Does UK social housing affect housing prices and economic growth? An application of the ARDL model

Faith Chorley[1] and Chunping Liu[2]

Abstract

This paper aims to establish a relationship between social housing, house prices and the whole economy using ARDL models. We find that there is a negative relationship between social housing and house prices in the short run but no evidence in the long term. Additionally, social housing was found inversely related to the economic growth of the UK economy in the long run but not in the short run. Based on these findings, increasing social housing can benefit younger families with affordability issues in the short term without causing any long-term concerns in the housing market. However, it does not help economic growth in the long run. Therefore, the government should consider a balance of trade-off between the housing market and the whole economy.

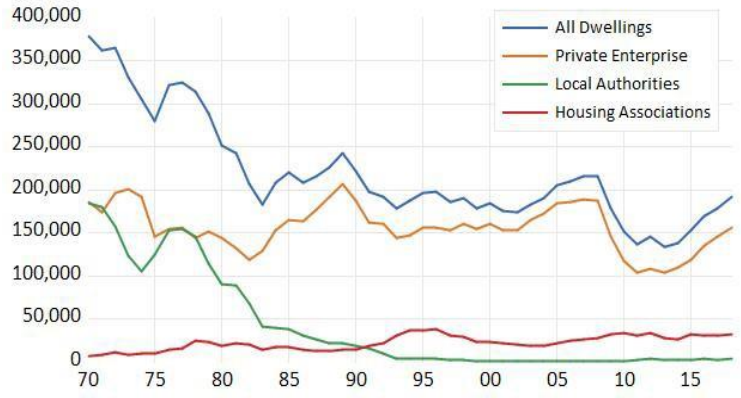
JEL Classification: R31, R38, O18

Keywords: social housing; house prices; GDP; ARDL Bounds test; cointegration

1 INTRODUCTION

Social housing has played a prominent part in UK history. Since 1869 the first tranche was built by Liverpool City Council, the UK government has been investing in affordable housing for those who are unable to afford private rents. After the First World War, considerable investment was made in social housing through the Addison Act (Housing, Town Planning, &c. Act 1919) to provide shelter for the heroes of the war who would otherwise be homeless or subject to slum landlords. After the Second World War, with the destruction of many homes, more investment went into building good quality homes at low rents. Until 1980, a scheme known as the Right to Buy was introduced by Margaret Thatcher's Conservative Government, which offered social renters the opportunity to buy their council properties at considerable discounts based on the period of tenure. This led to a surge of home ownership during the 1980s and 1990s. Since the introduction of the Right to Buy, construction has faltered, causing social housing stock to decrease considerably. Due to sales and lack of new builds, local authority housing stock has continuously fallen since 1978. In July 2016, the Scottish devolved assembly ended the Right to Buy scheme in Scotland because of the falling supply. Figure 1 shows the movement in social housing stock over this period. Governments today are providing more affordable housing for first-time buyers through the Help to Buy schemes; however, the consumer cost of 'affordable housing' is significantly higher than social rents. The new Affordable Homes Programme 2021 to 2026 aims to provide affordable housing for both social rent and affordable rent.

Figure 1: UK Housing Production



Source: Department for Communities and Local Government

There are many benefits of building social houses. It not only provides homeless people with a home but also contributes to communities and the economy in different aspects. With a proper home, homeless and low-income people can live healthy and happy lives, which increases life satisfaction (Rolfe *et al* 2020). At the community level, it reduces crime rates, enhances education outcomes and improves community cohesion. Alafat (2018 para. 28) confirms the role of social housing at the Chartered Institute of Housing's annual conference that, 'we all know that the lack of genuinely affordable housing is the biggest problem we face. And that social housing can provide a big part of the solution.' According to their survey, 80 per cent of people agree on the importance of social housing, and 63 per cent of people suggest building more social houses.

Households who are jobless or at low-income see the benefits of building social houses directly. However, when the government considers expansion or contraction of this policy, they need to know the implications of it. What are the implications of social houses to the households who are looking to buy properties? What are the implications for investors? In this paper, we investigate, to what extent, the impact of social housing on the private housing market and the whole economy. When the government considers adding investment in social houses, this paper can answer all these

questions.

This paper contributes to the existing literature in the followings. First, this paper adds a new empirical investigation on the limited literature by examining the impact of social housing in the UK. To the best knowledge of the authors, the impact of social housing in the UK has not yet undergone comprehensive research. Second, most studies use cross-session data, where the analysis is static without looking at the dynamic properties of this impact. The empirical analysis concentrates on micro studies where the discussion is based on household, district or even city level. We apply an empirical model using ARDL, where we can see the dynamic relationship between social housing and other markets at a macro level. Finally, this study provides an answer to the government if it needs to build more or fewer social houses. It also gives an idea to common households and investors what implications of social housing on their decisions.

The rest of our paper is organised as follows. Section 2 reviews the relevant literature. In Section 3, we explain the model, followed by methodology in Section 4 and data information in Section 5. Section 6 analyses the impact of social housing on the housing market, while Section 7 investigates that on the overall economy. Section 8 concludes this paper.

2 LITERATURE REVIEW

Regarding the impact of social houses on housing price, the first strand of literature uses test versus control area methodology before the 1990s, which compares the statistics, e.g. house prices of the neighbourhoods with and without affordable housing. With different varieties of the affordable house examined, the findings indicate no clear consensus, e.g. insignificant relationship in Babb *et al* (1984), a negative relationship in Guy *et al* (1985) and a positive association in Rabiega *et al*

(1984). There are many criticisms against the methodology used in this strand of literature. The major problem is due to the method that only uses comparative statistics of different neighbourhoods. There may have been either difference not easily apparent to the investigator or nuances of the neighbourhood that could not be captured by this type of methodology but that nonetheless affected housing prices.

