Medium-Term Cycles and Housing: Is Regional Integration Different?

Abstract

Drehmann *et al*. (2012) of the BIS lament the attention given to medium-term cycles. They highlight a financial cycle characterised by longer cycles in credit and property prices. Although the co-movement of regional residential property prices has been well-explored, they have not been examined in this range.

For the UK what is found is that, despite the ripple effect being more evident at the medium-term cycles, the degree of integration is greater than in the business range. Moreover, the segmentation of the UK is related to arcs. An Outer South, which surrounds London, is topped by the Midlands, with a less well integrated Northern grouping. Not only does this appear to reflect a monocentric system, but also implies that price *cycles* and price *leadership* could be related to price *levels*.

With differing price levels as a proxy for sensitivity to financial fluctuations, finance appears to be both promoting housing market integration and, with London, dissimilarity. Drehmann *et al*.'s call for the medium-term cycles to be made a policy focus is endorsed, but with the proviso that a London-centric view of the impact of credit liberalisation is important for national cohesion.

Introduction

Persistent medium-term cycles, beyond those associated with business cycles, have been neglected. This could be because their capture is not without some challenges and their spectrum is unclear. Comin & Gertler (2006) note that conventional business cycle filters tend to sweep longer oscillations into the trend. Drehmann *et al.* (2012) conclude that there is well-defined financial cycle that is best characterised by the co-movement of medium-term cycles in credit and property prices. As there is evidence that finance drives the synchronisation of national housing markets (Pomogajko & Voigtländer, 2012; Helbling & Terrones, 2003), which should apply to regions also, it raises the possibility that a financial channel may present a different map of housing market integration to traditional house price overspill models. These focus on labour market accommodation of spatial inequalities finding that the UK is segmented (Meen, 1999). This may not be the case for medium-term cycles, in part, because of the market dominance of several high street lenders whose commercial policies could affect all parts of the UK, concurrently.

The aim of this paper is to consider to what extent, by ignoring cycles in medium-term range, are we missing a bigger picture? Three issues concerning the nature of integration at the medium-term range are considered. First, it has been argued that the UK house price series is not representative of regional series (Drake, 1995; Cook & Watson 2016). Is it appropriate to use the UK as a benchmark for its regional system? London's significance to the UK makes it a candidate for a policy indicator. However, distinctive exposure to finance may make it unrepresentative of the UK market for policy purposes. The second concerns the delineation of sub-national groupings or clusters. Are similar regional clusters found across both cycle ranges? Is the UK more integrated in medium-term range? The third concerns the dynamic nature of house prices in the UK, the country most closely associated with the ripple effect. Is the ripple effect evident in the medium-term range?

The paper is structured as follows. First, there is a review of how housing and other cycles have been used in assessing extended market areas. Next, longer cycles are considered. The methods employed are discussed next. Euclidean distances can assess integration and form an element of Hierarchical Clustering. The data source, regional house prices from the Nationwide Building Society, is one commonly used by authors in the field. The results and conclusion complete the piece.

Housing Cycles and Market Integration

A number of papers estimate UK housing cycle periodicities to be in the business cycle range (eight years, with minor five and nine years; RICS, 1999: 7½ years; Gray, 2015: five to ten years; Gray, 2017: six to ten years; Alexander & Barrow, 1994: six to eight years; Rosenthal, 1986: and six and eight years; Wilson & Okunev, 1999). Market integration implies cycle similarity and synchronicity, so co-cyclicality is a marker of a cluster of regions. This co-cyclicality has been found using different methods in the business cycle range. For example, Pomogajko & Voigtländer (2012) find housing markets are integrated across OECD countries. Using factor analysis of the detrended series, they find a strong global (latent) factor during the two decades from 1990. Their explanations of such co-movement are based on monetary integration and similar interest rate movements.

Crone (2005), using *k*-means cluster analysis, allocates US States into regions based on similar business cycles. The cycles were extracted using Baxter-King filtered 18 month to 8-year business cycles. He sets about identifying groups of at least two States that minimise dissimilarity as assessed by squared Euclidean distances.

