four/five year business cycle, driven by changes in economic activity via deviations in occupier demand, development activity, rents and values. These real estate market fluctuations trigger a second longer eight/ten year cycle which marks the expansion phase of a longer swing (Barras, 2009). Informed by this theoretical and empirical backdrop, the current study re-examines UK commercial property cycle duration.

3. Dependent variable

MSCI (formerly IPD) Real Estate Rental Value Index data provides dependent variables for the research series. To operationalise rents, all property, retail, office and industrial

(Figure 1) series for the UK are selected for 1975-2015 period. As of December 2015, MSCI UK Annual Property database contained 23,693 properties with a total capital value of £202.0bn (MSCI, 2016). Table I presents with MSCI's database profile. Table II exhibits series summary statistics. Figure 1 shows series dynamics.

The use of rents rather than returns, yields or capital values comes from the economics of the commercial property market and its importance for property market participants (Barras, 1984; Scott, 1996; Ball *et al.*, 1998; Baum and Crosby, 2008). Following Barras (1984), rent level determines the profitability for developers and investors and, hence, the level of supply of new developments. Ball *et al.* (1998) document that, in the user market, rent is a payment an organisation makes in order to use commercial property. In the capital market, rent is used to estimate the value of the property. Subsequently, rent plays a central role in bringing four inter-related property markets (space user, capital, development and land) into simultaneous equilibrium. This importance of rent determination can be summarised as follows: when the economy expands, businesses grow and, as they hire more people, their



Source: MSCI (2016)

Figure 1.
MSCI UK all property rental index series (1975-2015)

	Capital value (£m)	Capital value (%)	Number of properties	Number of funds
All property	201,986.2	100.0	23,639	275
Retail	85,503.6	42.3	4,072	218
Office	56,666.0	28.1	2,519	210
Industrial	33,979.4	16.8	2,895	201
Residential	8,724.3	4.3	11,579	74
Other	17,112.9	8.5	2,574	183

Source: MSCI (2016)

Table I.
MSCI UK annual property database profile

space requirements increase. Inevitably, with supply effectively fixed, rents rise. Eventually, increasing rents trigger development; this leads to a surge in construction levels. During subsequent deflation, the entire sequence reverses. Clearly, forecasters and analysts, grappling with property market dynamics, focus on rents.

4. Methodology

First, the research uses the HP filter to assess cycles in UK commercial property market. The HP filter is a well-established algorithm for removing trend from the data (McGough and Tsolacos, 1995; Witkiewicz, 2002; Matysiak and Tsolacos, 2003; McElroy, 2008). However, it has not been without criticism. Commentators pointed to an issue of spurious cycles created by the filter and a constant value for the smoothing parameter λ which fixes filter bandwidth (Canova, 1994; Ahumada and Garegnani, 1999; Pedregal and Young, 2001; Ravn and Uhlig, 2002; Witkiewicz, 2002; McElroy, 2008). Nevertheless, HP filter has stood the test of time.

The HP filter, as opposed to the spectral analysis technique, operates in the time domain rather than in the frequency domain. In time domain, the focus is on signal (in this case, time-series values) deviation over time rather than on signal behaviour within each given frequency (Cohen, 1989). To date, frequency domain techniques (Barras and Ferguson, 1985; RICS, 1994; Wilson and Okunev, 1999) as well as structural econometric modelling (*inter alia*, Wheaton, 1987; Barras, 2009) have tended to dominate property market cycle analysis.

The principle behind the HP filter based is a four step equation. Equation (1) extracts growth component g_t and a cyclical component c_t from the series. Equation (2) determines the growth component. Equation (3) computes smoothing parameter. Equation (4) obtains the cyclical element of the time-series by subtracting filtered series from the original data set (McGough and Tsolacos, 1995; Hodrick and Prescott, 1997). Cycles' series are then used to measure property cycle duration:

$$y_t = g_t + c_t \tag{1}$$

$$\min \sum_{t=1}^{T} (y_t - g_t)^2 + \lambda \sum_{t=2}^{T-1} \left[(g_{t+1} - g_t) - (g_t - g_{t-1}) \right]^2 \tag{2}$$

$$\lambda = (10 \times n)^2 \tag{3}$$

$$\text{HPcycle}_t = y_t - \text{HPtrend}_t \tag{4}$$

Second, to strengthen analysis and gain additional insights into the duration of the UK commercial property cycles, the study computes time-series volatility. According to Koop (2006),

