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

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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 to be 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 must consider a balance of trade-off between the housing market and the whole economy.*

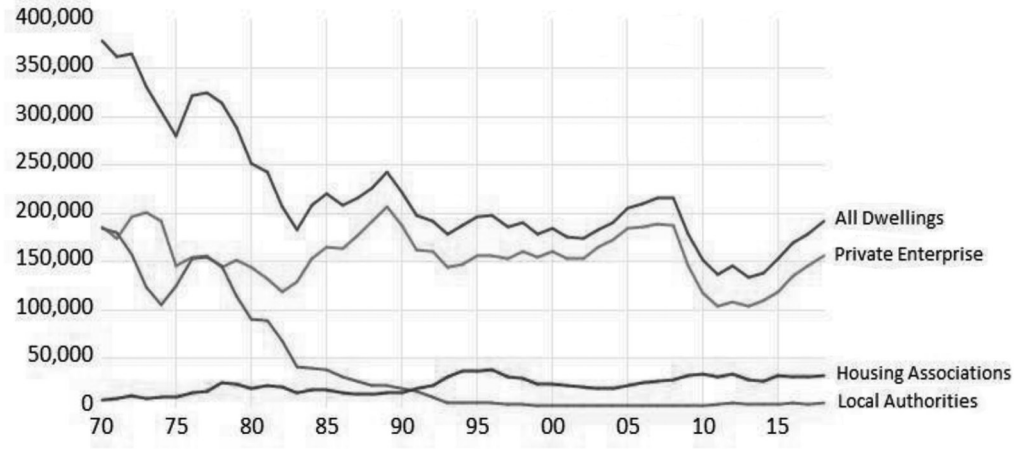
*JEL Classification: R31, R38, O18*
*Keywords: social housing; house prices; GDP; ARDL Bounds test; cointegration*

## 1. Introduction

Social housing has played a prominent part in UK history. Since 1869, when the first tranche was built by Liverpool City Council, the UK government and local authorities have been investing in affordable housing. 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. This lasted until 1980, when a scheme known as 'Right to Buy' was introduced by Margaret Thatcher's Conservative Government. This 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. With Right to Buy, construction also fell, causing the social housing stock to decrease considerably. Indeed, the local authority housing stock has fallen continuously since 1978. In July 2016, the devolved

Scottish government ended the Right to Buy scheme in Scotland because of this falling supply. Figure 1 shows the movement in social housing stock over this period for the UK. Governments today are providing more affordable housing for first-time buyers through 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 ways. 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, 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 on low-incomes 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 the impacts of social housing on the private housing market and on the economy as a whole.

This paper contributes to the existing literature in the following ways. First, it adds a new empirical investigation on the limited literature by examining the impact of social housing in the UK. To the best of our knowledge, the impact of social housing in the UK has not yet undergone significant investigation. Second, most studies use cross-sectional data, where the analysis is static without looking at the dynamic properties of this impact. The extant empirical analysis concentrates on micro studies where the discussion is based on household, district or city level. We utilise an empirical autoregressive distributed lag (ARDL) model, enabling us to analyse the dynamic relationship between social housing and other markets at a macro level. Finally, this study provides recommendations to the government over whether it needs to build more or fewer social houses. It also gives insights for households and investors as to the 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 and typically predates the 1990s. It compares statistics, e.g., on house prices of neighbourhoods with and without affordable housing. With different varieties of affordable housing examined, the findings indicate no clear consensus, e.g. an 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 that the method only uses comparative statistics for different neighbourhoods. There may have been either differences not easily apparent to the investigator or nuances of the neighbourhood that could not be captured by this type of methodology and the data it uses, but that nonetheless affected housing prices.