Longer Cycles and Finance

DiPasquale & Wheaton (1996) and Brühl & Lizieri (1994) argue that the forces acting on demand in a property market will be a function of the nature of the urban system and the industries it hosts. Storper & Walker (1989) maintain that industries produce regions, implying that regional performance is strongly influenced by industrial structure, and that agglomeration and industrial networks can define a region, which would be more evident over a longer horizon, consistent with Comin & Gertler's (2006) technological shocks thesis. Thirlwall's trade-based, core-periphery model projects that a peripheral region's growth rate will be constrained by the core (McCombie, 1988). As they are linked through trade, the periphery would have similar cycles to, but a lower income level than, the core, which has repercussions for house prices. Banks, using lending metrics based on equity and incomes, such as loan-to-income, fortify the price rise, acting as a financial accelerator (Aoki, 2004). Stein (1995) posits that, due to rising prices, existing owners in the market have enhanced equity in their property. Thus, price rises are pro-cyclical, favouring highly-geared, expensive regions (Smith & Tesarek, 1991).

A Leamer (2007) (Minsky) scenario suggests that the relaxation of these bank metrics can be seen in waves of financial liberalisation (Meen, 2011; Scanlon & Whitehead, 2011), which strongly magnifies the impact of the financial sector on the occurrence of booms (Agnello & Schuknecht, 2011). Aikman *et al*. (2015) find a 13-year periodicity in credit within a 130-year series of UK data: real loans or credit provision are pro-cyclical, with an amplitude twice that of the general business cycle, but a periodicity that is twice as long as the one for GDP. Moreover, they find a minor cycle of 4½-years in duration. Variations in GDP do not account much for perturbations in credit. Drehmann *et al.* (2012) consider the cyclical characteristics of credit, credit/GDP, house prices, equity prices, and GDP, across seven OECD countries, including the UK. They find that perturbations of between 8 and 30 years are more important than those of shorter periodicities in characterising the variables' behaviours.

There is evidence of medium-term cycles in property. Agnello & Schuknecht (2011) use a 15.7-year filter (Hodrick-Prescott λ = 10,000) to reveal an upward and a downward UK house price trend of seven years each. The long term undulations can be identified as 1983-1989, 1989-1996, 1996-2005, 2005+. Also taking a longer view, Bracke (2013) identifies 1989Q2 and 2007Q4 as peaks and 1996Q2 as a trough in UK house prices.

Using cluster analysis, Meller & Metiu (2017) show there is no global credit cycle, but groups of countries with similar cycles. Analysing credit data used by Aikman *et al.* (2015) over medium-range cycles (8-20 years), they find that in the 1973-2008 era, those countries with synchronised business cycles are more likely to have synchronised credit cycles. This highlights the possibility that, despite greater volatility, a stronger association exists between the regions, beyond the business cycle ranges, reflecting the role of finance.

Methods that examine co-movement in trend can also distinguish clusters. Applying principal component analysis to UK regional-national house price ratio data, Holmes & Grimes (2008) use the first factor to establish convergence to a stable price structure. They conclude that all UK regional house prices are driven by a single common stochastic trend and can be regarded as exhibiting strong convergence, suggesting a unified market in the long run. Having found no case of convergence, Cook (2003) goes on to use a momentum threshold autoregressive model to reveal asymmetry in region-nation house ratios. Outer South East, East Anglia and South West experience faster convergence during downswings but other regions, such as North, North West, West Midlands and Scotland exhibit faster rates in upswings.

Montagnoli & Nagayasu (2015) identify convergence clubs whilst Gray (2018) uses the number of cointegrating vectors as a measure of integration among regional series. Both identify a Northern club. The latter augments the Northern group with Midlands group whereas the former identify it as a convergence club in its own right. Both papers conclude that London has a distinctive trend. They differ over the structure of the south. The former find a south eastern outer ring plus Northern Ireland. The latter finds the southern regions do not have a common trend. Indeed, common trends are evident when south and midlands of England are combined. He adopts De Goei *et al*.'s (2010) view that the southern regional interaction is akin to a monocentric model with London as the centre, extending it to include the midlands.

Method

A time series X_t can be seen as comprising a growth or trend element g_t and a cyclical element x_t. Thus, $X_t = g_t + x_t$. This decomposition can be achieved using Hodrick-Prescott, Christiano-Fitzgerald and Baxter-King filters. A frequency domain filter, using a Fourier transform, would separate out components within a range of periodicities. Christiano & Fitzgerald (2003) propose a time-domain approximation to the frequency domain filter, using weights drawn from the power spectrum of the unfiltered series. This filter is selected not only because one can specify the frequency range but also Drehmann *et al.* use it. The range of cycles (8-30 years) used by Comin & Gertler (2006), may be too broad, capturing technological changes and distinct performance at longer horizons. Although Pomogajko & Voigtländer (2012) posit that financial cycles drive the synchronisation of national housing market, they apply a Hodrick-Prescott filter with a standard 1600 setting, which corresponds with cycles of up to 10 years. A filter setting of 15 years better focusses on the shorter end of the medium-term range capturing the credit cycle of Aikman, *et al*..

