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UK HOUSE PRICES: CONVERGENCE CLUBS AND SPILLOVERS

BY

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UK House Prices: Convergence Clubs and Spillovers *

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Abstract

This paper uses the log t test to analyse the convergence of house prices across UK regions and the presence of spillovers effects. We find that UK house prices can be grouped into four clusters. Moreover we document the dynamics of the house price spillovers across regions.

Keywords: Regional house prices; Heterogeneity; Convergence; Spillovers.
JEL classification: E31, E52.

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1 Introduction

The role played by the housing market in the latest financial crash and the following Great Recession, has led macroeconomic theory to investigate the contribution of housing wealth to the business cycles. This is frequently discussed by incorporating into a DSGE framework a household sector, whose consumption depends upon income and housing wealth.[1] The ultimate aim of this literature is to understand whether housing has an impact on economic fluctuations (see e.g. Iacoviello and Neri (2010)) in order to improve forecastability of the business cycle and formulate appropriate policy responses. The model solution is provided by nonlinear equations, which are then linearised (or *log*-linearised) so as to obtain fluctuations around the steady-state as well as decision rules. This is similar to the assumption that the economy is subject to only small disturbances and, importantly, the resulting equilibrium is unique. Since the steady state is defined under certain modelling conditions, it is important to evaluate whether this prediction and uniqueness are supported by the data.

We contribute to the literature by testing whether the UK housing market is characterized by a long run equilibrium, which all economic regions converge to. Although the UK housing market has been subject to extensive research, there is no clear agreement on whether a long-run convergence path exists. Early studies (e.g. MacDonald and Taylor (1993)) fail to find a robust convergence path; more recently Cook (2006) suggests that the previous negative evidence might be caused by asymmetric adjustment across regions. Holmes and Grimes (2008) find favourable evidence and suggest that moving towards a long-run equilibrium could be slow and takes quite a long time.

To this end, the novelty of this paper consists of the implementation of a log t test (Phillips and Sul (2007b)) to test whether multiple equilibria (i.e. convergence clubs) are present.[2] This approach has an attractive feature regarding the treatment of the steady-state (or the common factor); the steady-state is endogenously determined by the data themselves.

We complement our analysis by looking at house price spillovers across regions, and analyse the differences in the dynamics that drive return (i.e. inflation) and volatility spillovers over time for the UK regions. The variance decomposition analysis of the VAR model allows us to identify spillovers of return and volatility shocks.

In a nutshell our results suggest the presence of multiple steady-states in the UK housing market; this depart from a single steady-state often assumed by the macroeconomic models.

[1]See Iacoviello (2010, 2011) for a review and the influential model presented in Iacoviello and Neri (2010).
[2]This method has been implemented in economic growth literature (e.g., Phillips and Sul (2007a, 2009) as well as in convergence in prices Phillips and Sul (2007b).

2 Econometric framework

2.1 The log t test

For the analysis of convergence, we shall use the Phillips-Sul method (Phillips and Sul (2007b)); assume that panel data X_{it} with time $(t = 1, ..., T)$ and country $(i = 1, ..., N)$ is decomposed to the permanent (a_{it}) and transitory (g_{it}) components.

$$X_{it} = a_{it} + g_{it} \tag{1}$$

Since both components (a_{it} and g_{it}) may contain a common factor across regions (μ_t), equation (1) can be re-expressed as:

$$X_{it} = \left[\frac{(a_{it} + g_{it})}{\mu_t}\right]\mu_t = \delta_{it}\mu_t \tag{2}$$

Having recovered the time-varying idiosyncratic factor δ_{it}, the common factor will be calculated as the cross-sectional average of the panels under investigation. Since Eq. (2) suggests the presence of convergence of X_{it} if δ_{it} exhibits such evidence, the behaviour of the common factor is not the main focus in our definition of convergence. In other words, although this approach restricts to a single steady-state case in a panel (X_{it}), the stationarity of the steady-state will not affect our analysis of convergence.

