



Research article

Medium-term cycles in affordability: what does the house price to income ratio indicate?

David Gray*

Accountancy Finance and Economics, Lincoln International Business School, University of Lincoln, Lincoln, UK

* **Correspondence:** Email: dgray@lincoln.ac.uk.

Abstract: Using the Christiano-Fitzgerald filter to extract business and medium-term cycles, this paper considers house price, gross domestic product per head and the ratio of the two for the UK over 1955–2020. It shown that, although the synchronisation of business and medium-term cycles is associated with the largest price and ratio events, there a shift of volatility from the former to the latter cycle range, which begins in the 1980s. The medium-term cycles are closely aligned. Indeed, the phase-leading role of income over the others is at odds with current stabilisation policy thinking. The trend in income growth is steady but then, around 2002 peters into a stagnant period. The trend in the house price-income ratio is remarkably stable, but in the era of finance liberalisation, that stability is disrupted both in trend and cycle. This appears to be altered by the adjustment to greater financial accessibility. In effect, this trend traces the amount of debt that an agent’s income is expected to service when purchasing a dwelling, or the real interest rate. Any return to the “normal” cost of capital could have a severe impact on borrowers.

Keywords: Christiano-Fitzgerald filter; business and medium-term cycles; housing booms and busts; house price income ratio

JEL Codes: E32, R21, E51

1. Introduction

Medium-term cycles, those beyond with business cycles, have been neglected. It is common to filter out the cycles beyond the business range and ascribe them to the trend. Comin & Gertler (2006) posit that medium-frequency oscillations may be intimately related to business cycles and that business cycles may be a more persistent phenomena than conventional measures suggest. Borio (2014) argues that financial cycles are found among medium frequencies, which, through property, would affect business cycles.

Leamer (2007, 2015) argues that housing cycles *are* business cycles [in the US]. Building dwellings generates employment in construction, with consequent Keynesian income and supply chain expenditure growth. Through stable lending metrics, growing income would underwrite price growth. Thus, the interaction that Leamer implies is that house prices would influence, and be influenced by, this income. However, Leamer also sees property finance for purchase or building has longer cycles over which there are booms and busts, with corresponding regulatory scrutiny. An implication of these two positions is that cycles could be found in both the business and medium-term ranges, reflecting both real and financial economies in both incomes and housing. Their interaction is both formal through a ratio of housing affordability, but also through their mutual determination and dependence on income.

The aim of the paper is to assess the relative contributions of business and medium-term cycles to associated housing “booms and busts” in the house price-income ratio (here-on known as HPYR). To consider the role of medium-term cycles and the interplay with business cycles, real house prices, GDP per head and their ratio, the HPYR, are decomposed into three ranges using a Christiano & Fitzgerald filter. The medium-term cycle for affordability in this latter measure has not been considered previously. By implications, the analysis of trend in affordability beyond this is also novel.

The paper is structured as follows. First, there is a discussion of perspectives and estimates of financial and business cycles. Next, there is a review of how booms and bubbles are considered in the literature. This is followed by a discussion of house pricing, expectations money and interest rates. Data used and the method of trend extraction is considered next. The results cover the growth of prices and incomes over the six decades. Then extracted cyclical fluctuations with a maximum periodicity of 20-years for the three are explored. The 20-year cycle is decomposed into smoothed, which combines business and financial-credit ranges, and the residual, erratics. Synchronicity and variance is assessed over the decomposition. The revealed trends in affordability over the long terms are then considered. Conclusions and recommendations complete the paper.

A motivation for this analysis is combining two issues. The HPYR’s dynamics are used as a forward indicator of a crisis (IMF, 2019). Drehmann et al. (2012) (here on known as DBT) and Borio (2014) are concern about an unfinished recession, missed because of overlooking medium-term, which can mislead policy makers about potential economic crises associated with housing. Does the IMF’s indicator depend on the range of frequencies analysed? Additionally, of interest is whether the removal of a medium-term cycle from the trend component reveals anything about a long-term change in the financing of housing, perhaps related to financial liberalisation.

2. Perspectives on cycles

Pyhrr et al. (1999) review a large body of literature on real estate markets, and conclude that “the real estate literature supports the theory that real estate markets are cyclical”. A cycle [in property] is a recurrent but irregular fluctuation in a price or return. There are competing views on this periodicity.