De Groot & Franses (2008), who illustrate how an economics series could be modelled by [a pair of] cycles, suggest that the longer cycle reflecting the lower frequency would obscure the impact of the higher frequency cycle. Assume that there are two cycles present in the reference and the regional cycles: a business cycle of 28 quarters and a financial cycle of 14 years. The 15-year filter is posited to extract a series reflecting both income and credit fluctuations. For the 15 [10]-year filtering, 60 [40] quarters is used as the upper and two quarters for the lower setting. From here-on the data from the 15-year filter will be referred to as *medium-term cycle*s, and from the 10, *business* cycles. As the business are incorporated into the medium-term cycles, common results imply that overlooking medium-term cycles does not affect inferences or policy implications.

These cycles are considered in three ways: for synchronicity, integration and clustering. At the heart of these three is the notion of similarity, particularly 'similarity in shape' (Aghabozorgi *et al.*, 2015), which encompasses synchronicity and similarity (Mink *et al*., 2012). The former focuses on cyclical alignment and the latter, on amplitude. Keogh & Kasetty (2003) point out that normalisation is essential for time series data as without it time series similarity has no meaning. Affecting amplitude, this can be achieved by applying the Z-standardised form of the series. Cook's (2003) results are indicative of dissimilarity in regional-cyclical shape. Similarity in time is a special case of similarity in shape. Dynamic time warping entails aligning the series with the time axis. Realignment in time against a common reference in a UK context reveals delays. Li (2014) identifies the extent of asynchronicity by realigning cyclical series, selecting p by minimising the Squared Euclidean distance relative to a reference series. In this case the UK, $D_{iUK} = \sum_m (x_{it} - x_{UKt+p})^2$ $i = 1 \ldots n$, $t = 1 \ldots m$, $p = 0, \pm 1, \pm 2, \pm 3$. An alternative to this is to maximise the value of the cross correlation function $\rho^p(x_{it}, x_{UKt+p})$.

Summed across all n regions, $\sum_n D_{iUK}$ is standardised by $100/mn$. This mean Squared Euclidean distance (MSED) proffers a value that can be interpreted as the degree of joint similarity between the regions and the reference of the UK. The smaller the total, the more representative the UK series is.

Replacing UK with region $j = 1 \ldots n$, $i \neq j$, the MSED entails D_{ij} summed across the $(n - 1)$ other regions and standardised by $100/m(n - 1)$. This proffers a value that can be interpreted and the degree of joint similarity between the other regions and the reference of region *j*. The smaller the total, the more representative region *j* is of the UK.

A logical extension of this is to consider the degree of integration across the *n* regions $D_N = \sum_i \sum_j D_{ij}$. This is standardised by 100/(n – 1)×(mn). Lagging region *i* by *p* affects the distances against n – 1 regions, so may improve the measure of integration of region *i* but may worsen it for region *j*. This can be assessed by phase adjustment and by cycle range.

Two common similarity measures, correlation and Euclidean distances, act in differing ways where there is more than one cycle in the series. The former rewards similarity whilst the latter penalises dissimilarity. If one cycle has a common effect on both the reference and the regional series, by definition it does not imply a contribution to dissimilarity, so will have no impact on the size of the Euclidean distances. Mink *et al*.'s (2012) similarity measure captures this difference in amplitude in a not dissimilar way. This is not the case for correlation: the greater the common element, the higher the correlation coefficient. Keogh & Kasetty's (2003) normalisation ensures that inferences from the Euclidean distances are similar to those from correlations. They find that, after phase realignment and normalisation, Euclidean distances are superior to the challenger *similarity* measures they consider.

The standardised D_{ij} between two common sinusoidal series would generate a value between 0 and 400, where 200 [400] implies 90° [180°] out of phase. The cycle and delay are related. A two period delay at a 28 and a four period at a 56 period cycle both generate a dissimilarity value of 19.75 and a correlation of 0.9 singly and when combined. The 15-year filter would capture both. A four [three] period delay at both cycles would generate a dissimilarity value of 47.96 [27.5] and a correlation of 0.76 [0.86]. Moreover, assuming four period delay at both cycles, the dissimilarity value converges on 19.75 [76] with greater amplitude of the 56 [28] period cycle. If the delays at business and medium-term cycles are *not* independent, that lag adjustment should be consistently greater at the 15 compared with the 10-year filtered series.

Clustering is the third use. Hierarchical cluster analysis provides classifications among a group of variables based upon [dis]similarity: it maximises variation between groups and minimises differences between variables within a group. The algorithm searches for pairings between individual regions, converting them into clusters. It then pairs up clusters. The process continues until there is only one cluster.

