INTERNATIONAL REAL ESTATE REVIEW
2003 Vol. 6 No. 1: pp. 22 – 42

Cycles and Common Cycles in Property and Related Sectors

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This paper examines cycles and common cycles in the property market and the economy. While focusing on common cycles, the study also incorporates common trends in the meantime, so it covers the whole spectrum of dynamic analysis. It has been found that property shares common cycles, particularly with those sectors that are the user markets of property. The mechanisms of common cycles and the relative magnitudes of cycles of the sectors related to property are discussed to shed light on property market behavior.

Keywords
Common cycle, common trend, phase, property

Introduction

This study investigates the cyclical behavior of property and fluctuations in the property market with regard to common cycles that property shares with other sectors in the economy. The common cycle is one type of common factor that has attracted much attention in contemporary econometric modeling. The other common factors include, prominently, the common trend and cointegration, which focus on the long-run co-movement between two or more time series. While there have been several studies of common factor analysis involving property and other economic and financial variables, they have exclusively adopted the cointegration procedure and are largely in the cointegration relationship between direct and indirect property investment. The latter is usually represented by REITs (Real Estate Investment Trusts) in the US and property company shares in the UK. Examples of such research can be found in Lizieri and Satchell (1997), and

Wang, et al. (1997). To our knowledge, none has studied common cycles in property and other sectors in the economy in a modern business cycle framework, which would have incorporated contemporary econometric modeling strategies.

Common cycle analysis is important to property in that property is indicated by cyclical behavior that exhibits phenomenal fluctuations. Moreover, fluctuations in property originate not only in the property market itself, but also in some sectors of the economy. There are interactions between property and the economy - the former is influenced by and influences other economic and financial sectors in one way or another. A common cycle analysis of property, therefore, attempts to identify the patterns of cyclical movement in the property market, and establishes how these patterns fit into the business cycle of the economy. By revealing the mechanism underlying the cyclical movement and co-movement, a common cycle analysis would offer profound implications. In the following pages, we will briefly analyze the interaction that may exist between property and the economy, with specific reference to cycles and common cycles.

Construction is fundamentally relevant to property development. The relationship may not be clear using conventional regression methods. It is well-known that there are time lags or leads in construction output with reference to property activity, and it is expected that construction output would adjust and respond to property performance. Nevertheless, due to complexities in the building process, how construction output may respond to property market performance (e.g., in the long term, or in both the short and long term) is an empirical matter. In contrast to construction, the other major sectors of the economy in this study are the users of property. It is expected that these sectors would lead property during business cycles one way or another when property adjusts to the demands of these sectors.

One of the largest user markets of commercial property is the service sector, so there exists an embedded connection between services and property that might also be strong. Since the service sector and commercial property for services, retail property, and office property are comparatively easier to adjust in the economy, we would expect common cycles, if they exist, to be coincident or with small phase differences. The link between property and the production/manufacturing sector is through the latter's use of industrial property. Relative to the service sector and retail and office property, the players involved here are illiquid and incapable of making adjustments in the short term. Hence, the production/manufacturing sector's common cycles with property are unlikely to be coincident and may even have large phase differences.

The rest of the paper is organized as follows: Section 2 introduces the concept of common cycles and the rationale and evolution of common cycle analysis. It then presents the analytical framework for modeling common cycles with both coincident and phase-shifting attributes, and in both stationary and cointegrated environments. Section 3 makes empirical inquiry into issues on common cycles in the UK property market and economy, and reports estimation results and findings with the procedures introduced and developed earlier. Finally, Section 4 summarizes this study together with concluding remarks.

The Concept and Modeling of Common Cycles

The study of common cycles is an extension of common trend analysis. Common trend analysis itself is the multivariate generalization of the Beveridge-Nelson (1981) trend cycle decomposition, due to Stock and Watson (1988). This generalization has led to the "common trend representation," usually called the Beveridge-Nelson-Stock-Watson (BNSW) representation. Embedded in this representation is the concept of cointegration and the long-run co-movements among several time series. To extend the BNSW representation by incorporating common cycles is a natural development in econometric modeling. This kind of work can be found in Engle and Kozicki (1993), Vahid and Engle (1993a, b), Lippi and Rechlin (1994), Forni and Reichlin (1995), Gallo and Kempf (1995), Engle and Issler (1995), and Wang (1999).

The idea of common cycles bears a remarkable similarity to that of common trends and cointegration. But, while one lag/lead (phase-shifting) in one time series does not change common trend and cointegration relations, it does affect the way in which a combination of cycles behaves. In the simplest case, if time series xt and yt have a common trend, a linear combination of xt and yt-1 will have a common trend as well (cf Engle and Granger 1987). But this is not the case for common cycles. Furthermore, there are several kinds of common cycle. Therefore, common cycle analysis does not exactly resemble common trend analysis. As this study is an empirical application of common cycles, it is helpful to provide a definition for each of them first.