Using a Hodrick-Prescott (H-P) filter with a 10,000 setting, Agnello & Schuknecht (2011) reveal an upward and a downward UK house price trend of an average seven years each (1983–1989, 1989–1996, 1996–2005, 2005+), suggesting a 14-year cycle. Bracke (2013) identifies 1980Q3, 1989Q2 and 2007Q4 as peaks and 1982Q2 and 1996Q2 as troughs in UK house prices. Pitros & Arayici (2017) when directly analysing house price-earnings ratios see upswings including 1985–1989 and 1999–2007, and the downswings comprise 1990–1996, 2008–2009 and 2011–2012. Upswings tend to last for seven years whereas downswings have a 5½-year duration on average, which are similar to prices. They find that the cycles are lengthening.

Price and quantity supplied should be linked. Using spectral analysis, Barras & Ferguson (1985) find a major and a minor cycle for almost all the UK property construction series they examine. They find a short cycles of 3¾ years, and a major one twice that in private housing orders, and a 5¼ one in completions. Jadevicius & Huston (2017) reveal one of eight whilst Barras (2005) also mentions 20 and 50 years in commercial property. The Royal Institute of Chartered Surveyors (1999) find cycles in UK property of five and nine years (RICS, 1999). Given Leamer's (2007, 2015) arguments, these should have corresponding income undulations.

House price undulations should reflect the funding of house property purchasing; income and finance dynamics. DBT (2012) combine property and credit as a proxy for financial cycles, concluding that the financial and business cycles are different phenomena, and that when they interact, it is more likely that there is a financial crisis. A typical financial cycle has a lower frequency than a traditional business cycle, possibly for the UK at around 13 to 18 years (Aikman et al., 2015) (here-on known as AHN). This financial cycle is pro-cyclical, with an amplitude four to five times that of the general business cycle, as proxied by real GDP. Borio (2014) argues that the price cycle is not a constant of nature, dependent as it is on policy regimes. He claims an 11-year cycle before 1998 was extended to nearly 20 years after, with an average of 16 years.

Business cycles are taken to reflect income. Calderon & Fuentes (2014) identify a 7½-year cycle in UK GDP. Using spectral analysis, Levy & Dezhbakhsh (2003) show single peak at around 6 to 8 years. Also using the frequency domain, Gray (2017) finds UK nominal GDP has cycles around 10 and 5.45-year in duration. The peak in the nominal house price spectrum occurs at the 7½ with a minor peak at the 15-year cycle and a further small, but important one at 5.45 years. The business cycle in the financial deregulated post-1985 era, is extended to 10 years. Hiebert et al. (2018) find that average amplitude of variation in financial variables in EU countries has been around twice that of economic activity. Their work reveals an average duration of financial cycles is 11½-years, proxied by house price and credit growth, which exceeds that of business cycles, proxied by GDP growth, by more than 60%. Here, they use turning point analysis.

Volatility in different eras has changed. Iacoviello & Pavan (2013) compare the US housing market during the great moderation of the deregulation era and the great recession following 2007. Using a H-P filter, they reveal that real GDP, consumption, housing investment (construction) and debt all exhibit a fall in the degree of cyclicity in the period 1983–2010 compared with 1952–1982. In effect, their work captures the spirit of the period with declining volatility. The divide reflects differing eras of financial constraints and borrowing. So, one possibility is that lower downpayments should smooth housing demand. They find that when credit constraints are relaxed, aggregate volatility is reduced but idiosyncratic volatility rises.

The emphasis on housing as the driver is contentious. Jones et al. (2004) see that oil price shocks as the key driver of business cycles and find a stable oil price-GDP relationship over the entire

post-World War II period. Indeed, the post-1996 periods still yields movements of GDP that are largely attributable to the oil price shocks. Summers (2005) finds that the Great Moderation has been a common feature in much of the industrialized world. GDP volatility fell by about half in all of the G7 countries and Australia. However, as the timing of the decline in GDP volatility was not synchronized, it casts doubt on the idea that common global shocks, such as oil price shocks, played a primary role.

3. Defining bubbles or booms

Given the fluctuations in both income and price, it is the relationship between the two that is the focus. The IMF (2019) discusses the downside to house price movements (declines). They feature financial conditions development in households' real income, credit-to-GDP and house price to GDP/capita. The price-to-GDP/capita ratio captures the degree of deviation from "fundamental valuation" levels. It suggests HPYR has a stronger negative relationship with future house prices than median price level or high house price growth. Overvaluation (house price misalignment) is proxied by a one-standard-deviation increase in the HPYR, which appears consistently and significantly related to higher downside risks to house prices over time. This is because it likely signals a correction in house prices of between 0.5 and 1.0 percentage point in advanced economies within three quarters.

Rather than affordability, Lind (2009) and Zhou & Sornette (2006) emphasise growth rate in price as a bubble marker. The latter pair's, which covers 1993–2005, reveals a bubble in UK housing and ones in 22 US states. Agnello & Schuknecht (2011) define a boom as a notable current price deviation from long term trend. Notable is defined as a 10% deviation.