Agglomeration methods include Average Distance and Ward's method. Distances could be assessed by a Euclidean criterion. The Average Distance averages out the distances between the elements of the clusters. Ward's method entails minimising the squared error at each union of clusters.

Data

The regional data are drawn from the Nationwide Building Society's website for the period 1973Q4 to 2017Q2. This data set is quoted widely in academic papers, such as Cook & Watson (2016). As phase adjustments are applied, the effective data set covers 1974Q1 to 2016Q3.

Removing the cyclical elements using a 15 [10]-year filter setting, the extreme values in the UK house prices series of £10,567 [£10,071] and £189,296 [£199,134] occur at the beginning and end of the 42 years of the study. In Table 1, the ratio of the highest to the lowest price is 17.91 [19.77]. In other words, house prices grew in nominal terms just under eighteen [20] times.

Table 1 Price based on Trend

	EA	EM	LON	NI	NO	NW	OMET
Price(15y)	£194,334	£155,579	£416,973	£140,877	£129,166	£151,365	£315,635
High(10y)	£206,837	£165,932	£444,146	£158,707	£128,430	£150,154	£334,852
Price(15y)	£10,379	£9,260	£13,265	£10,012	£8,715	£8,931	£13,358
Low(10y)	£10,079	£8,766	£13,194	£9,300	£8,066	£8,129	£13,155
Growth(15y)	18.72	16.80	31.44	14.07	14.82	16.95	23.63
Rate(10y)	20.52	18.93	33.66	17.07	15.92	18.47	25.45
FTBHPER	5.28	4.43	10.33	3.84	3.40	3.86	7.19
	OSE	SC	SW	WA	WM	YH	UK
Price	£240,708	£146,454	£211,359	£149,117	£162,060	£149,642	£189,296
High	£255,426	£143,513	£223,881	£145,996	£171,769	£147,450	£199,134
Price	£11,194	£10,455	£10,421	£10,066	£10,312	£10,688	£10,567
Low	£10,959	£9,804	£10,026	£9,365	£9,582	£9,989	£10,071
Growth	21.50	14.01	20.28	14.81	15.72	14.00	17.91
rate	23.31	14.64	22.33	15.59	17.93	14.76	19.77
FTBHPER	6.09	3.34	5.98	4.05	4.64	3.75	5.31

EA=East Anglia, EM=East Midlands, LON=Central London, NI=Northern Ireland, NO=North, NW=North West, OMET=Outer Metropolitan London, OSE= Outer South East, SC=Scotland, SW=South West, WA=Wales, WM=West Midlands, YH=Yorkshire-Humberside, UK=United Kingdom.
Upper value 15-year filter, Lower value 10-year filter
FTBHPER= House price Earnings ratio for First Time Buyers in 2016
Source: Nationwide Building Society

In Table 2, there is UK house price volatility as assessed by standard deviation. The 15-year filtered series (0.084) is significantly more volatile than the 10-year one (0.057), just as with the regions. The smallest volatility measure is to be found in Scotland. The greatest volatility in the UK, found in Northern Ireland, resulted in part from its strong link to the Eire market and the property bubble there. After this, the more volatile regions are somewhat of a mixed bag. London, Outer South East and East Anglia have relatively high standard deviations [over 0.073] at business cycles but Outer South East has a relatively low value at medium-term cycles.