Common Cycles: Coincident and Phase Shifting

We used the VAR (Vector AutoRegression) model for investigating common cycles. First, let us set up a bivariate VAR model with p lags:

$$y_{1,t} = \sum_{i=1}^{p} a_{1i}\, y_{1,t-i} + \sum_{i=1}^{p} b_{1i}\, y_{2,t-i} + \varepsilon_{1,t}$$
$$y_{2,t} = \sum_{i=1}^{p} a_{2i}\, y_{1,t-i} + \sum_{i=1}^{p} b_{2i}\, y_{2,t-i} + \varepsilon_{2,t} \tag{1}$$

or:

$$y_t = A(L)\, y_t \ = A_1 y_{t-1} + \ \dots \ + A_p y_{t-p} + \varepsilon_t \ . \tag{2}$$

where L is the lag operator and:

$$y_t = \begin{bmatrix} y_{1t} & y_{2t} \end{bmatrix}, \quad \varepsilon_t = \begin{bmatrix} \varepsilon_{1t} & \varepsilon_{2t} \end{bmatrix}', \ \varepsilon_t \sim (0, \Sigma),$$

$$A_1 = \begin{bmatrix} a_{11} & b_{11} \\ a_{21} & b_{21} \end{bmatrix}, \quad \dots\dots \quad A_p = \begin{bmatrix} a_{1p} & b_{1p} \\ a_{2p} & b_{2p} \end{bmatrix}.$$

The coincident common cycle is defined as follows: if there exists a vector $\tilde{\alpha} = \begin{bmatrix} 1 & \alpha \end{bmatrix}$ such that:

$$\tilde{\alpha}'\, y_t \ = \ \tilde{\alpha}'\, \varepsilon_t \ , 3 \tag{3}$$

then it is said that there are coincident common cycles in y_t. It is equivalent to say that:

$$\tilde{\alpha}' A_1 = \tilde{\alpha}' A_2 = \dots = \tilde{\alpha}' A_p = 0 \tag{4}$$

Equation (3) is the most basic common cycle relationship. It is called co-dependence of order 0 in Gallo and Kempf (1995), and the coincident common cycle in Wang (1999).

A phase-shifting common cycle is defined as follows: if there exists a vector $\tilde{\alpha}$ such that:

$$\tilde{\alpha}' y_t = \tilde{\alpha}' \varepsilon_t + \tilde{\alpha}' \tilde{A}_1 \varepsilon_{t-1} + \dots + \tilde{\alpha}' \tilde{A}_k \varepsilon_{t-k}\,, \quad k < p \tag{5}$$

where $\tilde{A}_i$ (i=1,...k) is the combination of A_1, ... A_p (linear and non-linear), then it is said that there are phase-shifting common cycles of order k in y_t .

This representation was derived via nonlinear operations, and will be clarified later with the help of companion matrices. Vahid and Engle (1993b) called this common cycle relationship a non-synchronous common cycle. Wang (1999) proposed the concept of phase-shifting common cycles, arguing that in cybernetics or control engineering where the idea originated, two series are synchronous, even if there are lags or leads, as long as they keep the same lags or leads. A common cycle, be it coincident or phase-shifting, is clearly a combination of synchronous time series (eg, their phase [it could be zero] is locked). Gallo and Kempf (1995) used a co-dependence of high order (order k) to describe this common cycle relationship, although they adopted a moving average representation for their definition and discussion.

It is apparent that the issues of common cycles are, statistically, an over-identification problem and amount to multi-colinearity in parameter matrices. For coincident common cycles, there is over-identification in the original VAR system. In the second definition, over-identification happens in the moving average representation of phase-shifting common cycles after the matrix operation and transformation, and multi-colinearity is in its parameters of the lagged variables (i.e., in the autoregressive part of the transformed specification). The matrix operations, which are both linear and non-linear, lead to the cancellation of the autoregressive components and result in the moving average residuals of the lower order in a linear combination of the series.

Common Cycles in Cointegrated Systems

So far, the common cycle structure and relations have been defined and demonstrated. To combine common cycles into a cointegrated or non-stationary system would mean an inquiry into common cycles and common trends at the same time. Let us examine the following VAR process:

$$y_t = A_1 y_{t-1} + \dots + A_p y_{t-p} + \varepsilon_t \, . \qquad (6)$$

In recognition of common trends or cointegration, its error correction mechanism (ECM) form is:

$$\Delta y_t = - A(1)\, y_{t-1} + \Pi_1 \Delta y_{t-1} + \dots + \Pi_p \Delta y_{t-p} + \varepsilon_t \qquad (7)$$

where a non-zero rank A(1) implies cointegration or common trends, and $\Pi_i = - (A_{i+1} + \dots + A_k)$, i = 1, ... k-1. Using a Markov transition matrix, the process can be expressed in the first order VAR with the ECM:

$$\Delta x_t = \Pi \Delta x_{t-1} - \overline{A}(1)\, x_{t-1} + \omega_t \qquad (8)$$

where:

$$\Delta x_t = \begin{bmatrix} \Delta y_t \\ \Delta y_{t-1} \\ . \\ . \\ \Delta y_{t-p+1} \end{bmatrix}, \quad \Pi = \begin{bmatrix} \Pi_1 & \Pi_2 & \dots & \dots & \Pi_p \\ I & 0 & \dots & \dots & 0 \\ 0 & I & 0 & \dots & \dots \\ \dots & & & & \\ 0 & \dots & \dots & I & 0 \end{bmatrix}$$

$$x_t = \begin{bmatrix} y_t \\ y_{t-1} \\ . \\ . \\ y_{t-p+1} \end{bmatrix}, \quad \overline{A}(1) = \begin{bmatrix} A(1) & 0 & \dots & \dots & 0 \\ 0 & 0 & \dots & \dots & 0 \\ \dots & & & & \\ & & & & \\ 0 & 0 & \dots & \dots & 0 \end{bmatrix}, \quad \omega_t = \begin{bmatrix} \varepsilon_t \\ 0 \\ . \\ . \end{bmatrix}.$$

As indicated in Johansen (1988), A(1) can be written as the product of two nxr vectors βα' when there is a cointegration relationship, and □ is the cointegration vector. For common cycles to exist, the following conditions should be met:

$$\tilde{\alpha}' \Pi_i = 0, \ \ i = 1,...p ; \quad \tilde{\alpha}' A(1) = 0 \tag{9}$$

In fact, they can be expressed as a linear row dependence relation in a matrix consisting of two blocks:

$$B = [\ \Pi \ \text{-} \ \overline{A}(1)] \tag{10}$$

The above conditions are for phase-shifting common cycles of order 1 in a cointegrated system. Higher order phase-shifting common cycles in a cointegrated system are more complicated and usually empirically infeasible, so they will not be included in this study. Interested readers can refer to Wang (1999) for details.

Common Cycle Analysis of the UK Property Market

Variables, Data, and Background Information

To investigate common cycles shared by property and the economy, we have selected a range of economic and financial activities. These include the GDP sectors, the money supply, the leading indicators, unemployment, housing prices, and financial market investments. The GDP sectors include the aggregate GDP itself and its three major components: the construction sector (CO and RESA), industrial production (PDN), and the service sector (SVC). The agricultural sector is excluded, as the JLW (Jones Lang Wootten) index, which is used in this study, covers virtually no farmland. In addition, there is manufacturing (MNG), one of the most important components of the production sector, which is influenced by general economic conditions rather than other non-economic events (oil and utilities being two of the examples).

The construction variables include construction output (CO) and a derived variable - stock under construction (RESA). The money supply variable is the narrowly defined money M0.[1] The unemployment variable is the unemployment rate (UER). The leading indicators are the long lead (LL), short lead (SL), coincident (CC), and lag indicators (LG). The housing price is represented by the Nationwide Building Society house price index (NTW).[2] With regard to financial market investments, they are the general stock market index (FTA), the index of property company shares (FTAP), and the UK government securities gilts (GLT). Property is represented by the Jones Lang Wootten Total Return Index (JLW). All data run was from the second quarter of 1977 to the second quarter of 1993.

As the JLW index is used throughout this study to represent property performance, it is helpful to introduce some institutional background on the construction of the index. It was launched in 1977, and is the longest property index available in the UK.[3] The properties in the JLW index are drawn from 20 different funds, none of which account for more than 20% of its overall portfolio. These are funds that JLW values, advises, or manages. The index consisted of 179 properties as of March 1998, of which 49 percent are offices, 31 percent retail, 19 percent industrial, and the remaining are farms and miscellaneous properties. The value of these properties was £457 million and that of the funds was £3.01 billion as of 31 March 1998. The JLW index is appraisal or valuation-based; therefore, there is a smoothing

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[1] M0, the narrowly defined money, was chosen as the money supply variable in this study. The reasons for using M0 instead of M4, the broad money supply, are empirical. There was a big break in the M4 series in the fourth quarter of 1981 that was caused by the switch between the old banking sector and the new monetary sector. In July 1989, Abbey National's conversion to a public limited liability company caused minor breaks in the M0 series and major breaks in the M4 series. Although the first breaks in the fourth quarter of 1981 were removed from the changes in M4, the removal of the breaks in the changes in M4 resulted in as much distortion as the retention of the breaks in M4 levels. Besides these breaks, the M0 and M4 series had a similar pattern. Beyond the concern in breaks, M0 is more liquid and more public sensitive in representing the demand factors when separated from the supply or real factors.

[2] Although the Halifax Building Society (converted to a bank in 1998) house price index has the widest coverage in the UK, its quarterly index only started in 1983.

[3] The other major UK property index, IPD (the Investment Data Bank), although with a wider coverage, did not start compiling its monthly index until 1987; it was annual before 1987.

problem. So the JLW index is unsmoothed[4] before it is applied to empirical investigations.

