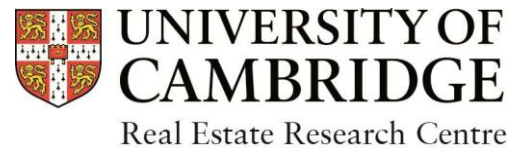


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**Title:** House prices, fertility rates, and homeownership: Evidence from the UK

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# House prices, fertility rates, and homeownership: Evidence from the UK

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## Abstract

This paper presents the results of a first quantitative study into the relationship between house prices and fertility rates at the local authority district spatial scale in the United Kingdom (UK). The study focuses on London Boroughs, from 2001-2020, and empirically examines the connection between fertility rates and house prices and interacts house prices with a baseline measure of home ownership. The core OLS estimates indicate that when borough-level home ownership rates are low (i.e., when there are lots of renters in the borough), a 1% increase in house prices is associated with a small decrease in fertility rates. However, when borough-level home ownership rates increase beyond 44.4%, this marginal effect turns positive, and increases in house prices are found to increase fertility rates, due to positive wealth effects that accrue to existing home owners. These findings are robust to a number of alternate model specifications, including the use of different independent variables and alternative lag effects. Additionally, the instrumental variable approach is employed to address potential endogeneity concerns, further strengthening the validity of our results. Finally, the results are in line with the predictions of qualitative evidence from London and of existing literature (Dettling and Kearney, 2014; Aksoy, 2016), and illustrate the importance of tenure patterns in shaping the relationship between housing and fertility.

**Keywords:** house price, fertility rate, homeownership, wealth effect, London

**JEL Classifications:** R31, J13, D31

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## 1. Introduction

Low and declining fertility rates are a matter of policy concern in the UK and across the developed world. If current period fertility rates are consistently below historic rates, a country risks developing a ‘top-heavy’ population pyramid, where there are a large number of elderly dependents relative to the working-age population. Indeed, this is the case in the UK, where low fertility rates, coupled with increases in life expectancy, have driven the elderly dependency ratio to an all-time high of 30% (World Bank, 2022). Failure to combat these demographic issues risks exacerbating a number of long-term economic problems. Without youthful workers coming in to fill vacancies left by retiring workers, the UK may face labour shortages and stagnant growth. Additionally, a Parliament Briefing Paper explained that as the UK population grows older, tax receipts are likely to fall, and welfare spending for the elderly will need to increase (UK Parliament, 2015). Understanding the drivers of fertility will allow policymakers to formulate better solutions to these issues. Predicting birth patterns also helps inform migration and urban planning policy. Consequently, the decline in fertility rates in the UK is a matter that requires further investigation by researchers and policymakers alike.

Falling fertility rates are, in part, emblematic of societal progression, but fertility rates remain consistently below desired levels, which indicates the existence of certain barriers to family enlargement. Many of the factors that help explain the global decline in fertility over the last 70 years are positive, such as the empowerment of women in education and work, lower child mortality, and increased contraceptive use (Roser, 2014). However, in developed countries, there is often a gap between ideal and realised family size (Beaujouan and Berghammer, 2019). Berrington and Pattaro (2014) explore this fertility gap in the UK and find that only 43% of individuals achieved the number of births they wanted. Importantly, the fertility gap indicates that there are certain obstacles hindering families from achieving their ideal family size. A central issue is cost. To help families realise their fertility intentions, policymakers must understand and tackle the financial hurdles that may prevent families from having a child.

A decomposition of the cost of a child indicates that the housing market might have a vital role to play in fertility decisions. Lino *et al.* (2017) in their US study, found that, across income groups, housing makes up the largest proportion of total child-raising

expenses. Additionally, an OECD publication states that ‘growing housing problems’ have played a ‘central role’ in fertility postponement and decline (OECD, 2016). Consequently, there is the intuitive notion that the affordability crisis in the UK housing market might have contributed to declining fertility rates.