The second strand of literature adopts the Hedonic model, estimating the relationship between social housing and property values after the 1990s. Nguyen (2005) reviews many studies about the types of affordable housing and their impacts, such as Cummings and Landis (1993), Lyons and Loveridge (1993), Goetz *et al* (1996), Briggs *et al* (1999), Santiago *et al* (2001). In general, these studies suggest that social housing affects more adversely on the properties proximally located. However, the magnitude tends to be very small. Lyons and Loveridge (1993 p 59) find that 'adding one subsidised unit within a quarter-mile radius of a house has the same dollar impact on that house's value as removing half a square footage in their houses'. On the other side, some studies find no significant relationship between social housing and house price (Cummings and Landis, 1993). In a more recent study, Diamond and McQuade (2017) discover that social housing construction in the US has heterogeneous effects on local house prices based on neighbourhood characteristics. It finds that house prices in lower-income areas drastically rise in the long run; however, in higher income and low minority areas, house prices decrease. This is due to the perceptions of the people in the area with higher-income families willing to pay more to move further away from affordable housing developments. The findings from this study suggest that building more affordable housing in lower-income and high minority areas could increase the wealth in those areas in the long term. Based on the review above, we can see that methodology has been improved during the past two decades, but there is still no consensus regarding the impact of social housing. Additionally, many studies use cross-session data which do not allow for the dynamic properties of this impact.

Furthermore, the empirical discussion focuses on micro levels, such as household, district or even city level.

In terms of the impact of social housing on the whole economy, Foden *et al* (2015) investigate the economic impact of social housing in Northern Ireland. They look at the importance of social houses in promoting economic growth, investing in people and communities, and building social and affordable housing. A survey of 12 organisations used produces evidence of the region-wide economic impact of social housing. An Economic Impact Assessment (EIA) is created from this survey, which analyses direct and indirect suppliers and income-induced effects. Accuracy is improved as at least two methods are used; however, the EIA is based on the original survey that is only conducted within Northern Ireland and, therefore, may not apply to the UK as a whole. Findings show that the total economic output supported by social housing organisations is 1.15 billion. The total gross value added (GVA) created for the Northern Ireland economy is 460 million, 1.4 per cent of total GVA. Social housing organisations directly employ 4,796 full-time equivalents (FTE) jobs and further 10,640 FTE jobs indirectly (Foden *et al* 2015). This proves that social housing has had a large impact on the economies and leads to higher employment in the UK, which in turn leads to an increase in GDP.

However, Foden *et al* (2015) only focus on the financial year of 2012/2013 with policy implications only valid at that year. Other studies do use time series analysis, such as Willcocks (2009), where he implements time series analysis in the UK housing market well by examining stationarity and producing four maintained regressions. He then finds an Autoregressive-Moving-Average model (ARMA) which Foden *et al* (2015) could have attempted, however, this research is only about the UK housing market in general and not just on social housing. Therefore, it only shows a representation of what should be used when analysing social housing through time series analysis.

An article by Lloyds (2015) finds that social housing is a driver of economic growth.

Every 100m invested in affordable housing supply generates 210 million of economic output and sustains 1,270 jobs. The housing programme that delivers 12,999 affordable homes per year can generate 2.6 billion of economic output. The research shows that affordable housing addresses inequality and provides a stable environment where we can implement policies to target educational attainment and reduce poverty. However, this analysis is still an analysis of statistics. Without a proper regression analysis, we cannot isolate its own effects rather than the economy overall.

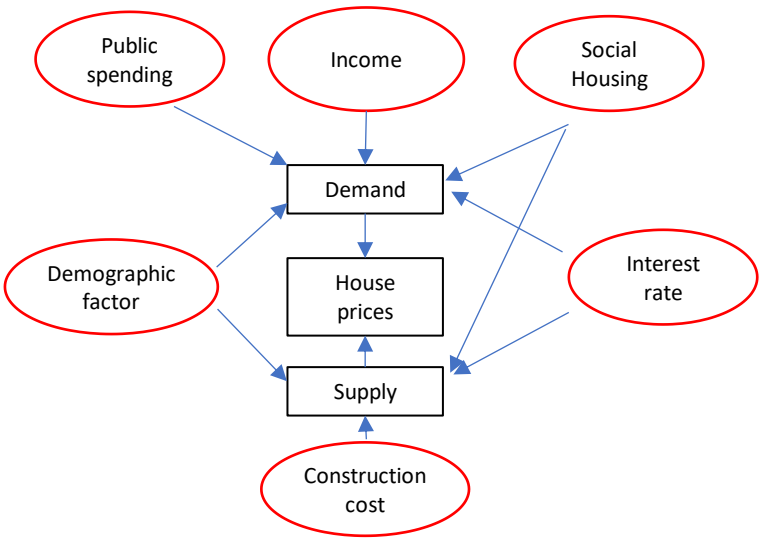
Many studies provide evidence of social housing improving certain economic factors such as employment, poverty and education. If these factors are improved through an increase in employment/educational attainment or decrease in poverty, then they should have a positive effect on GDP. Monk *et al* (2010) conduct a literature review for the Scottish government on the social and economic impacts of social housing. They find that there are differences between the microeconomic and macroeconomic impacts of low-cost homeownership with shallow subsidies. Low-cost homeownership tends to help lower-paid working couples and single people without children to buy a better property than they could otherwise afford. Housing policies influence the risk of old-age poverty. Although homeowners have a significantly lower risk of being income poor, the poverty-reducing effect of being a homeowner diminishes significantly. Government intervention in the form of social housing addresses market failure by providing decent homes for poorer households. Direct provision of affordable housing has other benefits, notably as part of creating mixed communities. Overall, they find strong evidence to support a relationship between poor housing, run-down estates, homelessness and low educational attainment. There is little research linking housing, social networks and employment outcomes, especially concerning social housing. There are significant gaps in the knowledge of the socioeconomic impacts of housing due to the lack of relevant data and the difficulty of disaggregating other factors in measuring the effects of housing on health and education.

We can also understand the relationship between social housing and the economy through the link between private house prices and the economy. The existing studies mostly agree on a positive relationship between house prices and economic growth (Coulson and Kim 2000; Davis and Heathcote 2005; Chen *et al* 2011; Liu and Ou 2020). However, the disagreement arises from the dominant channels through which house prices affect the economy. Iacoviello and Neri (2010) find that the housing market spillover mainly works through consumption rather than investment. The wealth effect on consumption is much stronger than the collateral impact. But Miller *et al* (2011) show that the impact of house price on the economy is due to the borrowing constraint. Particularly, when people have a lower home price to income ratio (financially constrained), the collateral effect through investment is larger than the wealth effect. In addition to that, several studies disagree the positive relationship, in particular the contemporaneous effect, such as Andra *et al* (2010).