Table 2 Cyclical Volatility

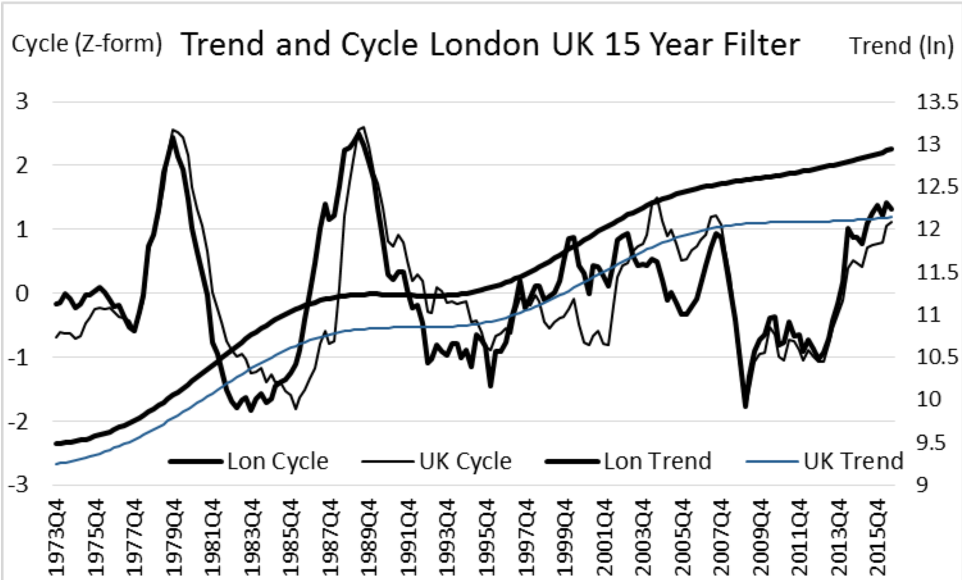
Region	Std. Deviation		Correlation with UK	
	10y	15y	10y	15y
UK	.057	.084		
LON	.073	.102	.883	.822(-1)
OMET	.066	.093	.908	.88(-1)
OSE	.074	.097	.932	.921(-1)
EA	.078	.101	.895	.924(-1)
SW	.066	.093	.94	.96
EM	.067	.100	.936	.962
WM	.065	.106	.938	.961
YH	.067	.101	.874	.9(1)
WA	.064	.100	.876	.892(1)
NW	.058	.111	.796(1)	.858(2)
NO	.058	.104	.621(1)	.756(3)
SC	.041	.069	.571(1)	.64(3)
NI	.086	.121	.433	.413

* sig at the 5% level ** sig and the 1% level
(-1) lead by one period

For the sake of ease, it is taken that a when a region is mentioned that is a reference to the house prices in that region. The cross-correlations at the business cycles show that most regions are synchronised with the UK reference series. The correlation coefficients indicate that the markets of North, Scotland and North West are out of synchronisation with the other regions' by one quarter. After phase adjustment, prices in Scotland and Northern Ireland remain notably less attuned to the references' relative to other regions.

The 15-year filter exposes a higher order of misalignment. The correlation coefficients indicate a greater lag for the price movements in North, Scotland and North West compared with the business cycle. In addition, Wales and Yorkshire-Humberside lag the UK by one quarter. London, Outer Metropolitan, Outer South East and East Anglia lead the UK. Price movements in the South West and the midlands remain aligned in the same way. Indeed, when arranged by distance from London, the delays are also in order, so corresponding with the so-called ripple effect in UK housing, implying the ripple effect is more a medium-term than a business cycle phenomenon. Figure 1 highlights the dissimilarities between London and the UK's trends and cycles.

Figure 1 Trends and Cycles of London and the UK



Squared Euclidean Distances

Concentrating on the business cycle results, as reported in Table 3, the baseline standardised value of D_M (SMSED for ALL) of 70.5 is improved if the three northern regions are shifted forward by one quarter (67.9). Switching to the 15-year filter, the values of 66.9 and 57.6 also show the benefit of realignment. Overall, the measures of dissimilarity are smaller with the lag [un]adjusted 15-year filter compared with the 10, implying the regional system is more integrated if viewed using medium-term cycles.

When the UK is the reference and the regions are lag-adjusted, at the 15-year filter, the SMSED is 31.5. This is lower than the unadjusted SMSED (35.5) and an improvement over the 10 (36.7). As with averaging across all pairs of regions, using the UK as a reference, points to greater integration at the longer cycle. The values that the UK SMSEDs comprises are presented in Table 3, columns 3, 4, 7 and 8, omitting those than do not change. One key inference is how distinctive Northern Ireland appears. It is in-phase with the UK but, by the indices used here, it does not appear integrated much at all.

The lowest SMSED-values in columns 1, 2, 5 and 6 are found in the West Midlands, whereas London, Scotland and the North are the least integrated, even after lag adjustment. Importantly, some SMSEDs for London, OMET and OSE *increase* when shifting from the 10 to the 15-year filter. London, OMET, Scotland, Northern Ireland and the North SMSED values (columns 1 and 2) are all above the mean for the UK, indicating that they have distinctive profiles beyond that related to phase. If they were omitted from the regional set, the UK would appear more integrated. At the shorter cycles, this applies to Scotland, the North and Northern Ireland.