Furthermore, the idiosyncratic component (δ_{it}) is assumed to follow the following specification which is discussed as suitable for economic data (Phillips and Sul (2007b)).

$$\delta_{it} = \delta_i + \sigma_i \xi_{it} L(t)^{-1} t^{-\alpha} \tag{3}$$

Following Phillips and Sul (2007a,b), $L(t)$ has a form of $\log t$, and $\xi_{it} \sim IID(0,1)$. Since δ_i and σ_i are region-specific fixed terms and given that log t is an increasing function over time, whether or not X_{it} converges toward δ_i will be determined by the size of α. They show that the convergence is ensured if $\alpha \geq 0$, and this null hypothesis can be tested using Eq. (4).

$$log(H_1/H_t) - 2log(L(t)) = a + blog(t) + u_t \tag{4}$$

where $L(t) = log(t+1)$, $H_t = (1/N)\sum_{i=0}^{N}(h_{it} - 1)^2$ and $h_{it} = X_{it}/N^{-1}\sum_{i=1}^{N} X_{it}$. Eq. (4) suggests that, all other things being equal, a large $log(H_1/H_t)$ corresponds to a large b. This in turn follows that $H_t \to 0$ as $t \to \infty$, which suggests that $h_{it} \to 1$ as $t \to \infty$. The latter implies that X_{it} approaches the cross-sectional average and thus is evidence of convergence. Alternatively, a negative b becomes evidence of non-convergence. Thus, the convergence hypothesis is tested by the null hypothesis of $b = 0$ against the alternative of non-convergence $b < 0$.

Since a rejection of the null does not necessarily implies that there is no convergence among regions which did not form an initial convergence club. The strategy is to search for convergence across all combinations of regions until $N-k = 1$, where k is the number of regions in convergence clubs. This terminal condition is the case where there is no further subgroup since multiple regions are required for the study of convergence.

2.2 Spillovers

The spillovers across regions are analysed using the Diebold and Yilmaz (2009) framework. For brevity of exposition consider a covariance stationary bivariate VAR $y_t = A_1 y_{t-1} + e_t$ or alternatively $y_t = \Theta(L)e_t$ in a moving average form. This can be re-written as $y_t = B(L)u_t$ where $B(L) = \Theta(L)Q_t^{-1}$, $u_t = Q_t e_t$, $E(u_t, u_t') = I$ and Q_t^{-1} is the lower-triangle Cholesky factor of the covariance matrix of e_t. The one-step ahead forecast ($y_{t+1,t} = Ay_t$) has an error vector given by:

$$\widehat{e_{t+1,t}} = y_{t+1} - y_{t+1,t} = B_0 u_{t+1} \begin{bmatrix} b_{0,11} & b_{0,12} \\ b_{0,21} & b_{0,22} \end{bmatrix} \begin{bmatrix} u_{1,t+1} \\ u_{2,t+1} \end{bmatrix} \tag{5}$$

The variance of the one-step ahead error in forecasting y_{1t} is $b_{0,11}^2 + b_{0,12}^2$ and $b_{0,21}^2 + b_{0,22}^2$ is that in forecasting y_{2t}. Moreover, following Diebold and Yilmaz (2009) the off-diagonal elements are the cross-market spillovers. The spillover index is then dened as:

$$S = \frac{b_{0,12}^2 + b_{0,21}^2}{b_{0,11}^2 + b_{0,12}^2 + b_{0,21}^2 + b_{0,22}^2} 100 \tag{6}$$

The model can easily be extended to the a case of $N = 12$ and 4-step ahead forecasts as in our case, and our analysis is based on VAR(1) which is determined by the Schwarz information criterion. Furthermore, in order to obtain results robust to the order of variables in the VAR, we implement a decomposition method proposed by Koop et al. (1996).

3 Data and empirical results

Quarterly data on house prices for the twelve UK regions are obtained from Lloyds Banking Group.[3] The data are standardized and seasonally adjusted, and cover the period from 1983Q1 to 2012Q3.

[3]The regions are North, York & Humberside, North West, East Midlands, West Midlands, East Anglia, South West, South East, Greater London, Wales, Scotland and Northern Ireland.

In order to apply the log t test to house prices, the matrix is created with the order of regions based on their average house prices in the final year (i.e., 2012). Then the house price convergence will be tested by creating a subgroup which contains first the two most expensive regions and then adding, one by one, less expensive regions to the subgroup. Thus, Greater London (hereafter London), the most expensive region, becomes one of the core member regions.