The second strand of literature adopts the Hedonic model, estimating the relationship between social housing and property values. This literature took off in the 1990s. Nguyen (2005) reviews many studies about the types of affordable housing and their impacts, including the work of 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 the properties more proximally located. However, the magnitude of this impact 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 prices (Cummings and Landis 1993). In a more recent study, Diamond and McQuade (2019) 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 results from 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-sectional data which do not allow for the dynamic properties of this impact to be evaluated. Furthermore, the empirical discussion focuses on micro levels, such as household, district or city.

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 produces evidence of the region-wide economic impact of social housing. An Economic Impact Assessment (EIA) created from this survey, analyses direct and indirect supplier 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 shows that social housing has had a large impact on the Northern Ireland economy and leads to higher employment, which in turn leads to an increase in GDP.

Lloyd (2015) finds that social housing is a driver of economic growth. Every £100m invested in affordable housing supply generates £210 million in extra economic output and sustains 1,270 jobs. The housing programme that delivers 12,999 affordable homes per year can generate £2.6 billion of extra economic output. The research shows that affordable housing addresses inequality and provides a stable environment where policies can be implemented that target educational attainment and poverty reduction. However, this analysis is still limited and does not fully explore the wider economic effects in an econometrically robust way.

Many studies provide evidence of social housing improving certain economic outcomes 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), reviewing the literature on the social and economic impacts of social housing, 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 of 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. These are significant gaps in our understanding of the socioeconomic impacts of housing, given a lack of relevant data and the difficulty of disaggregating other factors in measuring the effects of housing on health and education.

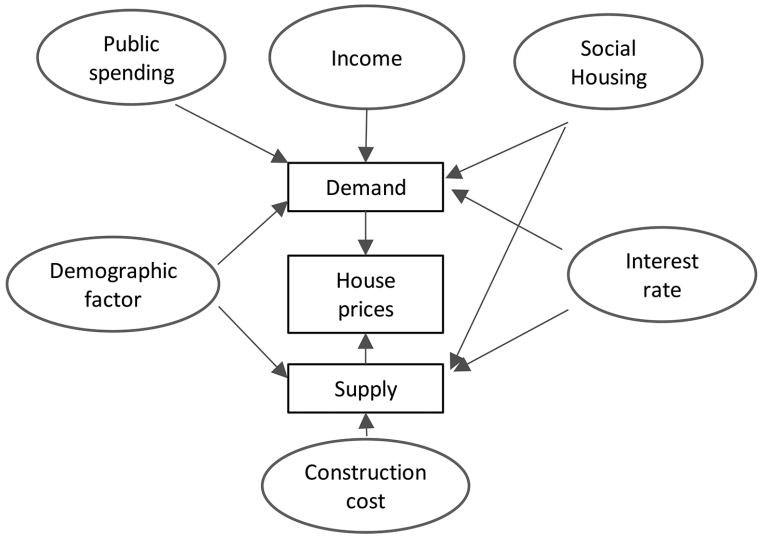
We can also understand the relationship between social housing and the economy through the link between private house prices and the economy. The existing studies mostly agree on a positive relationship between house prices and economic growth (Coulson and Kim 2000; Davis and Heathcote 2005; Chen *et al* 2011; Liu and Ou 2020). However, disagreements arise over the dominant channels through which house prices affect the economy. Iacoviello and Neri (2010) find that the housing market spillover works mainly 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 prices on the economy is a result of a borrowing constraint. In particular, when people have a lower house price to income ratio (financially constrained), the collateral effect through investment is larger than the wealth effect. Moreover, several studies disagree over the positive relationship, in particular the contemporaneous effect (*inter alia* Ghent and Owyang (2010).

## 3. Model

Existing studies about housing price determination are explained through supply and demand of the housing market (see Figure 2). The common variables investigated in these 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 (Adams and Füss 2010). Barot and Yang (2002) find that the real interest rate is negatively correlated with house prices in the UK given 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 is found to be significant as a factor determining house prices. Afonso and Sousa (2012) conclude that fiscal shocks affect property values positively and permanently. Aye *et al* (2014) find that the impact of a government expenditure shock on house prices is less than that on the stock market. Gupta *et al* (2014), meanwhile, find that unexpected government expenditure shocks have little impact on house prices, but expected government expenditure shocks are positively related to housing prices.