	All property	Retail	Office	Industrial
Mean	293.6	426.0	239.0	276.3
Median	323.0	427.5	264.0	312.4
SD	104.5	190.6	74.2	86.8
Kurtosis	−1.1	−1.3	−0.9	−0.9
Skewness	−0.5	−0.3	−0.4	−0.6
Minimum	100.0	100.0	99.6	100.0
Maximum	463.1	715.2	362.4	420.9
Count	41	41	41	41

Table II. UK all property rental series descriptive statistics (1975-2015)

analysts and researchers traditionally look at series parameters such as level, growth/return, and spread as part of the overall technical analysis framework. However, there are instances when volatility (measured by the variance) of the variables produces greater insights. According to *inter alia* Bera and Higgins (1993), Hamelink and Hoesli (1996), Stevenson (2002), Miles (2007), a popular approach to estimate financial volatility is autoregressive conditional heteroskedasticity (ARCH)-based modelling.

The current study uses simplified version of ARCH method. It estimates a squared difference from the mean as suggested by Koop (2006). This particular formula allows measuring periods of atypical volatility in the series.

Koop (2006) suggests a three-step procedure to dissect the volatility components of selected variables, with the provision that the series follows a pure random walk or that it follows a random walk with drift. First, the average of the series is estimated (series is in logarithms); second, deviations from the mean are taken; third, results are squared. This process is expressed as in the following equation:

$$\Delta y_t^2 = \left(\Delta y_t - \frac{\overline{y}}{t}\right)^2 \tag{5}$$

where y_t is the value of dependent variable at the period t, and $\overline{y}$ is series average. This formula establishes the volatility properties of the dependent variable.

The advantage of volatility analysis is that it further aids time-domain cycle scrutiny. As noted by Koop (2006), large rises or large falls of the series translate into increased spikes of the volatility series. In contrast, during stable times, the series does not change and hence volatility stays low. Cycle duration is then measured from spike-to-spike in the series. The hypothesis is that a combination of HP filtering and volatility screening tightens the duration diagnosis of UK commercial property market cycles.

Finally, as suggested by Koop (2006), more formal evidence on the pattern of volatility can be found by building an AR(p) model. The simplest AR(1) model is expressed as follows (Brooks and Tsolacos, 2010):

$$\Delta y_t^2 = \mu + \phi_t \Delta y_{t-1}^2 + e_t \tag{6}$$

where μ is a constant term, ϕ_j is an autoregressive parameter and u_t is an error term at a time period t.

This autoregressive specification permits an examination of time series persistence. In other words, volatility in one period depends on the volatility in a previous period. A $\phi > 0$ condition implies that an unusually high (low) volatility in the past period carries an unusually high (low) volatility for the coming period. In other words, if the volatility at the time period t is low it will tend to stay low; if it is high it will remain high. The presence of the error term means that there may be exceptions to rules and that volatility can drift sideways. However, in general the model implies that observed volatility clusters persist and therefore can be used for analytics.

Equations (5) and (6) also benefits from their simplicity. As series embody volatility rather than levels, thus standard asymptotic assumptions can be disregarded.

5. Empirical estimates

The original MSCI series is available from 1975. Over the 1975-2015 period, the index experienced interchanging episodes of rise and decline. Five distinct episodes of correction interrupt the series in the last 40 years. Figure 2 illustrates this rental series cycle performance. The graph reveals that the UK commercial property market corrected in mid-1970s, mid-1980s, early-1990s, early-2000s and 2008. The examination of the general