Tests on Cycles

Prior to common cycle tests, the existence of cycles should be checked. It is comparable to the cointegration test in that one should verify the existence of a unit root in the time series prior to the cointegration test. If a time series has a unit root, or similarly has a cycle, then the time series can be described as having a feature, as stated by Engle and Kozicki (1993). In addition to unit roots and cycles, other features could be outliers, breaks, etc. If one series has a feature and the other does not, then a testing procedure would put all the weight on the series that has no feature and zero weight on the series with the feature. Therefore, the time series without a feature, which in this case is cycles or fluctuations, should be ruled out from analysis.

Table 1 reports the statistics on the individual time series. The Ljung-Box Q statistic for serial correlation includes lags of up to 4, 8, and 16, with the last one being 1/4 of the total observations. The purpose for using several lags is partly to see whether there is any possibility for stock market indices to have serial correlation, so that they can be involved in common cycle analysis. The answer is a clear no. For the FTA series that represents stock market investments in general, the significance level is 0.5131 for lag 4, 0.4349 for lag 8, and 0.4977 for lag 16. The respective numbers are 0.4977, 0.7506, and 0.5541 for the FTAP series, the index of property company shares, or indirect property investment. Gilts is also very white, and the significance levels are 0.9391, 0.8617, and 0.5005 for these lags. Therefore, no

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[4] Blundell and Ward (1987), Firstenberg, et al (1988), and Ross and Zisler (1991) were among the first to raise the issue of smoothing in appraisal-based property indices and proposed approaches to correcting such indices. More recent research includes Giaccotto and Clapp (1992), Shiling (1993), Geltner (1993), Geltner and Barkham (1993), Ward (1993), Barkham and Geltner (1995), and Wang (1998), to mention a few. The early research on the issue, concerned by a substantially lower standard deviation in property return indices relative to that in the returns on other financial market investments, adopted an approach that assumes a random walk in the property return process to correcting or unsmoothing the indices. However, more recent studies have pointed out that, while there exists smoothing in property return indices, the property return process does not necessarily follow a random walk. Therefore, on the one hand, the valuation-based property index should be corrected or unsmoothed to obtain the true standard deviation in its return or the true risk associated with property investment. On the other hand, the index should not be “fully” unsmoothed, assuming a random walk process in property returns, which would have exaggerated the standard deviation in the returns on property. Almost all recent studies have recognized and accepted the stance that valuation-based property indices should be unsmoothed to a right extent. The difficulty and difference are, then, how to decide an unsmoothing factor reasonably. This study adopts a smoothing factor α=0.6241 from Wang (1998), who performed an empirical study on the same JLW index. The fully unsmoothing procedures can be found in most early studies (eg, Blundell and Ward [1987]), and Firstenberg, et al (1988).

information in stock market indices can be used for common cycle analysis. This is one of the reasons why one should rely on the real sectors in the economy for property research.

In a sense, the stock market is simply too efficient to be useful for this kind of inquiry. In general, most sectors have serial correlation. Those having highly significant serial correlation are construction, housing, the money supply, the service sector, the coincident leading indicator, and the lagging indicator of the ONS (Office for National Statistics). Aggregation seems to reduce serial correlation (which can be regarded as having common cycles in their component variables). For example, manufacturing has significant serial correlation using Q(4) and Q(8), but total production only has marginally significant serial correlation with Q(4), and the appropriate measure Q(16) is not significant at all. The serial correlation displayed in GDP is also rather weak. Three sets of Q statistic are provided for the JLW index, with one each for the unsmoothed, original, and fully unsmoothed series. The unsmoothed JLW index displays a reasonable degree of serial correlation. The fully unsmoothed JLW index, although based on the random walk assumption, still has serial correlation or cycle, but the serial correlation is very little. In addition, its serial correlation structure is distorted. Therefore, the fully unsmoothed JLW index is excluded from common cycle analysis. The stock market indices simply do not have any serial correlation or cycles, and neither could it be used for common cycle analysis.

After those time series without significant serial correlation, or fluctuations, being ruled out (also just one leading indicator is used, as the difference between leading indicators is mainly in their phase), common cycles will be tested. As on the test of cointegration and common trends where one would have difficulty conferring some economic meaning to more than one cointegration vector, one would also possibly encounter difficulties in explaining more than one common cycle. Therefore, the common cycle test is carried out in pairs between property and the other variables.

Unit Roots and Cointegration

Routine unit root tests are carried out as well. The existence of a unit root in the variables in levels can be confirmed, and a unit root in the variables in the first difference can generally be ruled out. The cointegration relation between property and other variables was verified by Malcolm, which is a Johansen testing procedure with RATS. The results are briefly reported in Table 2. Leading indicators and the unemployment rate are stationary, so they are excluded from the table. All other variables were confirmed to have the cointegration relationship with property, and there is only one cointegration vector in each pair between property and other variables. The selection of the cointegration models is based mainly on visual inspection of the graphs, as done by Johansen and Juselius (1992). In the following common cycle analysis, the error correction term is included when there is a cointegration relation in the pair and no error correction term.