There are different types of government expenditure that may lead to different effects on the housing market. García *et al* (2010) find that local policies to improve the quality of life, or the location-specific characteristics of a city (Barcelona in their study), 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 the demand side of the market (Barot and Yang 2002, Hilbers *et al* 2008). Holly and Jones (1997) investigate the housing market in the UK and find that income is the most important factor determining house prices in the UK. However, Brooks and Tsolacos (1999) argue that the most significant impact on house prices in the UK is the lagged value of house prices.

Other factors determining house prices in the literature are construction cost, demographic factors, housing bubbles, housing finance and housing quality. Demographic factors are seen as a significant determinant of house prices by some (e.g. Girouard *et al* 2006; Égert and Mihaljek 2007), but not (at least not directly) by others (Jacobsen and Naug 2005). The bubble is another consideration in the housing market (Engsted *et al* 2016), which is associated with people's expectations. 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. This will inflate the bubble even further.

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

$$LnHP_t = f(LnSH_t,\ R_t,\ GE_t,\ GDP_t) \tag{1}$$

where $LnHP_t$ and $LnSH_t$ are the logs of the 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 investigate further the link between social housing and the economy as a whole, we set up the model as follows,

$$LnGDP_t = f(LnSH_t,\ R_t,\ GE_t,\ u_t,\ \pi_t) \tag{2}$$

where $u_t$ and $\pi_t$ are unemployment 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 originated from Pesaran and Shin (1999) and developed by Pesaran *et al* (2001). The ARDL model became popular as it offered several advantages over 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 multicollinearity in the original model, leading to a better statistical disturbance term. Last, we can still use the ARDL method, even when the explanatory variables are endogenous (Pattichis 1999; Alam and Quazi 2003).

As our data contain 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 issue of endogeneity. The ARDL model for housing prices is specified as follows,

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

where the coefficients ($\alpha$, $\beta$, $\gamma$, $\lambda$, $\phi$) measure the short-run relationships, while $\delta_s$ characterises the cointegrating relationship. To investigate further the link between social housing and the economy as a whole, we specify the following model,

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

The coefficients ($\kappa$, $\xi$, $\varpi$, $\chi$, $\eta$) indicate the short-run relationships, while $\vartheta_s$ captures the long-run relationship. We first 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 these 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, we conclude that there exists a cointegrating relationship. If the *F*-statistic is lower than the lower-bound critical value, we are unable to reject the null hypothesis of the non-existence of a long-run relationship.