The housing crisis is particularly acute in London, where families are spending a large proportion of their income on rent, and the prospect of home ownership is becoming increasingly out of reach for a large segment of the population. Fertility rates in London have fallen quicker than in any other part of the UK in the last 10 years<sup>2</sup> and interviews with residents indicate that housing is a major factor in their childbearing decisions.

A resident of West London, who has chosen to not have any more children, explained his choice in an interview for the Evening Standard (Wills, 2021), stating that:

*“After rent and childcare costs, there’s nothing left every month.”*

Rolling Stone (Garland, 2022), interviewed Jess, from South-East London, who explained that:

*“When my boyfriend and I chat about the prospect of having children, the sticking point is always money... We spend around half our pay cheques on rent each month with the knowledge that we could be evicted at our landlord’s whim and priced out of the city... It’s the lack of somewhere to put down roots that makes me especially wary... a child needs a stable and secure home, and we can’t guarantee that right now.”*

This qualitative evidence indicates that for some Londoners, the housing market can shape decisions about fertility and may act as an obstacle to family formation and enlargement. Whilst qualitative research is strong on this topic, to date there has been no quantitative analysis of the impact of the housing market on fertility in London.

This study aims to fill this gap, and empirically examines the connection between borough-level house prices and fertility rates in London from 2001-2020. The analysis in this paper reveals a statistically significant link between housing and fertility and indicates that housing tenure plays an important role in shaping this relationship.

The rest of this paper is structured as follows: Section 2 presents a literature review, Section 3 sets out this paper’s research questions and testable hypotheses, Section 4

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<sup>2</sup> Author’s calculation using data from the ONS.

outlines the data used in the analysis and provides some descriptive statistics, Section 5 describes the empirical approach, Section 6 presents and discusses the results, and Section 7 concludes and suggests some policy implications.

## **2. Literature review**

This section presents some general context on the economic analysis of fertility, reviews the existing literature on the relationship between housing and fertility, and summarises the mechanisms through which the housing market might influence the childbearing decisions of families. The review identifies support for a potential empirical link between housing and fertility rates and illustrates that the nature of this relationship may depend on tenure patterns, that is, whether households own their home or not.

Before Gary Becker (1960), fertility choices were ‘widely considered to be outside the realm of economic analysis’ (Doepke, 2015). In *‘A Treatise on the Family’*, Becker (1991) summarises his earlier research and sets out a microeconomic framework for understanding fertility, where demand for children is a function of their relative price and family income levels (Becker, 1991, p.135). In his work, Becker mentions housing only briefly, when he hypothesises that cheaper housing costs in rural areas may help explain why ‘farm families have been larger than urban families’ (Becker, 1991, p. 138). This section builds on Becker’s analysis and explicitly considers the interaction between the housing market and fertility patterns.

The relationship between housing and fertility is shaped by several factors. This paper synthesises the existing literature into a cogent framework for understanding the impact of housing on fertility. This framework outlines five key mechanisms through which the housing market may shape fertility decisions: (1) a negative substitution effect, (2) the perception of home ownership as a prerequisite for family formation, (3) competition between home ownership and fertility, (4) a negative income effect, and (5) a positive wealth effect.

### *2.1 Negative substitution effect*

House price inflation can be expected to exert a negative substitution effect on the demand for children. Housing is a significant cost of raising a child. Consequently, house price

inflation increases the cost of raising a child relative to other goods. An increase in the relative price of children should give rise to a negative substitution effect, where households switch their consumption away from children in favour of other goods (Becker, 1991; Yi and Zhang, 2010). This effect should impact both home owners and non-home owners, as an additional child requires extra space, regardless of tenure. Since very few families want to stay childless (Berrington and Pattaro, 2014), it is possible that the sensitivity of demand for children with respect to their cost may be very low for first births. Cost considerations may play a greater role when a family debates whether to increase their family size from two to three, or three to four (Washbrook, 2013)<sup>3</sup>. Therefore, existing family size may impact the power of a negative substitution effect for children.