4. Returning to trend

A standard long run analysis technique is cointegration. It reveals stable relationships over an extended period, capturing mean reversion, which one would expect a stable house price-earnings ratio (HPER) would reflect. Malpezzi (1999) estimates an error correction model (ECM) for house prices and income in US Metropolitan areas, suggesting a HPER persists over the long run.

Rather than a stable relationship, Hu & Oxley (2018) find strong evidence of explosive behaviour among a majority of US States' HPERs. André et al. (2014) reveal that housing price-to-income and price-to-rent ratios, although fluctuating around stable levels over a 40-year period, in 16 OECD countries, are generally not found to be mean-reverting. The coefficient is, in most cases, significantly higher than unity. Gallin (2006) finds that there is little evidence for the cointegration of house prices and various fundamentals, including income at the national and local levels. Work by Zhang et al. (2016) with the logarithms of real house prices point to trend stationarity with structural breaks, so no cointegrated with income. Indeed, investigating European countries over the period 1970 to 2004, Ganoulis & Giuliadori (2011), using an ECM, find a certain "de-linking" of short-term house price dynamics from income. They split their sample at 1990, suggesting financial liberalisation changed the short run relations. So, there is some evidence to suggest the trend in prices deviated from the trend in incomes in some countries, possibly due to the deregulation of finance.

5. Methods

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. A multi-cyclical perspective envisages a price series as characterised by a range of cycles. At any given periodicity, the more important of these, the greater the deviation from trend (or amplitude). This is volatility can be assessed by standard deviation.

Using the Christiano & Fitzgerald filter, Borio, AHN (2015) and DBT (2012) define medium-term cycles as those of longer than eight years, with AHN (2015) setting the upper bound at 20 years. Anything beyond 20-years is defined as trend. Iacoviello & Pavan (2013) are among many that use the Hodrick-Prescott (H-P) filter with a 1600 setting and quarterly data, which captures up to ten-year cycles (Harvey & Trimbur, 2008) and which are taken to be in the business range. Thus, the two views of the business range are not comparable. In accord with H-P based work, such as Iacoviello & Pavan, *business cycles* are presumed to fall in the range, 2-to-10 years (8 to 40 quarters). This means it inflates the business relative to the financial cycle compared with AHN (2015) and DBT (2012). Filtered data in the 10-20-year medium-term range be referred to as the *financial-credit* cycle. The *Smoothed series* combines the two, covering two to 20-year periodicities. The distinction between a Christiano & Fitzgerald filtered full series and the Smoothed series are the one-off shocks, shorter cycles and seasonal effects, or erratics, which turn out to be unimportant.

As a means of revealing the dominant periodicity from a range, Gray (2018) utilises autocorrelations of filtered series. If x_{it} is a sinusoidal series, its autocorrelations will follow a cosine function. As such $r(x_{it} x_{it-p}) = 0$ at one quarter of a cycle. Where $ACF(p) > 0$ but $ACF(p + 1) < 0$, p is an indicator of $\frac{1}{4}$ of the periodicity. With quarterly data, this value would be the length of the cycle in years.

Time series analysis of comovement is beset by problems of noise, amplitude, delays, discontinuities, and temporal drift. Mink et al. (2012) propose two simple co-cyclical measures: *synchronisation* of cycles, where the periodicities of the series are considered; and *similarity*, where the “shape” of the cyclical component is assessed. Here, the former is assessed by Gray (2018) by converting the filtered variable x_{it} . It is indexed where $I(x_{it}) = 1$ if $x_{it} > 0$ and -1 otherwise, so that $I(x_{it})$ is binary. Meller & Metiu (2017) use this divide, whereas Mink et al. (2012) transform a cycle into values above 0 as $+1$ and those below 0. All three take slightly different approaches to pairwise synchronisation analysis. The approach here entails Cohen’s Kappa (κ), which assesses the proportion of agreement between (x_{it}) and (x_{jt}) *over and above* chance agreement. It is interpreted like a correlation coefficient and becomes very similar to Kendall’s tau-b. By benchmarking each series against the smoothed [income]series, there is a test of agreement of order (synchronicity) [with income]: the average number of coincidences of these “phases” gives synchronicity measure between 1 and -1 . One implies perfectly in phase; -1 perfectly out of phase; and 0 they are orthogonal. Moreover, as the synchronicity will depend on phase alignment, the series are considered for misalignment by selecting the highest Kappa in the $\kappa(I_{it} I_{jt+k})$, $k = 0$ to $+3$.