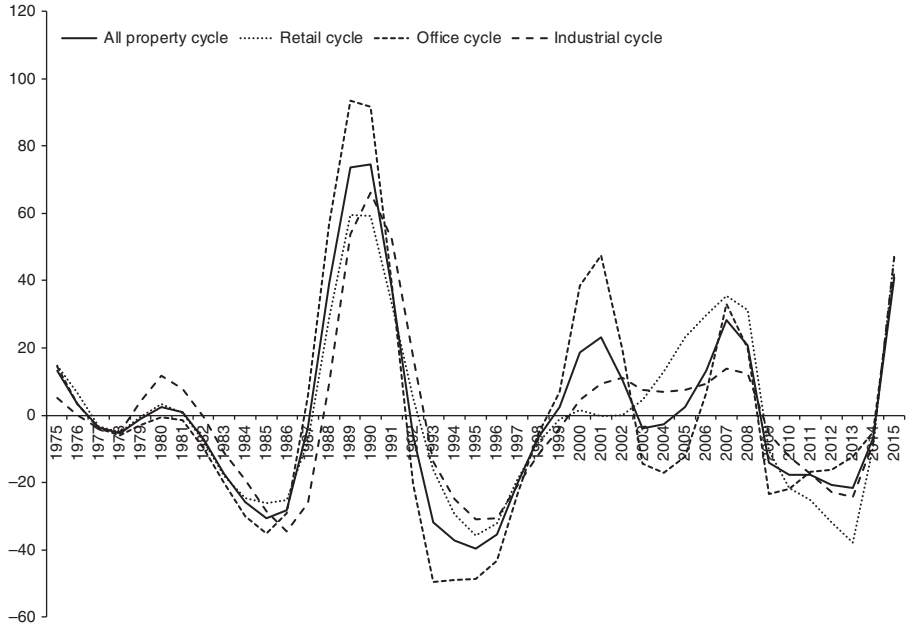


Figure 2.
UK all property rental series cycle performance

trends in commercial rental values over the sample period produced observations that corroborate those of Fraser (1984), Scott (1996), RICS (1994, 1999) and Barras (2009).

The property crash of 1973-1975 was mostly attributed to over-lending to the industry by secondary banks. The so called "Barber Boom", prompted by lax lending standards and inflationary environment at the time, drove property values upwards. On the back of ever rising property prices, secondary banks continued lending to the industry whist amassing loans on their books. However, a sudden correction ended the speculative party and turned property sentiment sours (Reid, 2003). Coupled with the 1972/1973 stock market crash (Pesaran and Timmermann, 2000; Davis, 2003) and the first oil "shock" in 1973/1974 (Hamilton, 1983), the property markets plummeted.

Over the following decade, the UK economy bounced back. The twin growth drivers were the shift towards services (especially financial services) and waves of deregulation that liberated credit markets and stimulated consumer spending. The initial optimism in government's ability to sustain growth proved misplaced as spending fuelled yet another property market boom (Ball, 1994). Inevitably, the bubble burst and inflicted severe commercial damage. Property values collapsed across the board. The most notable casualty was the fall of Olympia and York, a major international property development company (Coakley, 1994).

Relatively rapid recovery was followed by yet another correction in early 1990s. The decade started with a severe economic recession. High interest rates and an overvalued exchanged rate affected the overall economic performance. This had a knock-on effect on national property market (Gentle *et al.*, 1994; Meen, 1996).

A decade later another crisis hit the industry. The so called "dot com" boom initially infected technology stocks but soon spread. The subsequent stock market decline rippled out to UK and USA property markets (Anderson *et al.*, 2010; Bone and O'Reilly, 2010).

In 2008, UK commercial property market and the overall economy experienced what is now known as the worst crisis since the Great Depression (Reinhart and Rogoff, 2009; Claessens *et al.*, 2010). The toxic cocktail for the Global Financial Crisis involved uncritical

adoption of free-market ideology, low real interest rates, financial deregulation, innovation or chicanery and reckless lending (Shiller, 2006, 2012, 2013, 2014; Barrell and Davis, 2008; Goodhart, 2008). On the back of this growing bubble, the UK's commercial property sector enjoyed seemingly robust performance for more than a decade posting double digit returns as measured by the MSCI (IPD) All Property Total Return Index. However, risk was dangerously mispriced. A dramatic market correction killed euphoria and the public was shocked to discover the scale of fraud and regulatory ineptitude. Paulson's panicky daily press briefings exposed the extent of financial system fragility (Blinder, 2013) with MCSI (IPD) Quarterly Index declining 40.1 per cent over Q3 2007/Q4 2008 period.

Such dramatic events caution against simplistic interpretations of UK commercial property cycle statistics because the influence of various factors evolves as the market situation develops. The lack of conformity across various stages of market development clouds the interpretation of cycle length. Nevertheless, the cycle measurement from peak-to-peak and from trough-to-trough suggests that the average period of UK rental cycle is around eight years of duration. The average period between turning points is four to five years. Table III shows this UK commercial property cycle timing nomenclature.

Further visual and statistical analysis suggests that all four market segments turn at around the same time. However, sector cycles tended to deviate over the years. Due to the dominance of consumer demand, retail series often led whilst the office series tended to exhibit the largest amplitude. However, this heterogeneity notwithstanding, the overall findings suggest significant commercial cycle duration conformity. A high level of correlation among the series further supports this thesis. Table IV presents cycle series correlation estimates.