### *2.2 Home ownership as a prerequisite for family formation*

Increasing housing costs may exert downward pressure on fertility rates if families perceive home ownership to be a prerequisite for having a child (Mulder and Wagner, 2001; Vignoli, Rinesi and Mussino, 2012). Mulder (2006) explains that families may delay having a child until they own a home. She argues that this effect may be particularly strong in the UK, ‘where many feel the necessity to become home owners before they form families.’ An important moderating factor here is the cost and accessibility of debt. Purchasing a home becomes even more challenging if it is hard to obtain a mortgage and interest rates are high. In summary, if owning a home is a prerequisite for family formation, then an increasingly unaffordable housing market can be expected to depress fertility rates amongst renters unable to make the move to ownership.

### *2.3 Competition between the prospect of home ownership and childbearing decisions*

The cost of raising a child may ‘compete with the cost of purchasing a home’ (Courgeau and Lelièvre, 1992). In countries with strong home ownership aspirations, families may be prepared to postpone or forego having a child so that they can get a step on the property

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<sup>3</sup> Washbrook’s draft paper is cited by other papers on housing and fertility, but Dr Washbrook advises that, since it was never peer reviewed, it should not be relied upon and is thus not discussed further in this review.

ladder. Despite housing becoming increasingly unaffordable (ONS, 2022), ownership is still an important aspiration for many families in the UK (Pannel, 2016). Renters may prefer to allocate funds to saving for a deposit on a home, rather than spending on raising a child. Hui, Zheng and Hu (2012) and Lo (2012) explain that this effect may also impact recent home owners, because if families are spending increasing proportions of their earnings on purchasing a home and servicing mortgage payments, they may no longer feel as though they have the disposable income left to raise a child. Therefore, if the price of housing rises, and achieving the goal of home ownership remains central for households, then some families may be forced to delay or forgo other life aspirations, such as having a child, causing a corresponding decline in fertility rates.

#### *2.4 Negative income effect*

Inflation in the housing market can also depress fertility through a negative income effect amongst renters, as a consequence of higher rent payments. Private rental inflation reduces the disposable income of families, which impacts their financial capacity to raise a child. Simon and Tamura (2009) support this, finding a negative link between rent per room and fertility rates in their study of US counties from 1940-2000. The extent to which house price inflation depresses fertility through this mechanism depends on how strongly house prices and rents are linked. A large segment of potential new parents, or families looking to have another child, live in rented accommodation in the UK (YouGov, 2021; DLUHC, 2022). Consequently, understanding the interlinkage between the rental sector and fertility decisions may be crucial to explaining low fertility rates in the UK.

The evidence thus far indicates that housing market inflation may act as an obstacle to family formation and enlargement. A large portion of the recent literature focuses on Asia, where low fertility rates are a major policy concern, and a number of papers have found support for a negative link between house prices and fertility rates (Yi and Zhang, 2010; Hui, Zheng and Hu, 2012; Xuemei and Yuhao, 2019; Yin and Su, 2021). Liu, Xing and Zhang (2020) use survey and census data from 2005 and 2010 across China, matched to city level house prices for this period. They find a 'significant negative fertility response to house prices amongst renter families' but conclude that the effect is insignificant for home-owning families. This indicates that tenure may be a key

moderating factor in the relationship between the housing market and fertility rates. Consequently, analysis that separates home owners and renters may facilitate a deeper understanding of how house prices impact fertility decisions.

### *2.5 Positive wealth effect*

In fact, house price inflation could actually increase the demand for children from existing home owners through positive wealth effects. Therefore, it is important that any analysis of fertility accounts for tenure patterns within the housing market. House price inflation can be expected to impact the demand for children from home owners through two routes. First, if households are able to convert their increase in housing wealth into income through equity release, then family income will increase. Second, even if households are unable to extract equity from their house, an increase in house prices may contribute to a feeling of greater financial security. Empirical evidence indicates that house price inflation can generate positive wealth effects for children. For example, Lovenheim and Mumford (2013), using US panel data from 1985-2007, find that a \$100,000 increase in housing wealth causes a '16% to 18% increase in the probability of having a child' amongst home owners. Additionally, Clark and Ferrer (2019), using Canadian panel data from 1994-2010, find a positive relationship between house prices and fertility for existing home owners who are not planning to move. These findings indicate that tenure may be an essential component in the relationship between the housing market and fertility, and ownership rates in the housing market may be a crucial factor in determining the overall impact of housing on fertility.