Table 3 Standardised Mean SEDs: 15 and 10-year Filters

Region	Mean Region 15		UK 15-year filter		Mean Region 10		UK 10-year filter		Mean LON Adj	
	Unadj (1)	Adjust (2)	Unadj (3)	Adjust (4)	Unadj (5)	Adjust (6)	Unadj (7)	Adjust (8)	15y (9)	10y (10)
MEAN	66.9	57.6	35.5	31.5	70.5	67.9	37.5	36.7		
LON	86.2	73.6	41.2	35.5	66.5	66.1	23.3		0.0	0.0
OMET	73.2	60.1	28.0	23.3	63.0	61.5	18.2		6.1	9.1
OSE	61.5	48.6	17.7	15.1	58.1	54.9	13.5		15.2	16.7
EA	58.2	44.9	16.3	14.4	64.7	61.2	20.8		28.0	28.6
SW	49.7	40.9	8.0		55.7	52.2	11.9		28.6	29.2
EM	43.6	36.2	7.5		50.5	47.8	12.9		57.1	57.1
WM	43.1	36.0	7.8		49.8	47.4	12.4		59.2	54.0
YH	47.9	41.5	19.9	19.1	55.3	54.2	25.1		85.8	79.0
WA	49.2	42.5	22.0	20.5	54.4	52.9	24.7		90.9	76.3
NW	60.9	47.1	37.0	26.9	70.0	63.0	45.7	40.5	95.6	95.1
NO	72.3	59.6	53.9	46.0	93.6	87.8	79.7	75.4	114.3	137.3
SC	94.9	77.1	83.9	67.1	101.3	96.8	87.0	85.1	149.8	125.0
NI	129.0	140.8	118.2		133.7	136.5	113.0		152.6	86.4

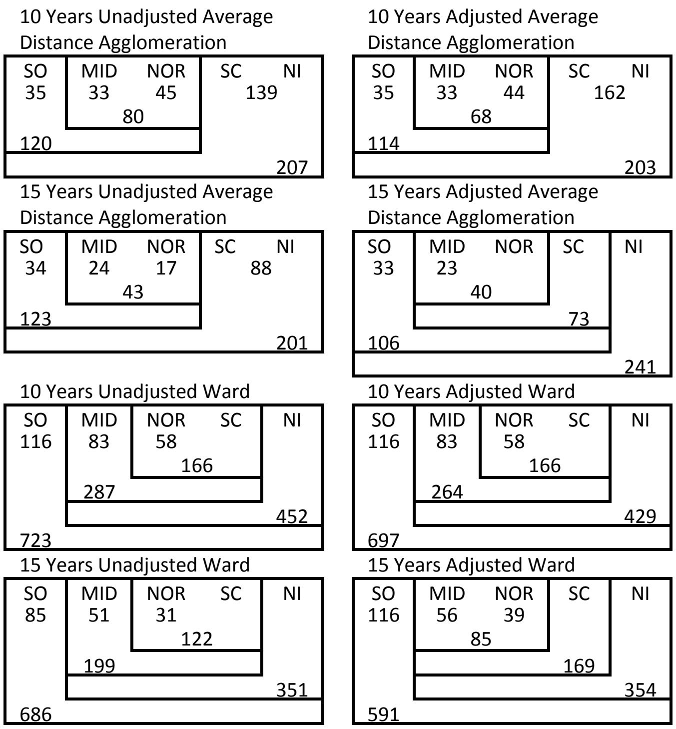
Medium Cycles = 15y Filtered using the CF 2-60 quarters criterion
Business Cycles = 10y Filtered using the CF 2-40 quarters criterion
Adjusted by the lags indicated in Table 2

Regional Clusters

The 10 and 15-year cyclical series are tested for clusters. Eight sets of clusters results are drawn to reflect Average Distance and Ward agglomeration methods, business and medium-term cycles, and phase adjustments. Table 4 reports the Agglomeration Schedule in a variant of a dendrogram, arranging the presentation into regional clusters. Mindful that clustering can result in structures that are at odds with any theoretical explanation, it is reassuring that the agglomeration methods pair up contiguous region in almost every case. The key exception is YH-Wales. Moving from pairings to clusters is again consistent with theoretical groupings. There are robust clusters of the south and the midlands. The north is more fluid. After some iterations, the following standard patterns emerged. A contiguous set in the South can be split: Inner South (LON OMET) and Outer South (OSE SW EA). There is central (EM WM) and a dislocated Midlands (YH WA). These form a contiguous Midlands arc around the South. There is also the Northern group (NO NW) plus two other regions (NI & SC). With the Ward-based agglomeration, Northern is commonly merged with Scotland creating an extended periphery. A key feature is the last aggregation entails the south merging with the rest, highlighting a clear distinction between the north and south of the UK. With Average Distance agglomeration, the schism is between a south and midlands against a Celtic fringe periphery: England and Wales are relatively well-integrated.