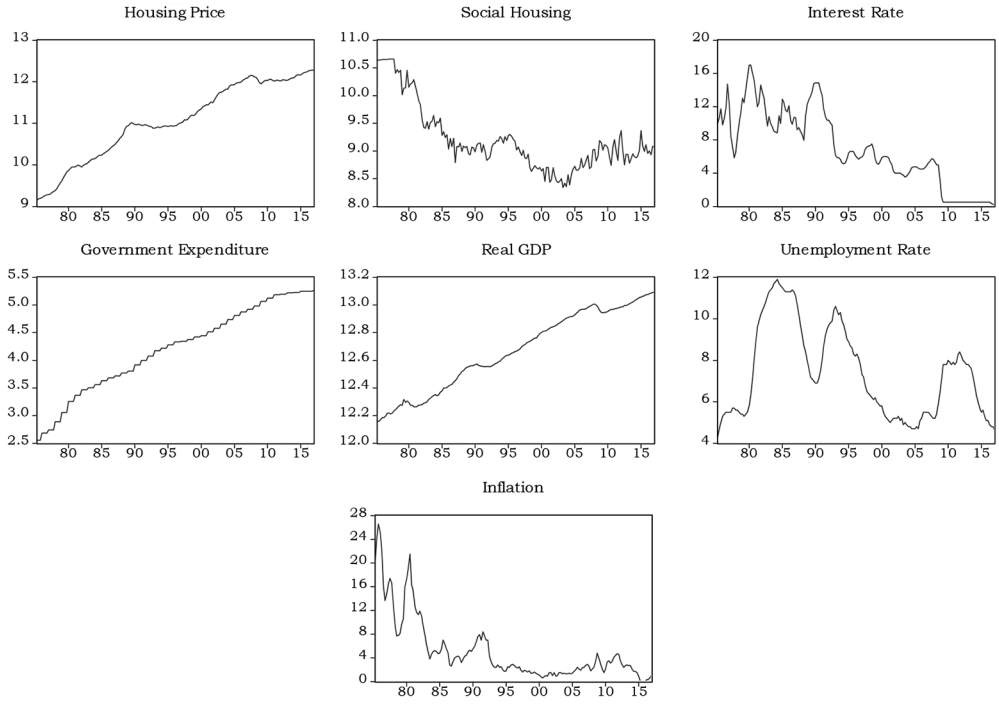
Moreover, if the *F*-statistic lies between the lower and upper-bound critical values, the result is inconclusive. There is another possibility; that the *F*-statistic is rejected, but *t*-statistic is not. This implies the cointegrating relationship (error correction term) arises because of the lagged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

## 5. DATA

The data covers from 1975Q2 to 2017Q1. House prices were collected from 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. The 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 variables over the sample period. Social housing completions fell between 1975 and 2002 as public 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 data. GDP closely matches the dips

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 and inflation are all in percentage points.

created by the housing bubbles. Government expenditure has been increasing year on year, but with more steady growth since 2010 as austerity policies were implemented. The interest rate between 1975Q2 and the 1990s fluctuated significantly. More recently it has been much more stable, following the decision to make the Bank of England functionally independent, and it was held at half per cent until 2016Q4. It then fell further to 0.25 per cent until the end of the data range. Unemployment fluctuated dramatically, moving inversely with GDP.

To estimate the long-run relationship between social housing and house prices by the ARDL approach, we first check the integration orders of all variables, to ensure that they are not integrated of more than order 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 that all variables except social housing are non-stationary in levels, but become stationary following first differencing. We can therefore conclude that all variables are I(1) except social housing, which is 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*** |
| $\varpi_t$ | constant | –2.45 | constant | –7.63*** |

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

## 6. Does Social Housing Affect the 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 long period, there

may be structural breaks existing in the final ECM or short-run model. We perform multiple structural break tests by the Sequential Bai-Perron method, outlined by Bai (1997) and Bai and Perron (1998), which offers sequential tests of L+1 versus L breaks, and reports breakpoints. If there are breaks, we include dummy variables to the long-run cointegrating equation and final estimation model. Finally, we perform diagnostic tests to ensure the model is stable, free of serial correlations and heteroscedasticity, and normally distributed.