Table 1: Serial Correlation in Individual Series

Series	Q(4)	sig level	Q(8)	sig level	Q(16)	sig level
JLW-unsmthd	20.4372	0.0004	22.8767	0.0035	38.3555	0.0008
JLW-original	70.4336	0.0000	74.3681	0.0000	107.9479	0.0000
JLW-fully unsmthd	5.9759	0.2010	10.2941	0.2450	15.8439	0.3925
PDN	7.5302	0.1104	9.0012	0.3422	12.1354	0.7346
CO	34.3577	0.0000	44.1157	0.0000	50.7638	0.0000
SVC	17.7542	0.0013	24.1725	0.0021	33.8870	0.0056
NWT	59.9269	0.0000	61.2236	0.0000	81.3520	0.0000
GDP	1.8768	0.7584	12.0061	0.1509	25.5425	0.0608
RESA	114.3367	0.0000	158.0207	0.0000	165.7199	0.0000
M0	60.3252	0.0000	71.9651	0.0000	87.4877	0.0000
MNG	15.1925	0.0043	16.6892	0.0335	20.5253	0.1975
FTAP	1.9614	0.7429	5.0648	0.7506	14.5999	0.5541
FTA	3.2738	0.5131	7.9852	0.4349	15.3707	0.4977
GLT	0.7954	0.9391	3.9486	0.8617	15.3311	0.5005
UER	211.6895	0.0000	290.6080	0.0000	318.3295	0.0000
CC	130.8385	0.0000	145.6726	0.0000	249.0968	0.0000
LL	96.1702	0.0000	127.4169	0.0000	233.2890	0.0000
SL	102.7752	0.0000	119.2907	0.0000	232.8703	0.0000
LG	127.2216	0.0000	144.7604	0.0000	230.8134	0.0000

In fact, only an analysis of property's relation to the unemployment rate and the leading indicator lacks an error correction term, as these two variables are themselves stationary and there exists no error correction mechanism between them and property. Only the unsmoothed JLW index is used in the cointegration analysis. Once a cointegration relation is confirmed by the unsmoothed property index, that relation should also exist for the original index, and vice versa. The confirmation of a cointegration relation with these variables means that property shares a common trend with them, and it is rather unusual if property does not move together with most economic and financial activities in the long-run. In the following discussions, it will be revealed that the situation is different for cycles and common cycles.

Table 2: Cointegration Tests

	One cointegration vector		Two cointegration vectors	
	λmax	λtrace	λmax	λtrace
PDNa	15.83	23.32*	7.49	7.49
COb	19.83†	26.54‡	6.71	6.71
SVCc	16.78†	16.97†	0.19	0.19
NTWa	15.70*	21.66†	5.96e	5.96e
GDPd	23.45†	32.00‡	8.55	8.55
RESAa	18.42†	19.40†	0.98	0.98
M0c	15.70†	16.87†	1.17	1.17
MNGd	18.03*	27.12‡	9.09	9.09

*significant at the 10% level, †significant at the 5% level, ‡significant at the 1% level.
a. model H5: with unrestricted constant and trend;
b. model H2: with restricted constant and no trend;
c. model H3: with unrestricted constant and no trend;
d. model H4: unrestricted constant and restricted trend.
e. the statistic is significant with this model; other models reject the hypothesis of two cointegration vectors, but marginally accept the hypothesis of one cointegration vector.
Critical values in Johansen and Juselius (1990) and Osterwald-Lenum (1992) were used as cointegration criteria; results were from running the Malcolm procedure with RATS.

Tests on Common Cycles

The results from common cycle tests are reported in Tables 3, 4, and 5 using the unsmoothed JLW series to represent property investment. Both the existence of coincident common cycles and one phase-shift common cycles are tested. The instrumental variable (IV) method is used to estimate the coefficient α in a relation that (Δy1t - $\alpha\Delta$y2t) has no cycles. This means (Δy1t - $\alpha\Delta$y2t) is the white noise residual and has no serial correlation with lagged Δy1t and Δy2t, and the cointegration residual is at t-1 if y1t and y2t are cointegrated. The coefficient from the direct regression of Δy1t on Δy2t would be biased, as Δy2t is correlated with the current period innovation or residual. The instruments used are the first and second lags of the JLW series and the other variable in the pair, plus the first lag of the cointegration vector if there is a cointegration relation. In the case of phase-shifting common cycles, the instruments are the second and third lags of the relevant variables, plus the second lag of the cointegration vector if the two variables in levels are cointegrated. 2SLS (2 Stage Least Squares) is a similar method.

There are four statistics reported. The first is α, the coefficient of the other variable (Δy2t) in the regression (the coefficient of JLW is set to one). A significant α suggests a relation or correlation, and although not necessarily a common cycle relation, it exists between property and Δy2t. Both the F-test and χ2 statistics are used to check for the existence of common cycles or the cancellation of cyclical components, which is suggested by the insignificant test statistic. The combined series is also examined against the serial correlation with the Ljung-Box Q statistic - no correlation with the lagged variables is equivalent to no serial correlation in the combined series itself.