3 MODEL

Existing studies about the housing price determination are explained through supply and demand of the housing market (see Figure 2). The common variables investigated in the studies are interest rate, public expenditure, income level, construction cost and unemployment (see Xu and Tang 2014). Interest rate is a crucial variable to affect the property values through different channels (Adam and Fuss 2010). Barot and Yang (2002) find that the real interest rate is negatively correlated with house prices in the UK due to the cost of financing. However, if the cost of finance is high, it also reduces the supply of houses (Hilbers *et al* 2008), which leads to an uncertain sign of housing price.

Figure 2: House Price Determination



Public expenditure associated with fiscal policy is another variable that proves to be significant in determining house prices. Afonso and Sousa (2012) conclude that fiscal shock affects property values positively and permanently. Aye *et al* (2014) find that the impact of government expenditure shock on house prices is less than that on the stock market. Gupta *et al* (2014) show that unexpected government expenditure shocks have little impact on house prices. However, expected government expenditure shocks are positively related to housing prices. There are different types of government expenditure that may lead to a different effect on the housing market. García *et al* (2010) find that local policies to improve the quality of life or the location-specific characteristic of the city of Barcelona have a positive impact on housing values. Income level or GDP is another variable to explain house prices, which is believed to be positively related to house prices through demand side of the market (Hilbers *et al* 2008; Barot and Yang 2002). Holly and Jones (1997) investigate the housing market in the UK, finding that income is the most critical factor to determine house prices

in the UK. However, Brooks and Tsolacos (1999) argue that the most significant impact on house prices is the lagged value of house prices in the UK.

Other factors in determining the house prices in the literature are construction cost, demographic factors, housing bubbles, housing finance and housing quality, etc. They all affect house prices through demand and supply. Demographic factors are considered as a significant determinant of house prices (Girouard *et al* 2006; Égert and Mihaljek 2007). But some studies argue that demographic factors do not affect house prices directly (Jacobsen and Naug 2005). The bubble is another consideration in the housing market (Engsted *et al* 2016), which is associated with people's expectation. When there is a bubble in the market, people predict that house prices will increase in the future and hence borrow money to make the purchase. Then it will drive up the bubble even further.

To explore the relationship between social housing and private housing market, we add social housing to the housing price model as follows[3],

$$LnHP_t = f(LnSH_t, R_t, GE_t, GDP_t) \quad (1)$$

where $LnHP_t$ and $LnSH_t$ are the logarithmic form of UK housing price index and social housing, respectively. This model selects the housing price index as an indicator of the housing market while controlling for macroeconomic variables such as interest rates (R_t), government expenditure ($LnGE_t$) and GDP ($LnGDP_t$).

For further investigating the link between social housing and the whole economy, we set up the model as follows,

$$LnGDP_t = f(LnSH_t, R_t, GE_t, u_t, \pi_t) \quad (2)$$

where u_t and π_t are unemployment rates and inflation rates. All the variables except social housing are control variables to explain GDP.

4 METHODOLOGY

To estimate the impact of social housing, we adopt the ARDL approach, which was originated from Pesaran and Shin (1999) and developed by Pesaran *et al* (2001). The ARDL model becomes popular because of several advantages in comparison with other cointegration methods. First, it can estimate the long-run and short-run parameters of the model simultaneously despite the problems posed by non-stationary time series data. Also, this approach does not require a prior determination of the integration order of the variables, unlike other methods which require that the variables are the same order of integration. Second, by allowing for different optimal lags of variables, the ARDL procedure is a more robust approach to determine the cointegration relationship in small samples. Third, the ARDL approach can reduce the consequence of the multicollinearity of the original model, leading to a better statistical disturbance term. Last, we can still use the ARDL method; even the explanatory variables are endogenous (Pattichis 1999; Alam and Quazi 2003).

As our data contains both I(0) and I(1) data (see Section 5), the ARDL approach is an appropriate method. Additionally, the ARDL approach can avoid the potential issues of endogeneity problem. ARDL model for the housing price model is specified as follows,

$$\triangle LnHP_t = \sum_{i=0}^{a} \alpha_i \triangle LnHP_{t-i} + \sum_{i=0}^{b} \beta_i \triangle LnSH_{t-i} + \sum_{i=0}^{c} \gamma_i \triangle R_{t-i} + \sum_{i=0}^{d} \lambda_i \triangle LnGE_{t-i} + \sum_{i=0}^{e} \phi_i \triangle LnGDP_{t-i} + \delta_1 LnHP_{t-1} + \delta_2 LnSH_{t-1} + \delta_3 R_{t-1} + \delta_4 LnGE_{t-1} + \delta_5 LnGDP_{t-1} + \varepsilon_t \quad (3)$$

where the coefficients (a, β, γ, λ, φ) measure the short-run relationships, while δ_s characterises the cointegrating relationship. For further investigating the link between social housing and the whole economy, we specify as follows,

$$\triangle LnGDP_t = \sum_{i=0}^{o} \kappa_i \triangle LnGDP_{t-i} + \sum_{i=0}^{p} \xi_i \triangle LnSH_{t-i} + \sum_{i=0}^{q} \varpi_i \triangle R_{t-i} + \sum_{i=0}^{m} \varkappa_i \triangle u_{t-i} + \sum_{i=0}^{n} \eta_i \triangle \pi_{t-i} + \vartheta_1 LnGDP_{t-1} + \vartheta_2 LnSH_{t-1} + \vartheta_3 R_{t-1} + \vartheta_4 u_{t-1} + \vartheta_5 \pi_{t-1} + v_t \quad (4)$$

The coefficients (κ, ξ, ϖ, $\varkappa$, η) indicate the short-run relationships, while ϑ_s captures long-run relationship. We firstly identify a tentative model by selecting the optimal lags using information criteria before estimating the models. Then the Bounds test and *t*-test are performed to show if cointegration exists or not. Meanwhile, we need to ensure the model used is free of problems. Finally, if cointegration exists, we analyse how social housing affects the housing market both in the short-run and long-run using Error Correction Models (ECM). The Bounds test examines the existence of cointegration with the null hypothesis of no cointegration ($\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$). Then a Wald test is applied to calculate the *F*-statistics. This must be combined with the *t*-statistics on the lagged dependent variable (H_0: $\delta_1 = 0$). Failure to meet the two requirements raises the possibility of degenerate cointegration relationships among the variables

(Pesaran *et al* 2001). We then need to compare them with the critical values provided in Pesaran *et al* (2001). If both *F*-statistics and *t*-statistics in absolute value are higher than the upper-bound critical values, the conclusion is that there exists a cointegration. If the *F*-statistics is lower than the lower-bound critical values and, then we fail to reject the null hypothesis of the non-existence of a long-run relationship.