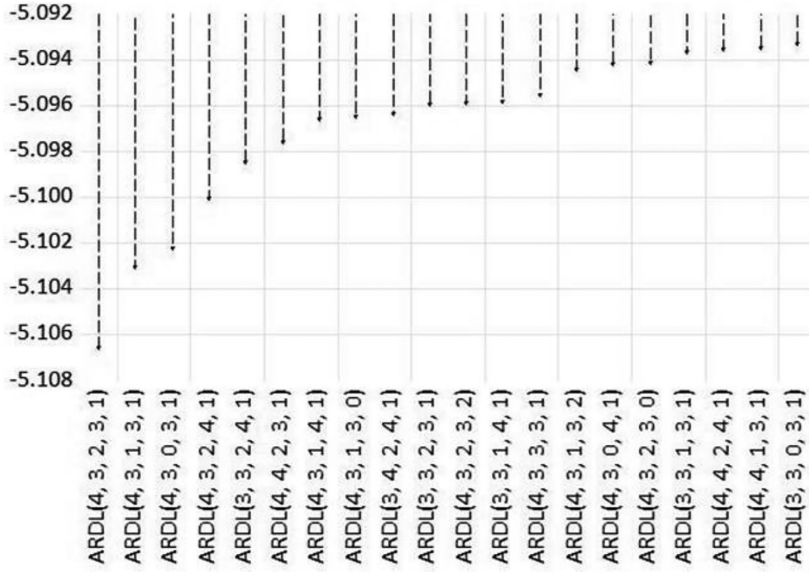
*6.1 Lag Selection*

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. We can see ARDL(4,3,2,3,1) has the lowest AIC and is therefore selected for the following estimations.[4]

Figure 4: Housing Price Model: Lag Selection




Notes: The graph shows the values of AIC for the 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 them 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 (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 variable. Therefore, there is no 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*-statistic = 4.74 | 10% | 2.45 | 3.52 |
| | 5% | 2.86 | 4.01 |
| | 2.5% | 3.25 | 4.49 |
| | 1% | 3.74 | 5.06 |
| *t*-statistic = –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 for 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.

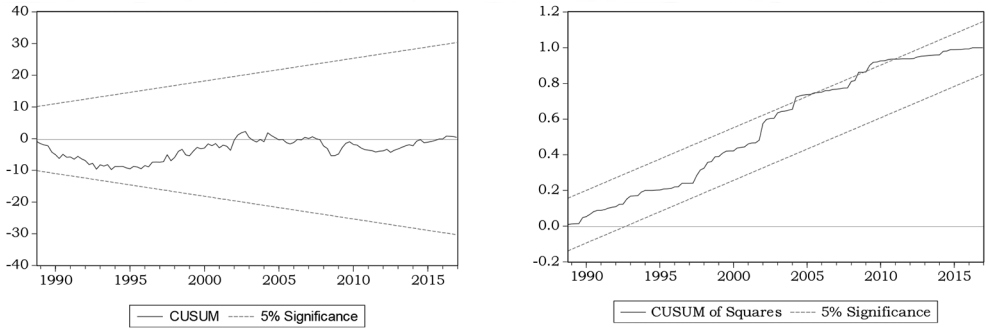
Table 3: Housing Price Model: Structural Breaks

| *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 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 a model lies within the lines, it is considered to be stable. Any movement outside of the lines suggests parameter or variance instability. Figure 5 shows that both statistics fall within the bounds at the five per cent significance level the majority of the time, which implies that there are grounds for assuming stability in the model.

Figure 5: Housing Price Model: Stability Tests




Notes: The CUSUM approach for detecting stability is developed by Page (1954).

In addition to the stability tests, we also perform other model diagnostic tests to ensure the error term satisfies the standard OLS assumptions. Serial correlation is problematic in time series models, as it affects 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 for heteroscedasticity, which indicates the model is free of this problem. Finally, the Jarque-Bera statistic 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 the 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 shown 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. This could be caused by the rise in housing stock. When more social houses, as opposed to private dwellings, are added to the housing market, it reduces property demand within the private housing market. Therefore, the housing price falls. We can confirm 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 contrasts 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, we also find that for every one per cent increase in additional social housing, house prices will increase by 0.03 per cent two quarters ahead, which we can find support in Rabiega *et al* (1984). The dummy variable shows high significance here.