These five effects are outlined in Appendix A, which summarises the ways in which the housing market might impact fertility decisions, and how these effects differ based on tenure. In conclusion, the literature indicates that the housing market plays a role in shaping the fertility patterns of households, exerting a broadly positive effect on the fertility rates of home owners and a negative effect for non-home owners. However, it should be noted that, in this paper, fertility is discussed as if it is always a perfectly thought-out decision. As Dettling and Kearney (2014) explain, this is not always the case; households may not consider all available information before having a child, some

pregnancies are unplanned, and other couples struggle to have a baby despite wanting one. Therefore, the observed response of fertility to house prices in the data can never be a completely full reflection of how the housing market impacts the childbearing decisions of households.

### **3. Research questions and testable hypotheses**

This paper aims to fill the following research gaps identified in the literature review. First, it will extend our understanding of the drivers of fertility and population growth within urban environments, which is a matter of importance to policymakers and planners alike. This paper will provide evidence of the link between housing and fertility at the London Borough level. Analysis at this spatial scale facilitates a deeper understanding of how fertility dynamics operate *within* a city, rather than at the aggregate level, as has been the focus of previous papers that have studied cities (Yi and Zhang, 2010; Hui, Zheng and Hu, 2012) or English Counties (Aksoy, 2016). This should also help improve precision, as the data are more closely spatially aligned to the underlying fertility patterns which are being investigated (Flowerdew, 2011). Second, the explicit focus on London adds to the literature and the findings may be applicable to other global cities, which have also experienced growth in house prices that has rapidly outstripped earnings. Finally, the existing literature is largely focused on Asian economies, this paper adds to the European literature and fosters a greater understanding of the relationship between housing and fertility in the UK.

The following research questions have been developed to guide the analysis in this paper:

- 1) Does the housing market impact the fertility decisions of households?
- 2) Is home ownership a moderating factor in the relationship between housing and fertility?

Two hypotheses are formulated in response to these research questions.

*Hypothesis 1:*

*An increase in house prices will have a significant impact on fertility rates in London Boroughs.*

This is devised in response to the first research question and draws from the existing literature, which predominantly finds a negative relationship between housing and fertility.

*Hypothesis 2:*

*An increase in the number of home owners in a given London Borough will lead to a more positive impact of house prices on fertility rates.*

This second hypothesis considers how home ownership shapes the potential connection between house prices and fertility rates. If everyone in the borough was a renter, and house prices increased, a fall in fertility would be expected, due to the mechanisms outlined in the literature review. On the other hand, if everyone in the borough owned their home, an increase in house prices is expected to have a more positive impact on fertility, as a consequence of positive wealth effects.

The following sections 4 and 5 outline the data and empirical strategy that will be used to test these two hypotheses.

## **4. Data and Model Specification**

### *4.1 Data and descriptive statistics*

The empirical approach in this paper utilises a balanced data set from 32 London Boroughs, across the period 2001-2020. The City of London has been omitted from the analysis due to a lack of reliable data for all variables. All data are at the borough-year level. House price data are obtained from the HM Land Registry, from 2001-2020, while home ownership rates, fertility rates and other control variables are obtained from the Office for National Statistics (ONS). Detail on the variables used in this analysis can be found in Appendix B.

### *4.2 Model specification*

Similar to the approach used by Dettling and Kearney (2014) and Aksoy (2016), this paper aims to empirically relate borough-level fertility rates to borough-level house prices and interacts house prices with a baseline level of borough-level home ownership rates.