Moreover, if the *F*-statistic lies between the lower and upper-bound critical values, then the result is inconclusive. There is another possibility that *F*-statistics is rejected, but *t*-statistics is not. This implies the cointegrating relationship (error correction term) is due to the lagged dependent variable but not on the others. In this case, it implies no real cointegration.

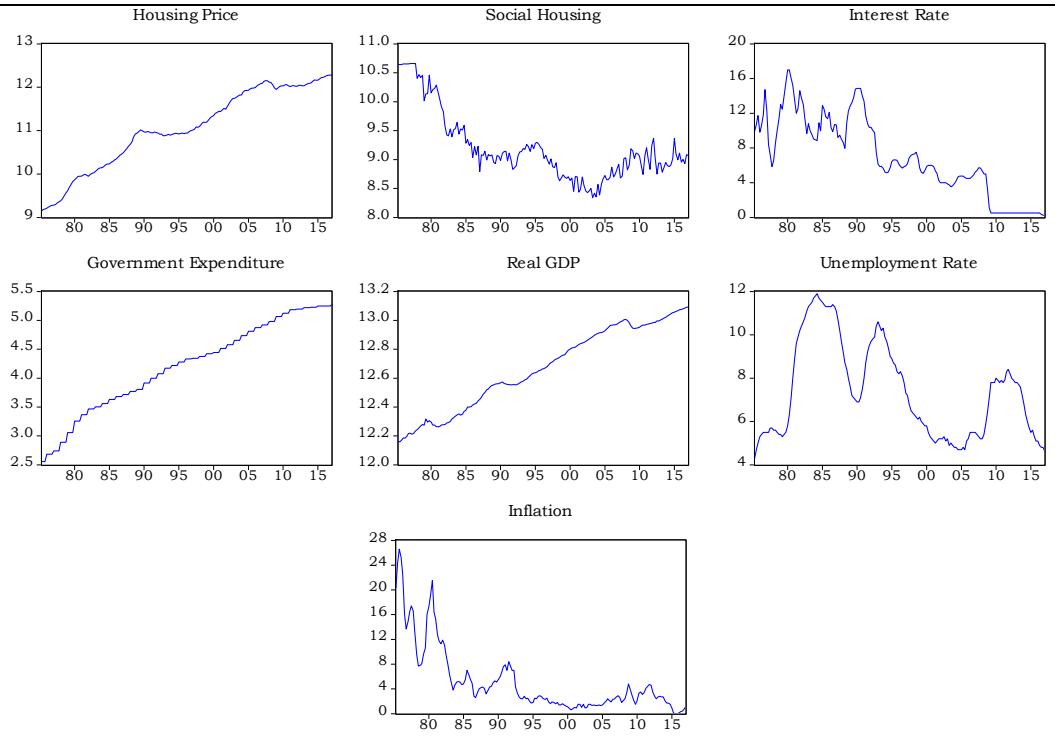
5 DATA

The data covers from 1975Q2 to 2017Q1. House prices were collected from the HM Land Registry Public Data. GDP and the unemployment rate were obtained from the Office of National Statistics (ONS). The interest rate was from the Bank of England. Inflation Rate was from the OECD. Government spending was from UK Public Spending. We use additional social housing completed as the indicator of social housing, which is available from the Ministry of Housing, Communities & Local Government. All variables except interest rate, inflation, and unemployment rate are in their logarithmic forms.

Figure 3 displays all the variables during the sample period. Social housing completions fell from 1975 to 2002 as an investment in social housing decreased. Data on social housing completions have been used instead of social housing stock. The housing stock does not accurately represent the social housing market, because the ability to buy and sell a social property is directly reflected in the social housing

completions. GDP closely matches the dips created by the housing bubbles, which could indicate a sign of correlation. Government expenditure has been increasing year on year with more steady growth since 2010, which could be due to the 2010 election when the Conservative Government restricted public sector funding. The interest rate between 1975Q2 and the 1990s fluctuated significantly. More recently it has stayed uncharacteristically stable, which was held at half per cent until 2016Q4. It fell further to 0.25 per cent until the end of the data range. Unemployment fluctuated dramatically and decreased on the lead up to a dip in GDP and rose dramatically during a decrease in GDP.

Figure 3 Time Paths of All Variables



Notes: the graph provides the time paths of all the variables between 1975Q2 and 2017Q1. Housing price, social housing, government expenditure and real GDP are in logarithmic forms. Interest rate, unemployment rate and inflation are all in percentage points.

To estimate the long-run relationship between social housing and house prices by the ARDL approach, we first check the integration orders of all the variables to ensure that they are not integrated with more than one. The Augmented Dickey-Fuller (ADF) test is the most popular approach for testing the integration order. In Figure 3 that $LnHP_t$, $LnGE_t$ and $LnGDP_t$ show an evident deterministic upward trend. Therefore, we include both intercept and trend in examining the stationarity of the level variables. Table 1 shows all except the variable of social housing are non-stationary at level but become stationary at the first difference. We can conclude that all the variables are I(1) except that social housing is I(0). Therefore, the ARDL method is appropriate.

Table 1: ADF Test

Variable	Level Assumption	D-F Statistics	First difference Assumption	D-F Statistics
$LnHP_t$	constant and trend	-2.33	constant	-2.81*
$LnSH_t$	constant	-3.03*	none	-2.30**
R_t	constant	-1.55	constant	-9.58***
$LnGE_t$	constant and trend	-2.32	constant	-2.87*
$LnGDP_t$	constant and trend	-1.41	constant	-3.93**
u_t	constant	-2.34	none	-3.81***
π_t	constant	-2.45	constant	-7.63***

Notes: ***, ** and * denote significance at 1%, 5% and 10% respectively.