Miles (2015) finds divergence in US regional house price cycles until the peak of the 2001–2005 bubble, which he argues, is a lot of local bubbles that coalesce into one large one. Using this idea but relating it to the alignment of business and financial-credit cycles, the data is split into two, separating out the bubble period where HPYR deviate more than one standard deviation from the trend line.

6. Data

The UK house price data are drawn from the Nationwide Building Society's web site. This data is for all housing from 1955. Average house prices are mix adjusted and based on loan approval data. Gross domestic product per capita (IHXT) is supplied by Office for National Statistics (ONS). The data is seasonally adjusted at current prices. The house prices and GDP are deflated by the Retail Price Index. Again, this is taken from the ONS. The HPYR is one value divided by the other.

A comparison with other studies suggests that there are similarities in approach but key differences. Pitros & Arayici (2017) use real UK house prices data drawn from the Nationwide statistics converted to annual figures. The HPERs are taken from the Halifax Bank, dividing their house prices by ONS average earnings for male full-time employees from the annual survey of hours and earnings at April each year. Subsequent quarters are estimated using the national average weekly earnings (series KAI7) across 1983–2014. Gregoriou et al. (2014) uses the same Halifax data but for regions across 1983–2009. The Nationwide's HPER uses mean gross earnings for each region as the others, but the quarterly earnings are calculated using straight line interpolation. Affordability studies face a common limitation, not reflecting the income of the actual buyers.

The ONS generates something different. It divides median house prices by median earnings. As with the others the earnings do not reflect the buyers' but all earnings. Values for 1997 (3.55), 2004 (6.53), and 2019 (7.7) are in line with the HPYRs of 4.39, 6.54 and 6.48.

7. Results

In 1955, the average house prices series of £1907 was five times the £376 GDP per head. A ratio increases with a positive [negative] change in the numerator [denominator]. A change in the HPYR can be disaggregated into changes reflecting house prices and into earnings. Using $\frac{HP_1}{Y_1} - \frac{HP_0}{Y_0} = \frac{HP_0}{Y_1} \left(\frac{HP_1}{HP_0} - \frac{Y_1}{Y_0} \right)$ there is a breakdown of decade changes from 1955 to 2015 in terms of differences in growth rates in Table 1. The HPYR for 1965 is 4.87, 0.2 income points lower than in 1955. This reflects an annualised 5.62% increase in median house price, which is off-set by a 6.04% annual rise in income over the decade. Prices rise by 3.07% per year so affordability was likely to be improving. Gregoriou et al.'s (2014) dislocation between income and price can be seen in prices growing 4 times the rate of incomes over 1995–2005 and the HPYR over two incomes point higher than 20 years previously. Also, stagnant real incomes are evident from 2005–2015 with inflation outstripping nominal income growth.

Table 1. Disaggregating decade change.

	Price £	GDP/C £	HPYR	Growth HP %	Growth Y%	Inflation %
1955	1907	376	5.07			
1965	3295	676	4.87	5.62	6.04	3.07
1975	10575	2046	5.17	12.37	11.71	8.84
1985	33654	7326	4.59	12.27	13.60	10.60
1995	51541	14647	3.52	4.35	7.17	4.68
2005	155094	23093	6.72	11.65	4.66	2.56
2015	191889	29409	6.52	2.15	2.45	3.02

Table 2 reports the deviations from trend, or the cyclical components. To establish the importance of financial-credit cycles, AHN (2015) separate out the financial from the business cycles and compare

the standard deviations. The real house price cycle has a variance of 13.1, of which erratics account for almost none (13.1–12.99). The 10–20-year financial-credit cycle has a greater volatility (9.27) than deviations in the 2–10-year business range (3.61).

As found by Hiebert et al. (2018) and AHN (2015) income is far less volatile than house prices. This is likely to reflect housing as a financial asset with buyers having both speculative investment and non-speculative consumption incentives when house purchasing. In contrast to prices, with income the business cycle range accounts for about the same volatility as the financial-credit cycle. The HPYR is more similar to prices, with more variance accounted for by the medium cycle. The variances are not directly comparable as the price and income are in log form and deflated. The HPYR has neither. A one standard deviation in the *Smoothed cycle* ($\sqrt{0.228} = 0.478$) is around half an income point. This reflects the indicator used by the IMF for a large event. A one standard deviation change for price is around 11% deviation from trend, which is consistent with a bubble definition in Agnello & Schuknecht's terms (10%), and so aligns with the IMF's indicator.

Table 2. HPYR Real income & price and growth, and volatility.