A regression model of the following form is used for the analysis:

$$\log TFR_{b,t} = \beta_0 + \beta_1 \log HP_{b,(t-1)} + \beta_2 (\log HP_{b,(t-1)} * \log HomeOwn_b) + \beta_3 \log HomeOwn_b + X_{b,(t-1)} + \gamma_b + \gamma_t + \varepsilon_{b,t} \quad (1)$$

In equation (1),  $t$  denotes the year of birth. This paper is concerned with the impact of house prices on fertility decisions. The decision on whether to have a child (i.e., conception) is likely to occur in the year before the actual birth occurs. Therefore, the independent variables have been lagged by one year. Also,  $b$  denotes London Borough, which is the spatial scale that the analysis is performed at. Additionally, house prices, home ownership rates, and total fertility rates have been log transformed, to facilitate a more intuitive interpretation of the key coefficients and to control for outliers.  $X_{b(t-1)}$  is a vector of the control variables, which include weekly wages, female employment rate, education levels, the share of foreign-born population, age, and net population change.  $\gamma_b$  and  $\gamma_t$  represent borough and year fixed effects respectively.

The two key coefficients in the regression model are  $\beta_1$  and  $\beta_2$ . First, for Hypothesis 1,  $\beta_1$  measures the impact of one-year lagged house prices on current-period fertility rates. Second, for  $\beta_2$ , house prices are interacted with home ownership (HomeOwn), which is held constant at 2001 levels. This interaction term is crucial for testing Hypothesis 2, which states that an increase in borough-level home ownership rates will lead to a more positive impact of house prices on fertility rates.  $\beta_3$  is the second conditional main effect. It looks at the direct impact of borough-level home ownership on fertility rates, without looking at the role house prices play.

## 5. Results and discussion

### 5.1 OLS estimations

The full estimations from the OLS regressions are presented in Table 1 below. Model 1 serves as the baseline pooled regression. Model 2 extends this specification by incorporating a set of control variables. Model 3 incorporates year fixed effects, while Model 4 includes both year and borough fixed effects.

Table 1. House prices and fertility rates - London Boroughs 2001-2020 - full OLS estimations

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	(1)	(2)	(3)	(4)
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logHP	-2.07599***	-1.66622***	-1.52055***	-1.13170***
logHP * logHomeOwn2001	0.47822***	0.37181***	0.31151***	0.29834***
logHomeOwn2001	-5.88209***	-4.59410***	-3.97503***	-2.62752***
Wages		0.00035***	-0.00027***	0.00003
Education		-0.00182**	-0.00112*	-0.00139*
Female Employment Rate		-0.00398***	-0.00175**	-0.00201***
Foreign Born		0.00243***	0.00228***	0.00313***
Age		-0.01158***	-0.01142***	-0.01308***
Net Population Change		-0.01413***	-0.01567***	-0.01129***
Year	No	No	Yes	Yes
Borough	No	No	No	Yes
N	608	608	608	608
Adj R <sup>2</sup>	0.569	0.725	0.872	0.933
F	324.328	152.283	135.514	143.619

Note: \*, \*\*, and \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Below is a simplified form of the regression equation in Model 4.

$$\log TFR_{bt} = \beta_0 + \beta_1 \log HP_{b(t-1)} + \beta_2 (\log HP_{b(t-1)} * \log HomeOwn_b) + \beta_3 \log HomeOwn_b \quad (2)$$

Marginal effects of lagged house prices on fertility can be estimated by taking partial derivatives, set out below.

$$\frac{\partial \log TFR}{\partial \log HP} = \beta_1 + \beta_2 (\log HomeOwn) \quad (3)$$

The coefficients estimated by Model 4 are now inputted into this equation. The impact of house prices on fertility at different rates of home ownership is plotted below.