First, let us examine coincident common cycles, as presented in Table 3. JLW's common cycle relationship is clearly found with the house price, the service sector, and the manufacturing sector, with very low insignificant levels for F, χ2, and Q, and a very significant α. Property seems to be more cyclical (i.e., the magnitude of its cycles is larger) than the service sector with α of 2.5033. In other words, the magnitude of cycles in property is about 2.5 times the cycles in the service sector. But the cyclical fluctuations in property are less than those in the housing market suggested by the α coefficient of 0.7103. The magnitude is about the same for property and the manufacturing sector. The existence of common cycles between property and the money supply and between property and total production has been marginally confirmed.

In the case of total production, the Ljung-Box Q statistic is the criterion, but recall that the PDN series is much more white than the MNG series, partly due to the aggregation. This result should be viewed with caution. With the money supply, only the F statistic marginally accepts the existence of common cycles, and property is relatively less cyclical than the money supply variable. There is no common cycle relationship found between property and the GDP series. This is not to rule out the cyclical co-movement of property with GDP, because the aggregation in GDP has reduced or phased out the fluctuations in the GDP index in general, and the GDP series is rather white in this given short period. In a sense, investigations at the sectoral level are helpful, not only in the sectoral analysis itself, but also in inferring implications for some economic aggregates. Quite beyond imagination, if not surprisingly, property shares no common cycles with the construction sector, although the existence of common trends or long-run co-movement between them is very evident. The common cycle relationship remains non-existent even if stock under construction, a derived variable that has a profound long-run relationship with property, is used in the test. The series of coincident leading indicators, GDP, and total production, although lacking a common cycle relationship with property, has a very clear correlation with property.

Table 3: Common Cycle Tests Coincident Common Cycles Using the IV Method

Series	α	F-test	χ^2 test	Q
PDN	1.0038	2.0996	4.5010	18.5485
	(0.0465)	(0.0795)	(0.0339)	(0.2928)
CO	-0.0814	3.6716	9.5803	42.8476
	(0.6448)	(0.0062)	(0.0020)	(0.0003)
SVC	2.5033	0.7650	2.2982	15.6771
	(0.0000)	(0.5791)	(0.1295)	(0.4757)
NTW	0.7103	1.0086	3.0500	19.7933
	(0.0001)	(0.4217)	(0.0807)	(0.1800)
GDP	2.4395	2.8848	8.8887	23.8026
	(0.0087)	(0.0222)	(0.0029)	(0.0939)
RESA	0.0501	3.1168	4.0808	36.6884
	(0.3460)	(0.0152)	(0.0434)	(0.0014)
M0	0.7684	1.9423	5.1160	29.4691
	(0.0095)	(0.1024)	0.0237)	(0.0210)
MNG	0.9347	1.5394	0.2551	19.7070
	(0.0151)	(0.1931)	(0.6135)	(0.2337)
UER	0.0010	3.3809	9.0456	41.9067
	(0.0306)	(0.0152)	(0.0026)	(0.0004)
CC	0.0009	2.9531	4.1912	34.3338
	(0.2604)	(0.0278)	(0.0406)	(0.0049)

Significance levels in brackets.

One should notice that, theoretically and empirically, the conditions for common cycles are rather less possible to meet than those for common trends or cointegration, as the former requires that the components in two series are proportional at every frequency of their cycles, whereas in the latter, merely the zero frequency component plus some elements very close to zero frequency (in fact it is these elements that would decide a cointegration relation, otherwise two I(1) series would always be cointegrated). Therefore, while many economic time series variables have common trends and are cointegrated, not so many have common cycles. To put it differently, there are many different paths for reaching a certain level of activity. Any path different from a pure random walk path is a cycle or fluctuation. So, there could be many different cycle patterns even two time series are bound to move together in their levels.

For those sectors with which property has no coincident common cycles, inquiry is made on whether there are phase-shifting common cycles. The existence of coincident common cycles does not preclude phase-shifting common cycles, as the latter (of order one) cancel (a majority of) cyclical components, but leave an MA(1) in their residuals. The test on the existence of phase-shifting common cycles is more difficult and complicated than that on coincident common cycles.

So, there are only brief explanations about the results, which are reported in Table 4. It appears that no clear pattern has emerged. Only GDP seems to have possible common cycle components after one phase shift suggested by the F-test and the Ljung-Box Q statistic. This possible phase difference between property and GDP should also come from some of the GDP sectors. Construction is one that still has no common cycles with property, but coherence has increased after one phase shift, viewed by the increased, but still significant, test statistics. The production and service sectors may also have some phase differences with property.