These estimates are in line with previous studies. As commented by Barras and Ferguson (1985, 1987a, b) and Scott and Judge (2000), the UK commercial property market experiences eight year cycles. On the periodicity criteria, the UK commercial property market appears to be linked to Juglar cycles, i.e. changes in inventory. This implies, as noted by Barras (1994, 2009), that UK commercial property market is driven by "supply cycles"

Table III.
UK all property rental series cycle timing

	All property		Retail		Office		Industrial	
Cycle phase	Year	Duration	Year	Duration	Year	Duration	Year	Duration
Trough	1978		1978		1978		1978	
Peak	1980	2	1980	2	1980	2	1980	2
Trough	1985	5	1985	5	1985	5	1986	6
Peak	1990	5	1989	4	1989	4	1990	4
Trough	1995	5	1995	6	1994	5	1995	5
Peak	2001	6	2000	5	2001	6	2002	7
Trough	2003	2	2002	2	2004	3	2004	2
Peak	2007	4	2007	5	2007	3	2007	3
Trough	2010	3	2013	6	2010	3	2012	5
Average		4		4		4		4
Average cycle		8		8		8		8

Table IV.
UK all property rental series cycle correlations

	All property	Retail	Office	Industrial
All property	1.00			
Retail	0.93	1.00		
Office	0.97	0.83	1.00	
Industrial	0.91	0.92	0.82	1.00

which are generated by two subsequent deviations in shorter business cycles and inherited construction lag, spawned by business cycles.

A cursory examination of rental series volatility indicates the large increase in fluctuations over 1978-1979, 1988-1992, 1991-1993 and 2008-2011 periods (Figure 3). This increased volatility is associated with major changes, either in a positive or in a negative direction. The subsequent volatility series screening supports HP filter cycle duration estimates. The UK commercial property market exhibits seven to eight year property cycles as measured from peak-to-peak and trough-to-trough. Table V illustrates volatility series timing. Correlation analysis confirms series interdependence. Correlation coefficients among volatility series are presented in Table VI.

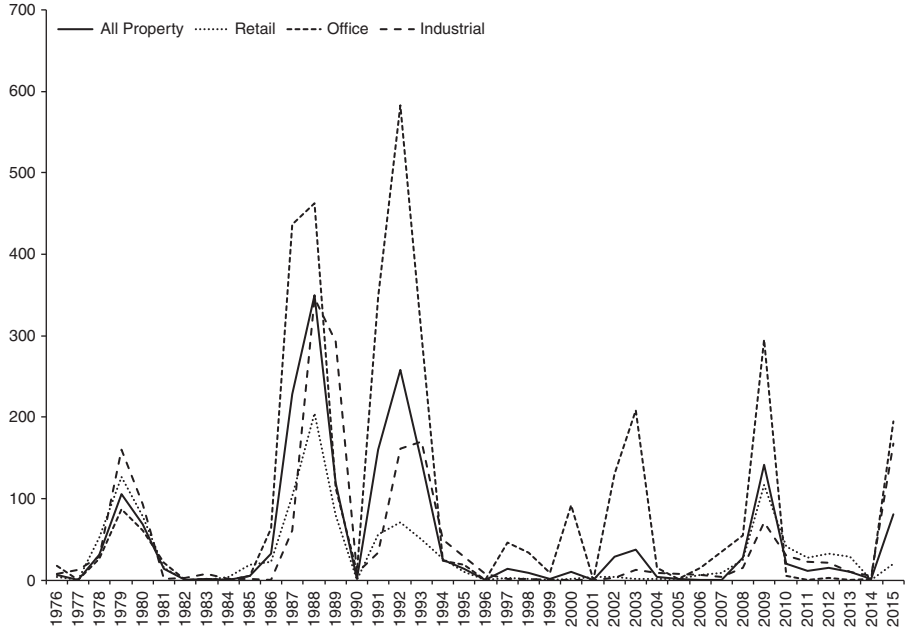


Figure 3.
UK all property rental series volatility

	All property		Retail		Office		Industrial	
Cycle phase	Year	Duration	Year	Duration	Year	Duration	Year	Duration
Peak	1979		1979		1979		1979	
Trough	1983	4	1982	3	1982	3	1982	3
Peak	1988	5	1988	6	1988	6	1988	6
Trough	1990	2	1990	2	1990	2	1990	2
Peak	1992	2	1992	2	1992	2	1993	3
Trough	1996	4	1996	4	1996	4	1999	6
Peak	2001	5	2003	7	2003	7	2003	4
Trough	2004	3	2006	3	2005	2	2007	4
Peak	2009	5	2009	3	2009	4	2009	2
Trough	2011	2	2011	2	2011	2	2012	3
Average		4		4		4		4
Average cycle		7		7		7		7

Table V.
UK all property rental series volatility timing

More formal evidence that rental values vary over time was obtained by building AR(1) models for each volatility series. Table VII reports the key model characteristics. The AR parameter coefficients are all significant. The R^2 for all specifications specification is around 0.30 which indicates that last year's volatility explains around one-third of the current volatility levels. What these estimates suggest is that the past trend is likely to continue in the future, i.e. high volatility in one period implies that it will be the same in the next period and vice versa.