Results of the test are reported in Table 1, where we also report the estimated *t-statistics*. Initially, this table shows whether London and South East (the second most expensive region in the UK) form a convergence club, and a *t-statistic* of -48.16 suggests that we can reject the convergence hypothesis. This confirms that house prices in London are substantially different from the rest of the UK. Next, we test whether regions other than London form a convergence club. Again no evidence of convergence is obtained with a *t-statistic* of -49.23.

The next task is to check if there are any regions which exhibit convergence with South East. After examining all combinations of house prices in regions other than London, we find evidence of convergence in the subgroup consisting of South East, South West, East Anglia and Northern Ireland. Their *t-statistic* is positive although it is insignificant. Then, as before, convergence is checked among regions which have not become a member of any convergence groups (i.e., ones excluding London, South East, South West, East Anglia and Northern Ireland), and we find evidence of non-convergence (*t-statistic*=-26.39).

In the next round, we examine if West Midlands, the most expensive region among the remaining, converges with some other regions. After considering all possibilities, we find evidence of convergence among West Midlands, Wales and East Midlands. The *t-statistic* is negative but statistically insignificant, and thus the null of convergence cannot be rejected by the data. Furthermore, the remaining regions (North West, York & Humberside, Scotland, and North) are reported to form one convergence club.

Summing up, we find that the UK house market is subdivided into 4 convergence clubs named Groups A to D in Table 2. Group A consists of London alone, Group B of South East, South West, East Anglia and Northern Ireland, Group C of West Midlands, Wales and East Midlands, and Group D of North West, York & Humberside, Scotland, and North. Interestingly the clubs seems to be spatially distributed with one notable exception (Northern Ireland, which is not adjacent to South East, South West, and East Anglia). We can speculate that this anomaly is likely due to the strong price increase in Northern Ireland in the first half of the 2000s which matches with other regions in Group B.[4]

Panels A and B in Table 3 present the spillover effects across region for annual house price

[4]Graphs and statistics not included here, but available upon request.

inflation and inflation volatility (squared inflation), respectively. The the ij cell in is the estimated contribution to the forecast error variance of region i coming from innovations to region j. Hence summing the off-diagonal terms in each row of the matrix we obtain Contributions from Others, while Contribution to Others are obtained by adding up the terms in the columns. So for instance innovation in London housing market returns are responsible for 18.2 percent of the error variance in forecasting South East returns, but only 5.9 percent of the error variance in forecasting Scottish returns. From Table 3 we have two major effects; firstly, as expected, there is a higher spillover across adjacent regions. Second, the Spillover Index is obtained by dividing the sum of the Contributions from Others by the Contributions to Others including Own. This indicates that 79.6% and 73.2% for the forecast error variance of annual inflation and volatility, respectively, can be explained by spillovers. However, this spillover effect is quantitatively more pronounced for the peripheral regions than for the core regions, while price innovations in other regions have limited impact on London and southern England. The result corroborates and supports the idea of a ripple effect from London prices to other regions.

4 Conclusions

This paper looks at the convergence of the housing market across twelve UK regions. We find the market to be characterized by four convergence clubs. Moreover our results suggests the presence of high degree of spillover across regions, with stronger spillover effects from the core regions.

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Table 1: The Convergence test for UK regional house prices inflation

Test	Group	1) t-statistic	Rest of Group	2) t-statistic
Test A	Gr. London	-48.16	All others	-49.23
	South East		excl. Gr. London	
Test B	South East	1.16	All others	-26.39
	South West		excl. Gr. London	
	East Anglia		South East, South West	
	N. Ireland		East Anglia, N. Ireland	
Test C	W. Mids	-1.25	North West, Yorkshire & H.	3.56
	Wales		Scotland, North	
	E. Mids			

Notes: The test is based on Phillips and Sul (2007b)

Table 2: The Convergence club

Clusters	Regions	Average price
Group A	Gr. London	149671
Group B	South East, South West, East Anglia, N. Ireland	103245
Group C	W. Mids, Wales, E. Mids	84791
Group D	North West, Yorkshire & H., Scotland, North	73369

Notes: In GBP.