As mentioned before, it is not easy to tell leads from lags in these pairs, and it is possible one series has leads over the other at, say, lower frequencies, but lags at higher frequencies. With phase-shifting common cycles of order one, the residual is MA(1), so longer lags in variables are also used and tested. According to Table 5, property and the unemployment rate UER seem to have some common cycle elements with one phase shift - the F-test statistic is not significant at the 5% level. The unemployment rate, which should be a stationary variable and regarded as such, is in fact very persistent and has some kind of upward trends,[5] so further tests (e.g., with even longer

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[5] Several studies have also reported this characteristic, such as Tschernig and Zimmermann (1992), Lindbeck and Snower (1994), Leslie, et al (1995), Dolado and Lopez Salido (1996), and Song and Wu (1997). They have inquired on whether the unemployment rate is stationary, persistent with long memory, or has a unit root and is not mean-reverting. Lindbeck and Snower (1994) found a persistence in the unemployment rate. Tschernig and Zimmermann (1992) did not believe that there is a unit root in the unemployment rate, but reported that unemployment exhibits long memory. Leslie, et al (1995) and Dolado and Lopez Salido (1996) supported the null of a unit root in the unemployment rate, whereas Song and Wu (1997) rejected the null decisively. They claimed that the failure to reject the null in several studies using standard unit root test procedures may be due to the low power of these tests. Lee and Siklos (1991) and Gil Alana and Robinson (1997) also rejected a unit root in the unemployment rate.

Although the postwar unemployment data in many western economies appears to show an upward trend, the data for this period only comprises a sample or sub-sample. In addition, common sense tells us that the unemployment rate cannot move without boundaries. For example, it is certainly not possible for the unemployment rate to reach 70 percent because it is unlikely to be over 20 percent. When the unemployment rate in Spain was about 20 percent, one would expect it to drop. There is a mean, but the mean may depend on the sample used. Foreign exchange rates have a similar characteristic about mean-reverting in the time series data. However, there are no economic constraints to contain, for example, the dollar mark rate in the 1:10 or 1:100 range. In fact, the rate moved well above that level during the hyperinflation of the German Mark in the 1920s. The unemployment rate data differs from foreign exchange lags to accommodate its serial correlation at higher orders) are of little help. With regard to leading indicators, they all have substantial higher frequency components to (more than) reflect economic fluctuations. These higher frequency components would not be cancelled out in most of their combinations with economic and financial time series, including property.

Table 4: Common Cycle Tests Phase-shifting Common Cycles Using the IV Method (Two Lags)

Series	α	F-test	χ^2 test	Q
PDN	1.0717	2.2909	5.2909	16.9678
	(0.0730)	(0.0586)	(0.0214)	(0.3877)
CO	0.0069	3.3400	7.4187	40.4072
	(0.9715)	(0.0107)	(0.0065)	(0.0007)
SVC	2.5538	1.0101	3.3091	15.3678
	(0.0000)	(0.4210)	(0.0689)	(0.4979)
NTW	0.7768	0.7530	2.0872	19.0690
	(0.0003)	(0.5876)	(0.1485)	(0.2106)
GDP	2.8607	1.7042	3.6462	21.7875
	(0.0055)	(0.1497)	(0.0562)	(0.1502)
RESA	0.0492	3.1666	4.6833	35.7926
	(0.3649)	(0.0142)	(0.0305)	(0.0019)
M0	0.7827	2.5916	7.7120	29.0958
	(0.0139)	(0.0360)	(0.0055)	(0.0233)
MNG	0.7922	2.0476	2.3817	21.7709
	(0.0424)	(0.0868)	(0.1228)	(0.1507)
UER	0.0010	2.8542	7.4330	40.7596
	(0.0325)	(0.0322)	(0.0064)	(0.0006)
CC	0.0013	3.0516	4.7109	32.2767
	(0.1427)	(0.0244)	(0.0300)	(0.0085)

Significance levels in brackets.

rates in that there are economic constraints. In this sense, the unemployment rate is regarded as stationary in this study.

Table 5: Common Cycle Tests Phase-shifting Common Cycles Using the IV Method (Four Lags)

Series	α	F-test	χ^2 test	Q
PDN	0.9939 (0.0753)	1.5126 (0.1714)	3.9789 (0.0461)	16.1872 (0.4400)
CO	0.2151 (0.1783)	2.6923 (0.0130)	7.1684 (0.0074)	36.1416 (0.0028)
SVC	2.5616 (0.0000)	1.8927 (0.0764)	6.0528 (0.0139)	15.2049 (0.5097)
NTW	0.8059 (0.0005)	1.5290 (0.1657)	3.0898 (0.0788)	15.0102 (0.4507)
GDP	2.4859 (0.0002)	1.6058 (0.1412)	5.5996 (0.0180)	22.4413 (0.1295)
RESA	0.0740 (0.1657)	2.1578 (0.0427)	3.9322 (0.0474)	31.6439 (0.0072)
M0	0.7210 (0.0335)	2.5962 (0.0161)	12.1518 (0.0004)	28.6301 (0.0266)
MNG	0.9406 (0.0135)	1.1166 (0.3701)	7.5964 (0.0058)	16.6337 (0.4097)
UER	0.0009 (0.0396)	1.8123 (0.0979)	6.6421 (0.0100)	39.0673 (0.0011)
CC	0.0011 (0.2201)	2.0460 (0.0605)	5.3291 (0.0210)	32.5282 (0.0085)

Significance levels in brackets.