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

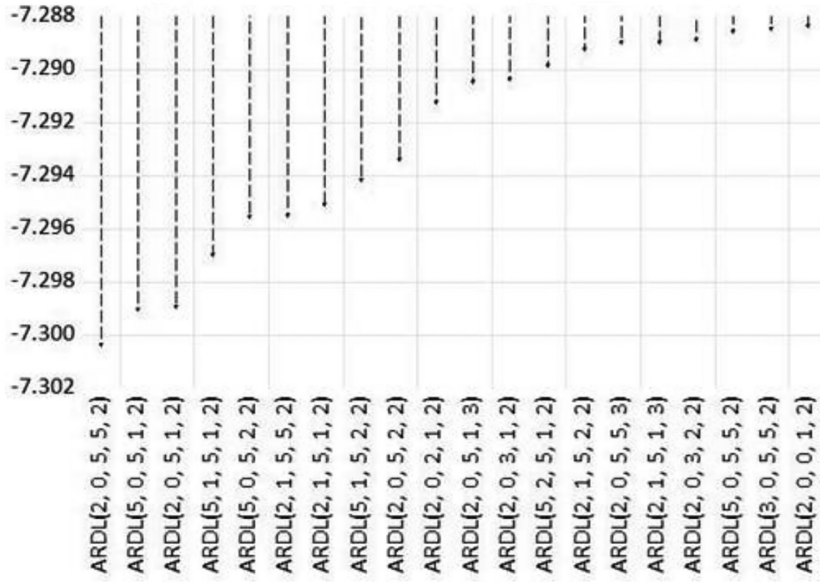
### *7.1 Lag Selection*

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

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

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 $\pi_t$.

### *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*-statistic and *t*-statistic allow us to reject the null hypothesis at the one per cent and 2.5 per cent significance levels, respectively, indicating that cointegration exists.

Table 6: GDP Model: Bounds Test

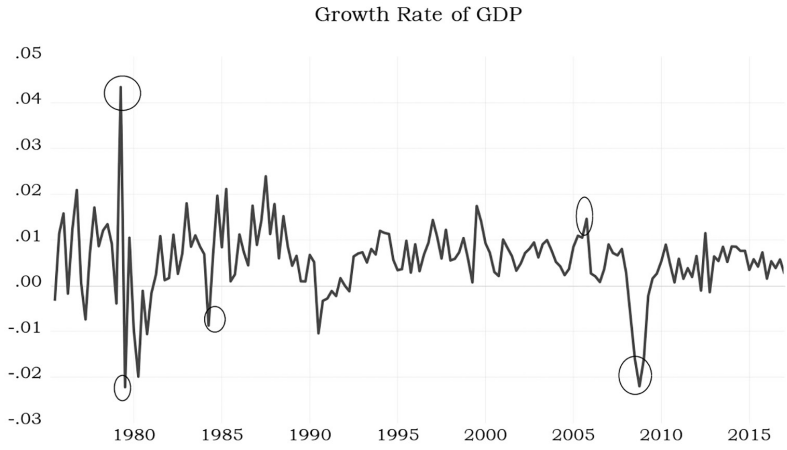
| *Statistics* | *Significance level* | *I(0)* | *I(1)* |
|---|---|---|---|
| *F*-statistic=5.25 | 10% | 2.45 | 3.52 |
| | 5% | 2.86 | 4.01 |
| | 2.5% | 3.25 | 4.49 |
| | 1% | 3.74 | 5.06 |
| *t*-statistic=-4.28 | 10% | –2.57 | –3.66 |
| | 5% | –2.86 | –3.99 |
| | 2.5% | –3.13 | –4.26 |
| | 1% | –3.43 | –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 the Bai and Perron method with 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, retaining only those found to be significant. The final break dates detected are shown in Figure 7.