		VAR ¹	<i>Kappa</i>	<i>p</i> -value	Lead + Lag	⁴ ACF (<i>p</i>) = 0
Income		0.734				
Smoothed	All ¹	0.662				11
2–20 yrs	2 nd 2	0.821				13
	Bubble ³	1.16				
Business	All	0.319	0.465**	0.000		7
2–10 yr	2 nd	0.258	0.314**	0.000		9
	Bubble	0.320	0.311**	0.004		
Financial	All	0.312	0.58**	0.000		16
10–20yr	2 nd	0.458	0.715**	0.000	–1	16
	Bubble	0.603	0.976**	0.000	–3	
House Prices		13.10				
Smoothed	All	12.99	0.576**	0.000	–2	13
2–20 yrs	2 nd	16.64	0.879**	0.000		13
	Bubble	33.28	0.929**	0.000	–3	
Business	All	3.61	0.507**	0.002	–2	7
2–10 yr	2 nd	2.02	0.265**	0.001	+1	7
	Bubble	6.29	0.510**	0.000	–3	
Financial	All	9.27	0.51**	0.000	–1	16
10–20yr	2 nd	13.56	0.726**	0.000	–1	16
	Bubble	19.06	0.951**	0.000	–2	
HPYR		232.6				
Smoothed	All	228.9	0.499**	0.000	–2	13
2–20 yrs	2 nd	270.8	0.865**	0.000	–2	15
	Bubble	597.0	0.927**	0.000	–3	
Business	All	72.0	0.08	0.194	–2	7
2–10 yr	2 nd	40.1	0.195*	0.017	+2	6
	Bubble	134.3	0.387**	0.000	–3	
Financial	All	153.2	0.504**	0.000	–2	16
10–20yr	2 nd	218.9	0.725**	0.000	–2	16
	Bubble	317.3	0.951**	0.000	–3	

¹Variance × 1000

² 2nd era 1982–2020

³ Bubble periods, 2–20 year HPYR > 1 SD

⁴ ACF lag when value becomes negative

7.1. Smoothed cycles

The Smoothed 20-year cycles (capturing cycles in the 2 to 20-year periodicity range) are displayed in Figure 1. To ensure that the time series are of the same volatility range, they are normalised by the standard deviation of the respective series. Using the HPYR as a guide, major peaks occur at 1974Q1, 1989Q3, 2004Q4, 2007Q3 and 2018Q1. Troughs in 1971Q2, 1978Q1, 1982Q4, 1996Q4 and 2013Q2. These echo Agnello & Schuknecht (2011) & Bracke (2013). Taking the definition of a boom or bust as a one standard deviation from the HPYR or HP trend, anything above one in Figure 1 constitutes a large event. For the UK, these occur on a regular basis, but interestingly from the 1970s onwards. The large events are not a product of deregulation, solely.

Using the ACF, Table 2 indicates periodicities around 7 and 16 years for the business and financial cycles of income, with “average” periodicity of 13 years across the aggregate series. Traditionally, GDP would be the measure of the standard business cycle. Peak-to-peak, counting points, signifies 5 years. Income has a financial-credit cycle over twice that length. Peak-to-peak indicates 15 years is a good marker.

Figure 1 also displays the house price and HPYR financial-credit cycle (10–20 years) and the business cycle (2–10 years) of around 16 and 7 years. For all three series the financial-credit cycle consistent with Agnello & Schuknecht’s (2011) work and AHN’s (2015) financial periodicity. Importantly, the business periodicity is of the same order as the more conventional estimates for housing and income periodicities reviewed earlier, but beyond the 8-year threshold.