Summary and Concluding Remarks

In this study, both coincident and phase-shifting common cycles are examined regarding property and the economy. Common cycle analysis on its own is an extension of common trend analysis. Although they have remarkable similarities, common cycle analysis differs from common trend analysis in that the phase matters in the former. Therefore, analysis is more complicated, and sometimes rather difficult. Moreover, common cycles have been examined together with common trends in a cointegrated system where the series involved have a cointegration relationship. Therefore, the study covers the whole range of the dynamic analysis involving property.

Although common trends and cointegration are not the topics of this study, they were tested prior to the investigations of common cycles, as the latter will be dependent on the empirical results from the former. The findings of this part confirm that property has a long-run co-movement with most sectors in the economy, as well as a long-run attribute. When considered in the long-run, property and other sectors of the economy are likely driven by the same or relevant fundamentals and, consequently, they may not move far apart. Moreover, property is closely related to the real sector of the economy. In addition to that, property shares long-run common trends with indirect property investment, as claimed in several previous studies. Property is not a purely financial market investment, but rather, in the meantime, an investment in production, trading, work, and storage spaces and capacity. Consequently, property shares similarities and possibly the same fundamentals with the real sector in the economy.

There were a number of major findings with regard to common cycles – the main topic of this study. First, it was discovered that property largely fits into the business cycle and, in particular, has common cycles with the service and manufacturing sectors. Deliberation on the result suggests that property appears to share common cycles with its user markets. This is evident from the fact that there exist common cycle relationships between property and the service and manufacturing sectors (possibly with the whole production sector) – two out of the three major components of GDP – and that there is no such relationship between property and the construction sector. The result also reflects the construction of the JLW index – 80 percent of the constituents are in the service sector (49 percent offices and 31 percent retail), and 19 percent are in the industrial production sector.

Second, the magnitudes of cycles are of some interest. Cycles in the property market are larger than those in GDP and the service sector. This suggests that adjustments in the property market are more sluggish than those in the economy in general, and particularly in the service sector, which is the most liquid part of the economy. The explanation could be that the amount of available property cannot be increased or reduced quickly and easily, thereby inducing greater magnitudes in property cycles. That is, the demand side factors have the most, if not sole, influence on movements in the property market in the short to medium terms.

Moreover, because there are lags in property development and between starts and completions of construction projects, and because there sometimes are cases of bad timing in property development and supply in response to the demand, the supply side of property does not always help close the gap between the demand for and supply of property. Consequently, the supply side of property often exaggerates, rather than reduces, the cycles in the property market. Cycles in property and the manufacturing sector are about the same size. In theory, the manufacturing sector could adjust itself to the business cycle by adjusting the inventory levels, albeit in a less rigid way, and its fluctuations should be relatively moderate. Therefore, the result should be interpreted with caution, since only 19 percent of the JLW Index is industrial property.

Third, it has been confirmed that commercial and residential properties have close links with regard to common cycles. However, the size of cycles in property is smaller than that in housing prices, which could be attributed to the existence of an indirect investment market for commercial property, which in turn reduces the fluctuations in the direct property investment market.

This study has the following implications. First, the findings suggest that prediction of cycles in the property market could be improved by analyzing cycles in other related sectors, as property and the other sectors of the economy share common cycles. The advantages of a joint analysis of property and the economy are the use of more information from other sectors, and the recognition of the underlying mechanism driving cycles and common cycles. This practice may help mitigate the fluctuations and magnitudes of cycles in property.

Second, the development of an indirect investment vehicle may help smooth out fluctuations in a related sector, as the empirical findings have suggested with regard to the commercial and residential property markets. Although the commercial property market exhibits more significant cyclical behavior than most parts of the economy, it fluctuates less severely than the residential property market, due partly to the existence of an indirect investment market for commercial property. In the residential property sector, the situation is rather different. Although the mortgage market for residential property has evolved considerably over the last decade from a largely lending/borrowing business based on individual properties to one that chiefly invests in property portfolios (not so in the UK), it remains much less mature. Its role is even less significant, if one takes the number of residential property owners into consideration. Unlike commercial property, the general population participates more fully in the residential property market, so any improvements would have considerable impact.

This study has also shown that an estimation of common cycles is complicated in practice in the time domain. As a recommendation to future researchers on cycles and common cycles involving property, one might benefit from adopting some estimation methods in the frequency domain, or of spectral analysis. The frequency domain methods are powerful and effective in the study of cycles, and the concepts of cross-spectra and coherence are closely related to common cycles with lively presentation. However, there are disadvantages too. The frequency domain methods are not conventional in economic research; as a consequence, communication of results and findings might be difficult. Furthermore, the available estimation procedures are limited.

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