6 DOES SOCIAL HOUSING AFFECT HOUSING PRICE INDEX?

To test and estimate the relationship between social housing and house prices, firstly, we need to identify a tentative model by selecting the optimal lags. Then the cointegration test is performed by a combined Bounds test and t-test. We can then decide whether to use ECM or short-run model to analyse how social housing affects the housing market. As the sample covers a very long period, there may be structural breaks existing in the final ECM or short-run model. We perform multiple structural break tests by Sequential Bai-Perron method, outlined by Bai (1997) and Bai and Perron (1998), which sequential tests of L+1 versus L breaks and report breakpoints. If there are breaks, we then fix it by including dummy variables to the long-run cointegrating equation and final estimation model. Finally, we perform a few diagnostic tests to ensure the model is stable, free of serial correlations and heteroscedasticity, and normally distributed.

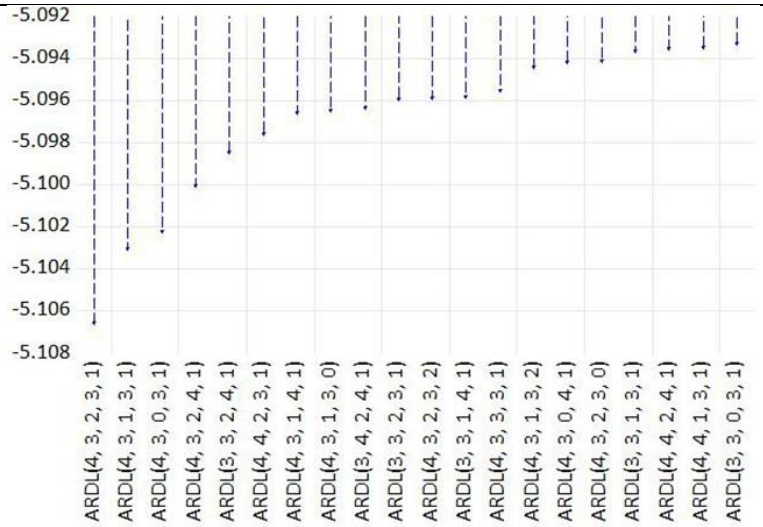
6.1 Lag Selection

The generalised ARDL model is specified as,

$$LnHP_t = \varphi_0 + \sum_{i=0}^{a'} \alpha_i' LnHP_{t-i} + \sum_{i=0}^{b'} \beta_i' LnSH_{t-i} + \sum_{i=0}^{c'} \gamma_i' R_{t-i} + \sum_{i=0}^{d'} \lambda_i LnGE_{t-i} + \sum_{i=0}^{e'} \phi_i LnGDP_{t-i} + \varepsilon_t' \quad (5)$$

where a', b', c', d' and e' are the optimal lag orders. We use AIC to choose the optimal lags for the level estimation. Figure 4 shows the AIC for the top 20 models where we can see ARDL(4,3,2,3,1) has the lowest AIC and therefore selected for the following estimations[4].

Figure 4: Housing Price Model: Lag Selection



Notes: The graph shows the values of AIC for top 20 ARDL models. ARDL(4,3,2,3,1) corresponds to the maximum lag order of $LnHP_t$, $LnSH_t$, R_t, $LnGE_t$ and $LnGDP_t$.

6.2 Cointegration Test

To see if there is any long-run relationship between social housing and housing price, we look at both *F*-statistic and *t*-statistic values and check it against the lower bound I(0) and the upper bound I(1) for different levels of significance. If both statistics are higher than the upper bound of I(1), there is a relationship between the variables and cointegration exists. Otherwise, there are stationary data, which implies no cointegration exists (Sam *et al* 2019). Table 2 shows that the *F*-statistic of 4.74 is higher than the ten per cent significance level for I(1). However, the *t*-statistic is insignificant, suggesting the significance of the error correction term comes from the lagged dependent variables. Therefore, there is no real cointegration in this model. The following analysis will be based on the short-run model.

Table 2: Housing Price Model: Bounds Test

Statistics	Significance level	I(0)	I(1)
F-statistics=4.74	10%	2.45	3.52
	5%	2.86	4.01
	2.5%	3.25	4.49
	1%	3.74	5.06
t-statistics=-3.48	10%	-2.57	-3.66
	5%	-2.86	-3.99
	2.5%	-3.13	-4.26
	1%	-3.43	-4.6

Notes: the critical values of I(0) (lower bound) and I(1) (upper bound) follows Pesaran *et al* (2001). We have incorporated the structural break tests in Section 6.3 before performing the Bounds test.

6.3 Model Diagnostic Tests

As the sample covers a few economic cycles, we test the existence of structural breaks in the model by the Bai-Perron method. Table 3 shows there is one systematic shift in the model. The detected break date is 1988Q3, which is in line with housing market history where house prices rose by 29 per cent in 1988 and 7.5 per cent in 1989, followed by a continuous decline in the next six years.

Table 3: Housing Price Model: Structural Breaks

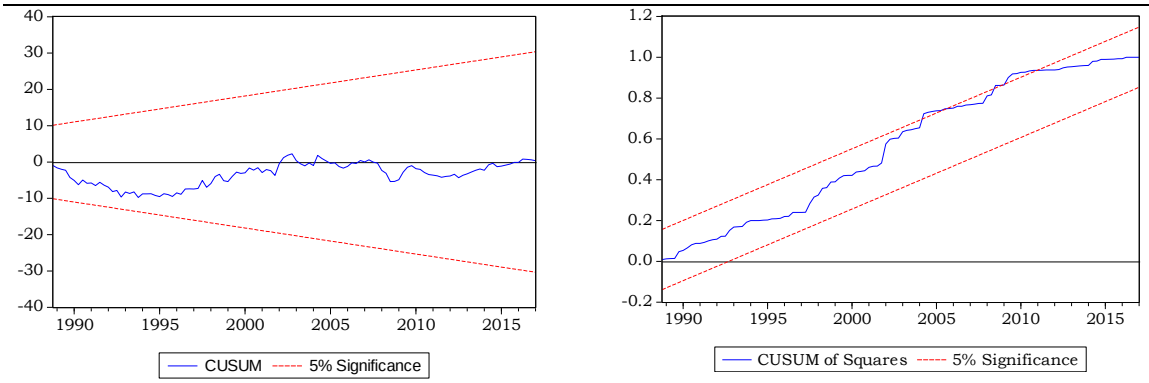
Break test	*F*-statistic	Scaled *F*-statistic	10% critical value
0 vs. 1	3.22	41.82	23.95
1 vs. 2	1.92	25.00	26.33
break date		1988Q3	

Notes: The critical values follow Bai and Perron (2003).