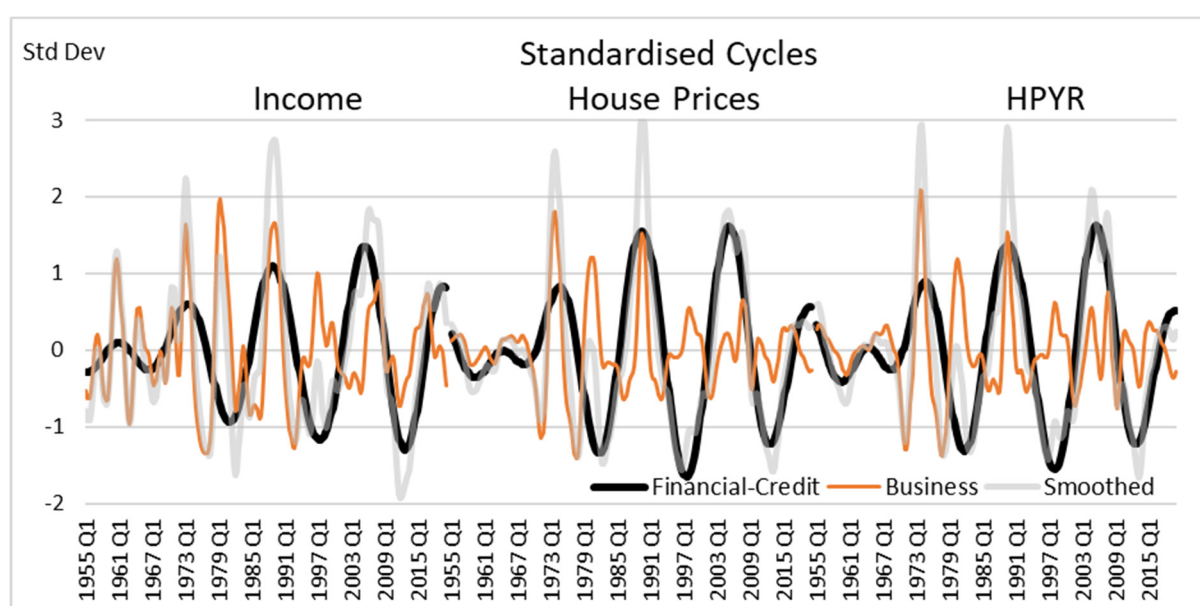


Figure 1. Standardised cycles.

7.2. Anatomy of cycles

Using a H-P filter with a 1600 filter, Iacoviello & Pavan (2013) reveal that real GDP, consumption, housing investment (construction) and debt all exhibit a fall in the degree of cyclicity in the period

1983–2010 compared with 1952–1982. As the filter will allocate anything beyond a ten-year periodicity into “trend” they ignore the financial-credit cycle.

Table 2 reports variance values for 1982–2020 (2nd era). First to note that the smoothed HPYR and the Finance cycles of income are longer, which corresponds with Borio (2014) and Pitros & Arayici (2016). Second, all three business cycle components have lower variances in the post-1981 era (or 153 quarters) than overall. However, the longer cycles have greater variance/volatility. In other words, there is a shift in volatility from business to medium term cycles.

DBT (2012) claim that it is interaction between business and financial-credit cycles that heralds a crisis. An example of the interaction can be seen in the double peak of 2004 and 2007 found in all the smoothed series, and where Agnello & Schuknecht and Bracke differ, is associated with the two cycles. The 2007 peak is more a business cycle one whilst the other is attributable to the financial cycle. But they almost coincide.

To consider the importance of the medium-term relative to the business cycle range there is a review of the bubble dynamics. Using the one standard deviation (0.478) deviation from trend threshold, there are 82 quarters where the smoothed HPYR is in a bubble period. All occur after 1969. Of these, 11 are associated with business spikes; 11 are combinations of business and financial spikes but neither pass the 0.478 threshold; 5 where both pass the threshold, and 52 solely to the financial cycle. So, 31% of the periods from 1970 were linked with a large deviation in the finance cycle. Performing the same procedure for real house prices tells a very similar, but slightly worse story, with more periods beyond the threshold. It is more a finance than an interaction story.

7.3. Cyclical alignment

Not unrelated to DBT (2012), Miles (2015) sees alignment of cycles as a cause of a crisis. It does appear so in Figure 1. There are tests for alignment between each series and that of the smoothed income cycle. Alignment and leadership would imply some underlying cause. Taking house prices and income as an example. Kappa of 0.576 indicates a positive and moderate association. Indeed, house prices across the three cyclical ranges are of the same order of association. This is not the case for HPYR where income and the ratio are not aligned at the business cycle. This could reflect the cycles themselves. Cosine waves of differing periodicities are orthogonal.

The post-1981 period is associated with stronger bonds between the smoothed income cycle and others. Kappa increases to over 0.86 for both house prices and HPYR, which implies a greater prominence financial-credit cycle in determining both. The business cycle alignment actually declines. This could reflect the switch in emphasis from the business to the financial-credit cycles in general.

There is a consideration of alignment in the bubble period. The alignment is much stronger between house prices and HPYR with income at the financial cycle. Indeed, 0.951, suggest almost perfect alignment with the ratio’s financial cycle. Again, the business cycle is not that prominent.

Ganoulis & Giuliadori’s (2011) and Gregoriou et al.’s (2014) point that house prices and incomes became dislocated in the short run is supported in both synchronicity and in variance. Rather than dislocated, the three series are more cyclically aligned in the financial-credit domain, suggesting the link has shifted investment horizon. Lenders and buyers could be looking to invest over 15 years. In a sense, taking a permanent income view of affordability is consistent with long run housing consumption and liberalized finance (Campbell & Mankiw, 1991) so the rise in prominence of the financial cycle should in part be related to greater debt, but that debt being linked to income.