The results show that lagging raises the measure of integration, but interestingly, in the case of the Ward criteria, which penalises inter-cluster differences more harshly, does not change the clusters that emerge. With Average Distance, the phase adjustment alters how Northern Ireland agglomerates, revealing it as isolated at the 15-year cycle. Nevertheless, regional cluster agglomeration coefficients are also reasonably stable in the face of phase adjustment and cycle range.

Table 4: Agglomeration Schedule, with Coefficients



(So)uth (LON OMET & OSE SW EA). (Mid)lands = (YH WA EM WM & NW), (Nor)thern = (NO NW)
Values are agglomeration coefficients

Taking Table 4 as the guide, Standardised MSEDs for the super-regions are generated. Table 5 shows Inner South's greater index of integration at medium-term cycles (column 3 vs. 1). The most integrated cluster (least dissimilarity) is Outer South (columns 1 and 3). Using larger groupings with similar SMSEDs, at the 10-year, one can identify a South and a Midlands; at the 15, a South and an extended Midlands that includes Northern.

Table 5 Dissimilarities within Clusters

Super Regions	10-year SMSED Unadj (1)	10-year SMSED Lag Adj (2)	15-year SMSED Unadj (3)	15-year SMSED Lag Adj (4)
Inner South	9.1		6.0	6.1
Outer South	6.7		5.7	8.1
Inner & Outer South	15.3		14.2	14.5
Midlands	16.1		10.9	10.0
Northern	26.3	26.0	9.9	13.5
Midlands & Northern	33.2	29.5	18.4	15.5
All bar NI SC	50.2	47.1	47.0	35.8

Inner South = (LON OMET) Outer South = (OSE SW EA) Midlands = (YH WA EM WM) Northern = (NO NW)

Reference Cycle for the UK

The values in Table 3 for the UK indicate that it is more similar to the regions as a whole than any alternative candidate, both with and without lag adjustment. London, as an alternative reference, becomes decreasingly illustrative of the other regions as one shifts focus from the business to medium-term cycle and as one moves away from the south east of England.

In Table 2, correlations decline with distance from the East Midlands. This is replicated with increases in SMSEDs in column 3 of Table 3. That said, using each region as a reference, its neighbour, the West Midlands, has the second lowest SMSEDs in columns 1 and 2. They are much lower than London's but above UK's. What emerges is that, even after adjusting for asynchronicity, the degree of cyclical dissimilarity is related to distance, as assessed from London (column 9) and the East and West Midlands (columns 2 and 4): one could misdiagnose cycle dissimilarity as reflecting asynchronicity (Gray, 2017).

Cohesion

With the notable exceptions of NI's and London's, dissimilarly values in Table 3 in the medium-term range (column 2) are lower than at the business cycle's (6), pointing to housing market integration being driven by finance, as Pomogajko & Voigtländer (2012) argue, but in the narrower range of cycles than Meller & Metiu (2017) and Drehmann *et al.* (2012) explore.

Mainstream ripple explanations of commuting and arbitrage predict co-movement between neighbouring regions. The pairings and key clusters that emerge comprise contiguous regions but where they do not is instructive. The South West is contiguous with Wales but not with East Anglia yet has a closer association with the latter, a similarly-average priced region. The East Midlands is contiguous with OSE and East Anglia but again is more closely associated with Wales. The West Midlands is more closely linked to Yorkshire-Humberside than OSE. Importantly, these results are robust against lag adjustment and cycle range.

The Midlands cluster forms an arc around Outer South, which itself arcs around the core or the Inner South. Northern is a distance beyond Midlands. From Table 1, the descending order of average price is Inner South; Outer South; Midlands; and Northern. This constellation resembles a monocentric urban structure, with those regions equidistant from the centre having a similar price level.

Although the asynchronisation is greater at the medium-term cycles, the structure of the delays does not indicate a different set of forces at work. Consistent with Meller & Metiu (2017), what emerges at business cycles is a reflection of medium-term cycle relations; the ripple effect, though is evident at the medium rather than the business cycles.

It is interesting that there are similarities between these clusters using cycles and the ones specifically using long term perspectives. Montagnoli & Nagayasu (2015) and Gray (2018) find a Northern club (NW NO SC YH), which is extended (WA WM EM) to provide some notable overlap with the cycle-based clusters. The southern group has to be extended into the midlands by the latter to identify an Augmented Southern (OMET OSE SW EA WM EM) group. The former puts Northern Ireland in a South East group (SE SW EA NI). The contrast here is that the south appears to more coherent in terms of cycle than trend. The north is the reverse. The midlands appear to be a bellwether of national house price activity and a conduit of price information, whilst London is distinctive.