Table 3: Spillover effects across regions

	Gr. London	South-East	South-West	East Anglia	W. Mids	E. Mids	Wales	The North	North West	Yorks.	Scotland	N.Ireland	From others
Panel A - annual regional inflation													
Gr. London	25.9	15.0	10.0	9.4	3.7	6.2	7.2	7.3	3.9	7.2	1.4	2.9	74.0
South East	18.2	18.1	13.5	11.7	5.8	6.5	6.3	6.9	3.7	5.6	1.7	2.0	82.0
South West	12.2	13.6	17.1	14.1	9.4	7.0	7.3	5.8	4.7	5.9	1.8	1.1	83.0
East Anglia	13.7	16.1	12.0	22.3	7.3	3.8	6.1	6.1	4.4	4.1	2.8	1.3	78.0
W. Mids	8.0	9.7	14.3	13.2	16.0	7.3	7.5	5.5	7.3	7.8	2.8	0.6	84.0
E. Mids	10.4	10.6	13.4	12.6	9.9	11.5	7.4	6.7	6.5	8.0	2.4	0.4	88.0
Wales	8.2	8.4	11.3	10.6	12.0	6.9	15.1	8.0	6.4	9.3	2.6	1.1	85.0
North	8.1	6.3	8.5	7.0	10.0	8.1	12.2	16.5	7.3	12.0	3.4	0.6	84.0
North West	7.4	6.7	11.4	7.2	10.3	8.3	10.7	8.8	13.4	12.7	1.8	1.2	87.0
Yorks.	7.4	7.5	12.2	9.1	12.2	8.8	10.0	7.7	7.3	13.8	3.2	0.7	86.0
Scotland	5.9	7.5	8.5	6.0	8.1	6.0	6.5	10.8	5.8	11.8	14.8	8.2	85.0
N.Ireland	4.0	2.6	5.6	2.8	3.3	2.1	0.7	10.2	1.3	3.6	3.1	60.7	39.0
To others	104.0	104.0	121.0	104.0	92.0	71.0	82.0	84.0	59.0	88.0	27.0	20.0	955.0
													Spillover index
Including own	130.0	122.0	138.0	126.0	108.0	83.0	97.0	100.0	72.0	102.0	42.0	81.0	**79.60**
Panel B - regional inflation volatility													
Gr. London	47.7	20.0	8.6	7.3	2.3	3.3	1.4	0.1	1.9	2.1	1.4	4.0	52.0
South East	25.6	27.7	14.7	17.1	3.0	3.3	1.1	0.7	1.4	0.3	3.1	2.1	72.0
South West	10.9	17.3	20.9	29.1	7.3	4.0	3.4	0.9	2.1	1.0	2.8	0.4	79.0
East Anglia	14.0	22.9	15.1	34.5	4.1	0.8	2.1	0.3	0.6	0.2	4.1	1.3	66.0
W. Mids	5.9	13.8	19.7	28.8	12.1	4.6	5.9	2.1	2.7	2.1	1.8	0.5	88.0
E. Mids	5.9	11.8	19.8	23.0	7.2	15.3	4.8	1.8	5.8	2.9	1.3	0.4	85.0
Wales	3.4	7.1	13.7	13.5	13.5	6.1	18.0	12.0	4.9	5.0	1.1	1.6	82.0
North	1.1	2.2	7.4	2.9	7.4	11.9	16.8	33.4	3.8	11.1	1.3	0.7	67.0
North West	3.0	5.4	12.3	7.9	9.3	10.5	16.0	11.2	12.9	9.8	0.2	1.5	87.0
Yorks.	2.9	6.9	17.1	16.4	12.9	8.7	11.4	8.5	5.1	8.2	0.4	1.5	92.0
Scotland	1.0	2.6	6.0	1.7	5.9	3.8	11.3	13.5	4.9	11.5	19.3	18.5	81.0
N. Ireland	1.9	2.3	1.4	0.2	0.9	0.3	3.1	4.0	1.4	6.6	6.3	71.6	28.0
To others	75.0	112.0	136.0	148.0	74.0	57.0	77.0	55.0	35.0	53.0	24.0	33.0	878.0
													Spillover index
Including own	123.0	140.0	157.0	182.0	86.0	73.0	95.0	89.0	48.0	61.0	43.0	104.0	**73.20**

Notes: Variance decomposition based on Diebold and Yilmaz (2009).