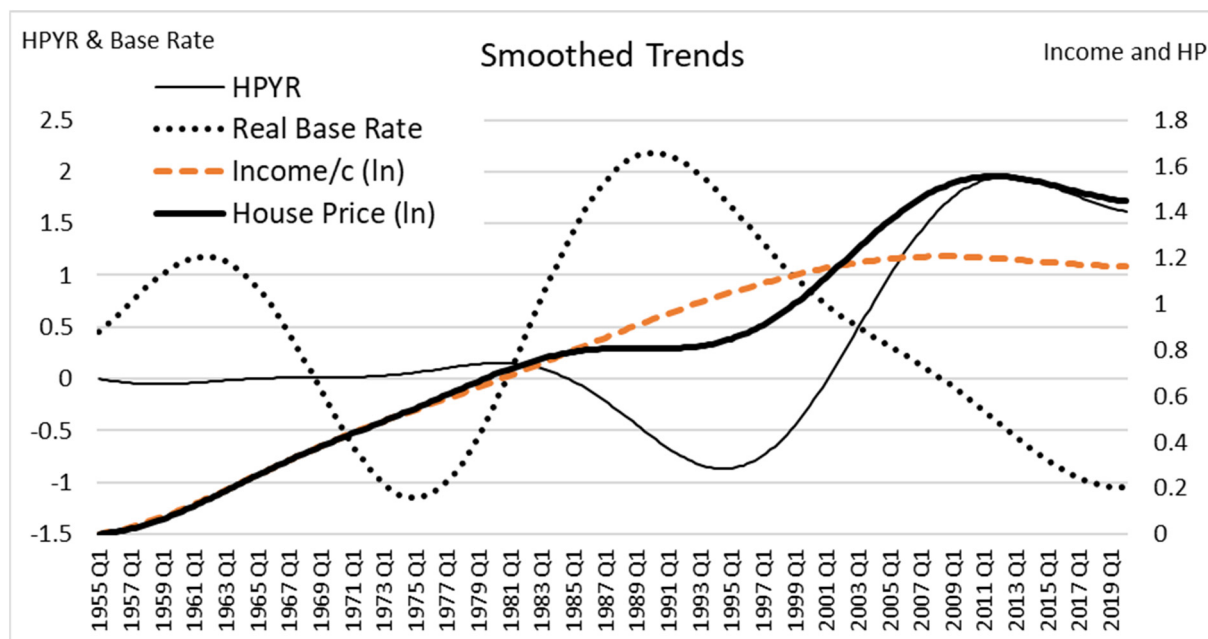
7.4. Lead indicator

The Kappa values vary with cyclical phase. Table 1 shows that Kappa is at a peak when housing is assessed at two quarters behind income. In other words, income leads house prices. It also leads HPYR by 2 quarters, which extends to 3 quarters when in the bubble period. Interestingly, HPYR does lead income by two quarters in the post 1981 era at the business cycle suggesting with this approach, the IMF's leading indicator property of housing is supported. Again, this highlights the importance of using multiple-cycle lens. It could be that the business cycle element concerns excessive speculative lending, whereas the financial-credit cycle picks up longer term movements in lending metrics, where anaemic growth in income encourages borrowers to adjust their attitudes to debt, incrementally.

7.5. Trend

Removing the business and financial cycles from the HPYR shows two remarkable relations. In Figure 2, the HPYR is almost flat until around 1982, reflecting (real) prices and incomes growing at the same rate. A long-term relationship that would be picked up by error correction mechanisms. The 1982–1995 period is not touted as such but, obscured by a unique coincident of a bubble in both business and financial-credit cycles, initially housing becomes much *more* affordable. From then, perhaps with the second liberal financing phase, there is a rise in prices and debt levels, where HPYR levels rise above historical norms. As such, this trend analysis is only partly in keeping with Hu & Oxley (2018) who find strong evidence of explosive behaviour over 40 years.

An asset-price model would predict higher asset prices with a fall in the cost of capital. Miles & Monro (2019) claim the real interest rates decline account for all of the doubling of house prices relative to incomes from 1985. From the paths in Figure 2 affordability and real interest rate move in opposite directions, suggesting a fall in the trend HPYR follows costlier borrowing. The two change directions in the mid-1990s, so the explanation works until 2014. Also covering a long period, Iacoviello & Pavan (2013) conclude that with financial deregulation and the great moderation there is less volatility, and debt changes little. The trend in income series illustrates the progressive decline in real income growth so that by 2002 there is a stagnant period. Prices continue to rise so that the HPYR suggest they are out of line with long term norms. Lower real interest rates (trend) and deregulation of finance (medium-term) does match the experience of housing in Britain and Europe from the mid-1980s and is consistent with rising debt levels. Importantly, the cleft reflects a problem of lower income growth, which emerges in the 2000s.