The short-run model is also checked by a set of CUSUM statistics (Brown *et al* 1975).

The first one looks at the cumulative sum of the recursive residuals while the CUSUM squared tests specify the distance of the residuals. Figure 5 plots the statistics with five per cent critical value lines. If it lies within the lines, then the model is considered to be stable. Any movement outside of the lines suggests parameter or variance instability. Figure 5 shows that both statistics falls within the bounds at five per cent significance level for the majority of the time, which implies that there are grounds for stability in the model.

Figure 5: Housing Price Model: Stability Tests



Notes: The CUSUM approach for detecting stability is developed by E. S. Page of the University of Cambridge

In addition to the stability tests, we also perform other model diagnostic tests to ensure the error term satisfies the assumptions of the error term. Serial correlation is problematic in the time series data models, which affect the standard errors of the estimates. The Breusch-Godfrey LM test checks for serial correlation by testing the null hypothesis of no serial correlation. Table 4 shows that there is no serial correlation for the housing price model with the selected lags. We use the Breusch-Pagan test to test heteroscedasticity, which indicates the model is free of this problem. Finally, the Jarque-Bera statistics suggests that the error term from this model cannot be rejected

as a normal distribution. Therefore, the short-run model does not suffer from these problems.

Table 4: Housing Price Model: Model Diagnostic Tests

Test type	Statistics type	Statistics value	P-value
Serial correlation (Breusch-Godfrey)	LM statistics	1.53	0.22
Heteroscedasticity (Breusch-Pagan)	LM statistics	6.00	0.95
Normality	Jarque-Bera	1.73	0.42

Notes: the null hypothesis of Breusch-Godfrey test is that the model has no serial correlation, while the null hypothesis of Breusch-Godfrey is homoscedasticity. The null hypothesis of normality test by Jarque-Bera is that the error term is normally distributed.

6.4 Short-run Model

Since the Bounds test indicates the non-existence of a long-run relationship between social housing and commercial house prices, we apply the short-run model. The estimation results are in Table 5, where we can see that additional social housing has a significantly negative impact on house prices in the short run. For every one per cent increase in additional social housing, house prices decrease by 0.03 per cent contemporaneously. It could be due to the rise in stock which will decrease house values as shown through the supply and demand theory. When more social houses, as an alternative to private dwellings, are added to the housing market, it reduces the property demands of the private housing market. Therefore, the housing price falls. We prove that our results are consistent with most of the studies using Hedonic models, such as Cummings and Landis (1993), Lyons and Loveridge (1993), Goetz *et al* (1996), Briggs *et al* (1999) and Santiago *et al* (2001). But this output strongly

disagrees with Hall (2015) who finds that social housing does not decrease property prices when they are fully and coherently integrated. Even the negative impact is relatively small, consistent with most of the literature using the Hedonic model. However, for every one per cent increase in additional social housing, house prices will increase by 0.03 per cent in two quarters ahead, which we can find support in Rabiega *et al* (1984). The dummy variable shows high significance here, which confirms the Bai-Perron test.

Table 5: Housing Price Model: ARDL Estimation

Variable	Coefficient	Standard error
constant	-0.0039	0.0028
$LnHP_{t-1}$	0.3717***	0.0748
$LnHP_{t-2}$	0.1497*	0.0810
$LnHP_{t-3}$	0.1128	0.0705
$LnSH_t$	-0.0284***	0.0111
$LnSH_{t-1}$	0.0100	0.0120
$LnSH_{t-2}$	0.0286***	0.0113
R_t	0.0499	0.1821
R_{t-1}	-0.2970*	0.1755
$LnGE_t$	-0.0762	0.0513
$LnGE_{t-1}$	0.2234***	0.0509
$LnGE_{t-2}$	0.2156***	0.0483
$LnGDP_t$	0.7403***	0.1939
D1988Q3	0.0708***	0.0190

Notes: ***, ** and * denote significance at 1%, 5% and 10% respectively.

7 IMPACT ON GDP

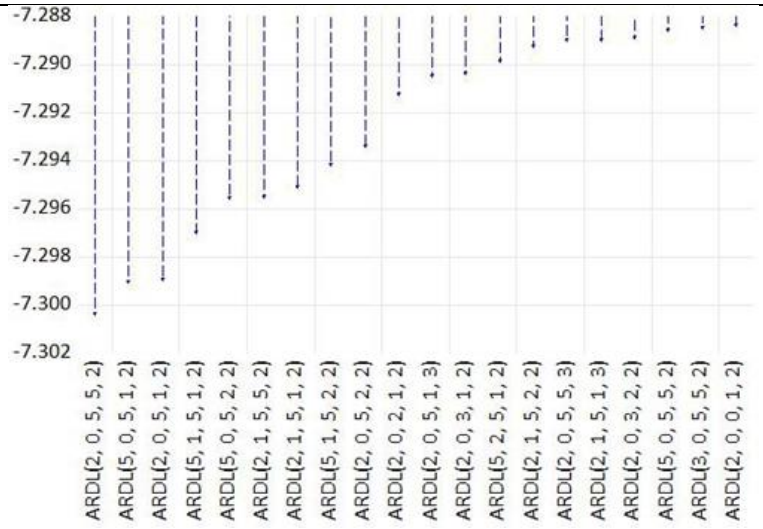
7.1 Lag Selection

To see a broader impact of social houses on the economy, we establish an ARDL model specified as,

$$LnGDP_t = \vartheta_0 + \sum_{i=0}^{o'} \kappa_i' LnGDP_{t-i} + \sum_{i=0}^{p'} \xi_i' LnSH_{t-i} + \sum_{i=0}^{q'} \varpi_i' R_{t-i} + \sum_{i=0}^{m'} \varkappa_i' u_{t-i} + \sum_{i=0}^{n'} \eta_i' \pi_{t-i} + \nu_t' \quad (6)$$

where o', p', q', m' and n' are the optimal lag orders. Again we use AIC to choose the optimal lags. Figure 6 shows the AIC for the top 20 models where ARDL(2,0,5,5,2) has the lowest AIC and therefore selected for the following estimations.