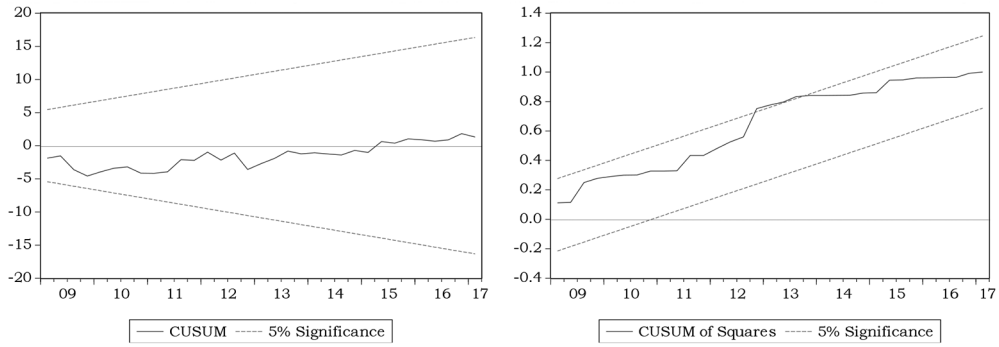
Figure 7: GDP Model: Structural Breaks




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

Figure 8 presents the CUSUM and CUSUM squared statistics test, where we can see both the CUSUM and CUSUM squared test lie inside the five per cent intervals after we fit the dummy variables. Table 7 shows the results of serial correlation, which also shows 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 Page (1954).

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 negative 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 short-run studies, such as Foden *et al*

(2015) and Lloyd (2015). Social housing may have a positive impact on GDP via a reduction in poverty in the short term, but our study suggests 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 |
| $\varpi_t$ | –0.0273 | 0.0384 |
| $\varpi_{t-1}$ | –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* | *Standard error* |
|---|---|---|
| $LnSH_t$ | –0.1621** | 0.0617 |
| $R_t$ | –2.7944*** | 0.0063 |
| $u_t$ | –0.6660** | 0.0088 |
| $\varpi_t$ | –0.6093 | 0.0102 |

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

The negative long-run relationship between GDP and social housing might be understood 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 state. This finding also agrees with Englund and Ioannides (1997), who found that an increase in GDP leads to a rise in house prices, but also a negative correlation between social housing and GDP. This result is contradictory to the positive impact in the literature; however, most studies are not directly comparable, given the lack of relevant data and the difficulty of disaggregating other factors in measuring the effects of housing on health and education.

## 8. Conclusions

This paper discusses the impact of social housing on the housing market and GDP in the UK, using data for 1975Q2 to 2017Q1. We use the ARDL Bounds test to test the existence of long-run relationships. Then the short-run or ECM are set up to examine the impact of social housing. As the sample covers a long timeframe, we also consider potential structural breaks in the housing market and economic data. The estimations and Bounds tests are all adjusted with structural breaks. The final models are tested for serial correlations, heteroscedasticity and normality concerns.

The results show that social housing investment has a contemporaneous negative impact on the private housing price in the short run. This finding is in line with most of the Hedonic literature (e.g. 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 falls 0.16 per cent in the long term.

Based on these results, this research offers several practical insights. Although there is a high demand for social housing, the UK government needs to be cautious in expanding investment in social houses. On the one hand, there is a limited budget to increase social homes, particularly under current financial circumstances. In addition, 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. On the other hand, 1.2 million homes need to be built to satisfy the needs of younger generations (BBC News, 2019), with an increase in social housing demand likely as a result of the economic fallout of Brexit and coronavirus on the job market. Furthermore, increasing social housing can benefit younger families who face affordability challenges, although the estimated negative impact of this on housing prices is modest.

Meanwhile, the government can maintain support for other types of affordable housing, such as the Help to Buy scheme. By doing so, it may ease the demand for social houses, particularly under current economic conditions.

This research also suggests for stakeholders more widely that expanding investment in social houses can help improve affordability for first time buyers. Meanwhile, there is no negative impact on existing property owners.

For investors and buy-to-let landlords, who seek capital gain, they could see property values fall in the short term, but jump back after two quarters. Hall (2015) suggests that more integration between social housing and private rented/owned housing increases social cohesion and 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.

A key limitation of this research is that it cannot predict 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 can 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 non-economic implications. By doing so, the government can design a more effective social housing policy.

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## Endnotes

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3. We have considered construction cost and unemployment. However, both have been removed as they were found to be insignificant, in both short-run and long-run. We did not consider adding demographic factors, as they are not relevant to the time series nature of this research.

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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