HPYR, Real House Price and Real Income per head standardised by the initial value
Real Interest rate standardised by the standard deviation

Figure 2. Trends in the levels.

Donnell & Pannell (2019) show that total residential transactions in 2019 are in line with the 60-year average, with peaks in 1989 and 2004. They estimate that the average UK private household moves home once every 20-years, with a trough of around 25 years around 2010 and a peak of eight years in the late 1980s. The pattern appears similar to the HPYR.

Reviewing the first-time buyer in both Ireland and the UK, Jamei & O'Brien (2017) find that they have accounted for a very stable share of housing transactions since the early 2000s. The decline in the repeat buyer (mover) market is notable. Between 2004 and 2012 across the British Isles, movers accounted for more than half of property purchase mortgages. By 2016, movers' share of new purchase mortgages had fallen for six successive years in the UK and two in Ireland. Indeed, Hudson & Green (2017) estimate that there is a drop of around 400,000 transactions each year since the bubble burst in the UK. They highlight 140,000 missing moves that can be attributed to a decline in the rates of moving among mortgaged home-owners. Indeed, they argue that insufficient equity is the dominant factor holding back the mortgaged mover rate. The missing movers correspond with the decline in moving rate (Donnell & Pannell, 2019) and the trend in price and HPYR up to around 2014, possibly explaining why Miles & Monro's (2019) real interest rates thesis may not apply then.

8. Conclusions

This paper sets out to consider the longer-term variations in a national house price-income ratio. Using a cyclical filter, the results suggests that there are medium-term and business cycles that occasionally conspire to cause large disruptive events in the economy. It was envisaged that income would be strongly featured in the business cycle range. However, its influence is evident beyond business cycles.

What is found is that the UK's medium-term cycles corresponds with Gregoriou et al.'s (2014) house price-earnings ratio profile; Borio's (2014) UK financial cycle; and DBT (2012) financial cycle. Borio's assertion about the importance of financial-credit cycle for stabilisation policy is supported. Rather than the idea of combinations, bubbles have shifted from the business cycle range in the 1970 to the financial-credit cycle range. Indeed, for most of the occasions where there is a large price or ratio deviation it is more likely to be a financial than a business cycle-driven phenomenon, reflecting a European wide shift (Ganoulis & Giuliadori, 2011).

The IMF point to the ratio being an indication of a crisis. What is found here is that its indicator highlights the same abnormal events as Agnello & Schuknecht's (2011) house price measure, which operates in longer cycles. However, in that range it is more of a lagging indicator. That said, the lag is small relative to the length of the longer cycles, so its use as an indicator is not undermined. Perhaps the noise of the short-run and the restructuring in the trend of the ratio is obscuring that affordability in the medium and long term is more an income problem, driving borrowers to borrow more.

Removing the medium cycles from trends in affordability measures, reveals that the deregulation has affected the link between prices and income. The trend in real income growth is steady but then, around 2002 peters into a stagnant period. The trend in the house price-income ratio was remarkably stable, but in the era of finance liberalisation-great moderation, that stability is disrupted both in trend and cycle. This explains why shorter analyses reveal explosive systems and why cointegration might be found in earlier periods. The findings of Iacoviello & Pavan (2013) are supported in the business cycle range, yet volatility in the lower frequencies and a schism in the trend implies that the claims of a moderation are more like squeezing part of a balloon. A deregulation of house purchase funding has raised the debt load, lengthened investment horizons and injected volatility.

The filtering, though, highlights the importance of the real interest rate and a long-term shift in the debt ratio of home buyers, which is obscured by bouts of tightening regulation. That said, perhaps a rise in the risk-free rate of return, despite its impact on borrowers is overdue. Evidence from elsewhere indicates that mortgaged-owners are not returning to the market as frequently as they once did. Perhaps this is a reflection of a perceived over-indebtedness and an excessive price relative to income. Mortgages can be made more affordable by extending the term. The median mortgage term for first time buyers has risen to 30 years. With repeat buyers going the same way, the limit to house prices could be the threat of pushing many to paying-off their loan after retirement.

An interesting extension of this is to consider the cospectral properties of the house price and income. Although beyond the scope of this work. As examined by Gray (2017) a key advantage of analyses in the frequency domain is that the cospectrum and phase can estimate measures of association and leadership at various cycles. However, the values are dependent on the frequencies estimated in sample spectrum matching closely with the business and financial cycles, and that they account for a stable proportion of the variation. Moreover, estimating association and phase between the house price-income ratio and real interest rates at the low frequencies would be novel.

Conflict of interest

There are no conflicts of interest in this paper.

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