Turning to *Housing Market*, Table 29, from the Office for National Statistics for all buyers in England and Wales or the First Time Buyer Affordability or House Price Earnings Indices of the Nationwide (Table 1, FTBHPER for 2016), relative regional house price levels correspond with loans-to-income/affordability of mortgage payments. So, through lending metrics, the arcs have similar sensitivities to income and financial cycles. Thus, it is posited that similar price *cycles* and price response/ *leadership* could be related to price *levels*. Higher price levels are supported by the anticipation of further increases in credit and asset prices (Allen & Gale, 2000; DiPasquale & Wheaton, 1996; Lee *et al*., 2015), which, in a Thirlwallian core-periphery context, will favour London, spilling over to the south of England (De Goei *et al*., 2010). The greater dissimilarity in the longer cycle range for the south eastern regions is consistent with this thesis.

If national interest rate policy is focused on short term house price inflation, this will be skewed by the leading region, London and its cycle. London has four interwoven factors that make it distinct. First, London operates at the core of the UK regional system, so it could be argued that it should influence the growth of other regions as personified by the ripple effect, instigating change. Second, linking Thirlwall with Stein, potentially higher income growth would favour a relatively highly-geared property market, more exposed to the financial accelerator.

Third, London's property is integrated into the world of portfolio investment (Abbott & De Vita, 2012; Fernandez *et al.*, 2016). Fourth, it has by far the most prominent financial sector of any region and is integrated into a global capital market, rendering it distinctly exposed to a financial cycle, and a conduit between global finance and the UK regions (Holly *et al*., 2011).

A Leamer-Minsky financial cycle is based on a relaxation of prudent lending criteria. Lending multiples are more likely to be binding on loans in the high-priced regions of the south. In the face of inadequate construction, a prolonged period of relaxation would accelerate London's price *trend* more than others, but importantly dislocate the high-priced south from the north, as has been chronicled in the past (Hamnett, 1988). Moreover, with an integrated banking network, one could envisage commercial decisions about mortgage lending criteria in a buoyant London market spilling-over to other regions. With delayed responses to these common shocks, the ripple could be a reflection of this relaxation.

Given its distinctive cyclic character and that is out of phase with the following regions, seeking to moderate the atypical cycle in London could destabilise a housing market elsewhere. That said, a solely UK focus could miss the early warnings in London.

Conclusion

This paper considers the co-movement of regional residential property prices using medium-term cycles, a range in which they have not been examined before, using Euclidean distances in novel as well as established approaches. In the process, the ripple effect, super-regions and the reference series are explored.

It is argued that business cycles are likely to reflect medium-term cycle relations, so the concern that there was a set of unobserved distinct interactions (Drehmann *et al*. 2012) is not supported. That said, the ripple effect is more apparent in the medium-term than in the business cycle range. When using the Hodrick-Prescott filter and quarterly data, the standard setting would provide regional cyclical components that only partly expose the extent of the asynchronisation.

Despite the apparent greater cyclical asynchronicity, the UK appears more integrated when assessed using medium-term cycles. In both cycle ranges an Inner and Outer South a Midlands, and a Northern group emerges, reflecting other work in the field that emphasises trend. Reassuringly, the Euclidean distance-based agglomeration methods pair-up contiguous regions. Moreover, the UK clusters form concentric arcs around London. As, after lag-adjustment, the approach combines those of similar ‘cyclic shapes’, the ripple effect does not reflect a single, but asynchronised, UK cycle.

It is posited that affordability and the financial accelerator interact to make the price dynamics more responsive to finance the higher the price level: the gearing ratio reflects the price response to a financial cycle. Price *cycles* and price *leadership* could be related to price *levels*. With differing price levels as a proxy for sensitivity to financial fluctuations, it is posited that the monocentric urban model provides a framework for envisioning regional housing clusters.

Finance appears to be both promoting housing market integration and dissimilarity. It is averred that the finance channel provides a means of explaining a ripple emanating from London and the structure of housing market clusters. The UK and London considered as alternative reference series for the regional set. Despite the segmentation, the UK series, as the regional system reference, is preferred. That notwithstanding, Drehmann *et al*.'s call for medium-term cycles to be made a policy focus is endorsed. The Bank of England has added lending multiples to its regulatory armoury, recently. To prevent unrealistic expectations about future credit expansion influencing investment decisions and to forestall growing regional dissimilarities, the divisions between the UK and London trends *and* cycles could be used to proffer forward guidance of lending multiples managed actively.

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