Figure 6: GDP Model: Lag Selection



Notes: The graph shows the values of AIC for top 20 ARDL models. ARDL(2,0,5,5,2)

corresponds to the maximum lag order of $LnGDP_t$, $LnSH_t$, R_t, u_t and π_t.

7.2 Cointegration Test

To see if there is any relationship between social housing and the overall economy, we perform Bounds tests. Table 6 shows that there exists a long-run relationship as both the *F*-statistics and *t*-statistics reject the null hypothesis at one per cent and 2.5 per cent significance level, respectively, which suggests that cointegration exists.

Table 6: GDP Model: Bounds Test

Statistics	Significance level	I(0)	I(1)
F-statistics=5.25	10%	2.45	3.52
	5%	2.86	4.01
	2.5%	3.25	4.49
	1%	3.74	5.06
t-statistics=-4.28	10%	-2.57	-3.66
	5%	-2.86	-3.99
	2.5%	-3.13	-4.26
	1%	-3.43	-4.6

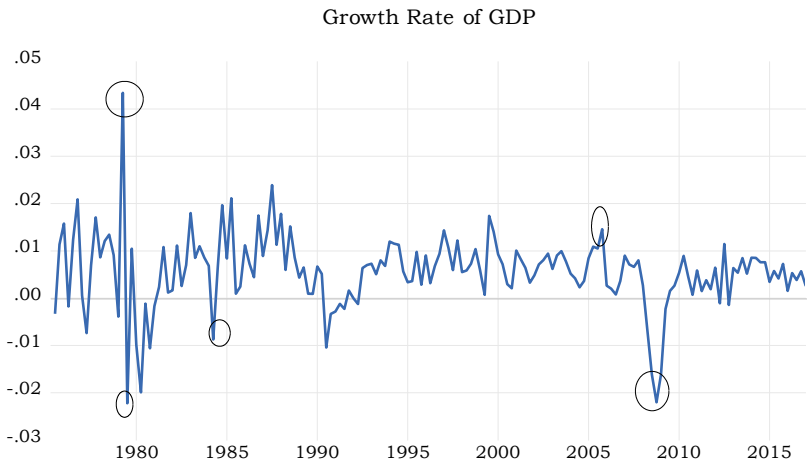
Notes: the critical values of I(0) (lower bound) and I(1) (upper bound) follows Pesaran *et al* (2001). We have incorporated the structural break tests in Section 7.3 before performing the Bounds test.

7.3 Model Diagnostic Tests

To detect the structural breaks for the GDP model, we combine Bai and Perron method along with some known dates in British economic history, such as the oil crisis in the late 1970s and early 1980s, dot-com bubble in early 2000 and the financial crisis in 2007. We focus on these critical events and fit dummy variables into the model. We

only keep the significant dummy variables in the model. The final break dates detected are shown in Figure 7.

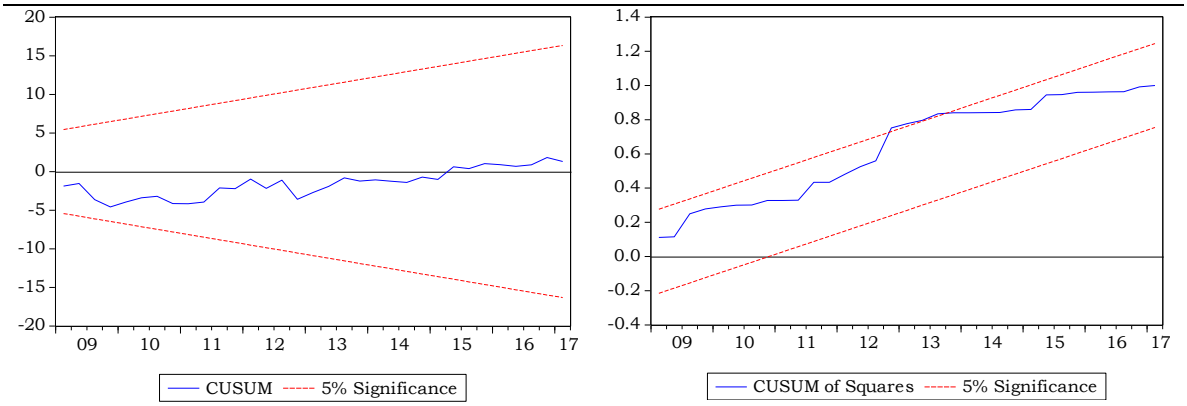
Figure 7: GDP Model: Structural Breaks



Notes: The break dates identified are 1979Q2, 1979Q3, 1984Q2, 2005Q2 and 2008Q4.

Figure 8 presents the CUSUM and CUSUM squared statistics test, where we can see both CUSUM and CUSUM squared test lies inside five per cent intervals after we fit the dummy variables. Table 7 shows the results of serial correlation, which also proves that there is neither serial correlation nor heteroscedasticity. The error terms also satisfy the assumption of standard normal distribution.

Figure 8: GDP Model: Stability Tests



Notes: The CUSUM approach for detecting stability is developed by E. S. Page of the University of Cambridge

Table 7: GDP Model: Model Diagnostic Tests

Test type	Statistics type	Statistics value	P-value
Serial correlation (Breusch-Godfrey)	LM statistics	1.49	0.47
Heteroscedasticity (Breusch-Pagan)	LM statistics	22.36	0.32
Normality	Jarque-Bera	2.29	0.32

Notes: the null hypothesis of Breusch-Godfrey test is that the model has no serial correlation, while the null hypothesis of Breusch-Godfrey is homoscedasticity. The null hypothesis of normality test by Jarque-Bera is that the error term is normally distributed.

7.4 Error Correction Model

The Bounds tests indicate a long-run equilibrium relationship between social housing and the UK economy. When we look at the estimation of the error correction model in Table 8, we can see that additional social houses have no significant impact on the economy in the short term. However, there is a long-run relationship between them. For every one per cent increase in additional social housing, GDP will drop 0.16 per cent in the long term (see Table 9), which is contradictory to the studies, such as Foden

et al (2015) and Lloyds (2015). However, all those studies are short-run studies, which are not comparable to our results. Social housing may have a positive impact on GDP due to the reduction of poverty in a relatively short term. But our study shows that this policy may harm the economy in the longer term.