This information is of significance for analysts or/and investors. Suppose that the last year's rental value y_{t-1} equals 0. This implies that current volatility value Δy_t^2 equals constant. For the all property series the constant is 52.98, it is 5.41 for retail, 91.15 for office and 51.35 for industrial series. In this situation, if one would like to predict volatility in period t in order to judge the likely behaviour of the series, the fitted AR(1) would suggest the same volatility in the next period. Since the error is unpredictable, it can be ignored (it can be either positive or negative), and therefore by implying that $y_{t-1} = 0$, the volatility in period t would equate to an intercept, which is significant when looking at the volatility scale (Figure 3). If the assumption is that $y_{t-1} = 1$, then volatility in the period t increases to the sum of an intercept and volatility series coefficient ϕ_t. The difference between two assumptions is small as all AR parameter coefficients are around 0.50. This low value of the intercept indicates that volatility mostly comes from the base.

Figure 3 illustrates that the volatility in 2015 peaked compared to its most recent performance. Considering this trend for all four dependent variables, UK rental values are likely to experience greater volatility in the coming years. In other words, rental values are likely to edge downwards in late 2016/early 2017.

The research suggests that the UK commercial property cycle has a duration of eight years. The new three-step algorithm, used to screen cycles, matches earlier investigations and confirms the usefulness of this technique. Given the relative ease of specifying and populating proposed formulae, the HP filtering, volatility and autoregression algorithm provides insights for a spectrum of domestic and foreign property market stakeholders to improve market timing or monetary policy oversight.

Governments and central banks can use the three-step model to forecast national property market dynamics in dampening speculative excess at its peak and stimulating the market when it dives south. Commercially, the new model could prove invaluable for investors, financiers or developers. A better commercial property market cycle timing can help tighten property investment analytics, feasibility forecasts and cut investment risks.

Table VI.
UK all property rental series volatility correlations

	All property	Retail	Office	Industrial
All property	1.00			
Retail	0.87	1.00		
Office	0.93	0.67	1.00	
Industrial	0.79	0.79	0.62	1.00

Table VII.
AR(1) volatility model characteristics

	Constant	AR parameter	R^2	DW
All property	52.98 (0.04)	0.54 (0.00)	0.31	1.55
Retail	5.41 (0.07)	0.81 (0.00)	0.65	1.01
Office	91.15 (0.02)	0.48 (0.00)	0.23	1.60
Industrial	51.35 (0.03)	0.48 (0.00)	0.22	1.54

Note: NB: p-values in parentheses

This is particularly relevant in the current Brexit context where a downward direction in UK commercial property rents is likely over the coming year. Financial models with optimistic rent prospects are likely to be caught short. *Ceteris paribus,* declining rents dampen development levels leading to a stall in construction starts. However, for developers, this turn in rental cycle provides with a window to build up their land-banks and prepare projects for the next market cycles rather than rush construction. Investors and fund managers, aiming to acquire commercial real estate, should re-consider their UK property investments. A projected decline in rents will drive down values and push yields up, making non-core commercial real estate investment less viable. Considering historical trajectory, the turn in rents is likely to continue for next four years. During subsequent deflation, it is recommended that investors refine their investment strategies in anticipation of market uplift at around 2020.

6. Conclusions

The cycle literature illustrates that debate on property cycles has lasted more than a century but contention remains. Over the years, economists and scholars sought to untangle various cycles' and clarify their duration to improve forecasting. Econometrics strengthened these cyclical investigations. For the UK, time-domain, frequency-domain and simultaneous equation modelling techniques were the preferred methods to screen cycles duration.

The current research applied a novel way to measure UK commercial property market cycles. First, the HP filter de-trended the selected series. Next, series volatility (measured by the variance) was scrutinised to isolate atypical fluctuations. Both techniques generated a UK commercial property market cycle length in accord with previous estimates. Finally, to gauge volatility persistence and potential UK commercial property market outlook, these volatility series were regressed.

The dependent variable used for the research was the MSCI All Property Rental Index for the UK over 1975-2015 period. The study found the average period of UK rental cycle duration as measured from peak-to-peak and trough-to-trough was around eight years of duration. The average period between turning points is between four and five years. Certainly, this univariate cycle result is indicative only and would benefit from the inclusion of macro-considerations. Nevertheless, the current estimates provide, *ceteris paribus*, reasonable support for a change in UK commercial rental trajectory for 2016/2017 which is likely to last until 2020.

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