Table 8: GDP Model: ARDL Estimation

Variable	Coefficient	Standard error
constant	0.3834***	0.0761
$LnGDP_{t-1}$	-0.0126	0.0721
$LnSH_t$	-0.0002	0.0027
R_t	0.0241	0.0468
R_{t-1}	0.0322	0.0495
R_{t-2}	-0.1013**	0.0485
R_{t-3}	0.0053	0.0472
R_{t-4}	0.0922*	0.0470
u_t	-0.8458***	0.2342
u_{t-1}	-0.3437	0.2556
u_{t-2}	0.0387	0.2575
u_{t-3}	-0.1885	0.2514
u_{t-4}	0.5379**	0.2104
π_t	-0.0273	0.0384
π_{t-1}	-0.1178***	0.0372
ECM_{t-1}	-0.0258***	0.0052
D1979Q2	0.0349***	0.0050
D1979Q3	-0.0244***	0.0057
D1984Q2	-0.0158***	0.0047
D2005Q4	0.0136***	0.0048
D2008Q4	-0.0153***	0.0049

Notes: ***, ** and * denote significance at 1%, 5% and 10% respectively.

Table 9: GDP Model: Long-run Cointegration

Variable	Coefficient	Std. error
$LnSH_t$	-0.1621**	0.0617
R_t	-2.7944***	0.0063
u_t	-0.6660**	0.0088
π_t	-0.6093	0.0102

Notes: ***, ** and * denote significance at 1%, 5% and 10% respectively.

The negative long-run relationship between GDP and social housing could be due to public spending. Social housing is a form of public spending. As there is relatively limited literature directly analysing this link, we could understand it through the channel of public spending. According to the Solow model, if government spending is higher, it will leave less saving and investment, which will create a lower level of income in the steady states. These finding also agrees with Englund and Ioannides (1997) research that said an increase in GDP leads to a rise in house prices. According to the negative link found in the house price equation, Englund and Ioannides (1997) imply a negative correlation between social housing and GDP. This result is contradictory to the positive impact in the literature; however, most of them are not comparable due to lack of relevant data and the difficulty of disaggregating other factors in measuring the effects of housing on health and education.

8 CONCLUSION

This paper discusses the impact of social housing on the housing market and GDP in

the UK using a sample covering from 1975Q2 to 2017Q1. We use the ARDL Bounds test to test the existence of long-run relationships. Then the short-run and ECM are set up to examine the short-run and long-run impact of social housing. As the sample covers a long period in history, we consider the potential structural breaks in the housing market and the whole economy. The estimations and Bounds tests are all adjusted with the structural breaks. The final models are diagnosed in terms of serial correlations, heteroscedasticity and normality issues.

The results show that adding social housing investment has a contemporaneous negative impact on the private housing price in the short run, which is in line with the most of Hedonic literature (Cummings and Landis 1993; Lyons and Loveridge 1993; Goetz *et al* 1996; Santiago *et al* 2001). For every one per cent rise in additional social housing, house prices decrease by 0.03 per cent contemporaneously. For every one per cent increase in additional social housing, house prices will increase by 0.03 per cent in the two quarters ahead. However, in the long run, social housing has no significant effect on the housing price. The findings also suggest that social housing has no immediate impact on the whole economy. However, it has a significantly negative long-run relationship with GDP. For every one per cent new investment in social houses, GDP should fall 0.16 per cent in the long term.

Based on the results, this research can draw several practical implications. In terms of the government side, although there is a high demand for social houses from the public, the UK government needs to be cautious in expanding the investment in social houses. On the one hand, there is a limited budget to increase social homes, particularly under this uncertain future from the Brexit and coronavirus crisis. In addition to this, for every one per cent increase in social houses, GDP falls 0.16 per cent in the long term, which is not a negligible impact. However, on the other hand, 1.2 million homes should be built to satisfy the needs of younger generations (BBC News, 2019). This number will be higher, as more people lost jobs during the

pandemic. Building social houses is more urgent than at any other time. Furthermore, increasing social housing can benefit younger families with affordability issues, as the housing price falls significantly with more social houses supplied, although the amount is not substantial. Therefore, the government could squeeze the budget to implement policies to increase social housing and not just affordable housing as social rent provides more stable outgoings for poor families.

Meanwhile, the government can maintain or support the other type of affordable houses, such as the Help to Buy scheme. By doing so, it may ease up the demand for social houses, particularly during the transition stage of Brexit and after the pandemic. Although social housing affects GDP in the long-run, it does not have any significant effect in the short run. Therefore, policies to encourage social housing temporarily is an ideal plan.

This research does not only provide policy implications for the government but also provide some useful information to common households and investors if the government is expanding the investment in social houses. For the common households, they see adding social houses can make homeownership easier for first time buyers. For the households who have already owned properties, they cannot see the direct benefits. Even if they upgrade or downgrade their homes, the impact of social housing is minimal. However, for the investors and buy-to-let landlords who are expecting a capital gain, they will see property values fall immediately but jump back after two quarters. Therefore, the decisions of new investment can be avoided after half a year. James Hall (2015) suggests that more integration between social housing and private rented/owned housing increases social cohesion is a better solution to ensure the stability of the housing market. When housing tenures are fully integrated, social housing does not reduce property prices.

The limitation of this research is that it cannot tell the optimal number of social houses. Based on the analysis above, we can see that adding social houses can benefit

low-income people with a home, first-time buyers with affordability issue and communities with lower crime rates and happy lives. However, more social houses mean more public spending and less economic growth in the long run. From the government side, it would be useful to know the overall impact, including the non-economic implications. By doing so, the government can act precisely to the social housing policy. Further research could look at other social impacts of this policy. Additionally, setting up a welfare function linking economic and non-economic factors is necessary.

ENDNOTES

[1] Faith Chorley: Nottingham Trent University, 50 Shakespeare St, Nottingham NG1 4FQ, UK (Email: faith.chorley@outlook.com).

[2] Chunping Liu: Corresponding Author: Economics Department, Nottingham Trent University, 50 Shakespeare St, Nottingham NG1 4FQ, UK (Email: chunping.liu@ntu.ac.uk).

[3] We have considered many other variables in the model, such as construction cost and unemployment. However, both are removed due to insignificancy in both short-run and long-run. We did not consider adding demographic factor, as it is not relevant to the time series data.

[4] The optimal lag order for Equation (3) is calculated by deducting the optimal lag orders in Equation (5) by one.

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