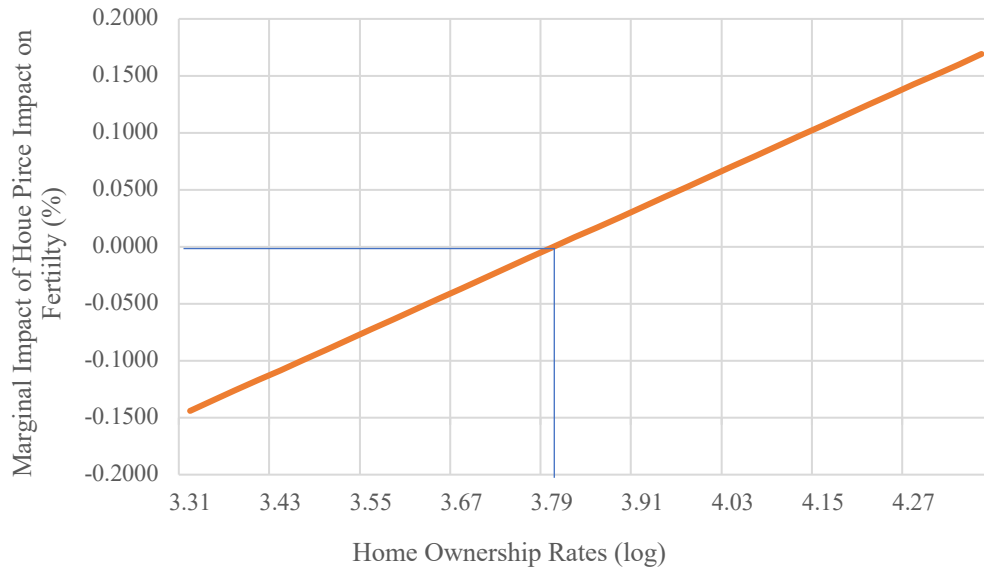


Figure 1. Graph showing the impact of home ownership on the relationship between housing and fertility, London Boroughs, 2001-2020

Figure 1 illustrates that, at low levels of home ownership, a 1% increase in one-year lagged house prices leads to a small decrease in current period fertility. This is in line with the two key hypotheses and the framework set out in the literature review. House price inflation is expected to depress fertility among renters, for four reasons: (1) a negative substitution effect, (2) if home ownership is perceived as a prerequisite for family enlargement, (3) if saving for a home competes with childbearing ambitions, and a (4) negative income effect. However, when borough-level home ownership rates reach 44.4% (which is 3.79 when log transformed), the marginal effect of a 1% increase of house prices on fertility rates becomes positive. A rise in house prices raises the asset wealth of existing home owners, which they may use to fund their childbearing aspirations (Dettling and Kearney, 2014) and as home ownership rates pass 44.4%, this effect appears to dominate. Home ownership is now set at its mean 2001 level (55.328). This facilitates an estimation of the net effect of a 1% increase in lagged house prices on fertility.

$$\frac{\partial \log TFR}{\partial \log HP} = -1.13170 + 0.29834(\log(55.33)) = 0.0511\% \quad (4)$$

These findings indicate that, **at the mean 2001 home ownership rate, a 1% increase in one-year lagged house prices increases current period fertility rates by 0.0511%.** This paper, in line with Dettling and Kearney (2014), identifies a positive net marginal effect of house prices on fertility at the mean home ownership level. However, Aksoy (2016), in his investigation of English Counties from 1995-2013, found that this overall effect was negative. He explains that during his sample period, ‘rents closely track movements in house prices.’ Whereas in this paper, house price inflation rapidly outstrips growth in weekly rents in London Boroughs from 2001-2020. From 2001-2020, house prices rose by 202%, whilst weekly rents increased at less than half of this rate, at 73%<sup>4</sup>. Consequently, during this period, the asset wealth of existing home owners grew at a faster rate than the rental payments of non-home owners. This might explain why, in this paper, the positive wealth effect appears to dominate the negative effects on renters. However, this net effect is based on a 2001 mean home ownership rate, which has been kept constant in this analysis to reduce endogeneity concerns and control for compositional changes in tenure patterns over time (Aksoy, 2016). Home ownership rates have slowly declined over time since 2001, and the mean rate was 46.8% in 2021 (ONS, 2023a). Therefore, if home ownership rates keep declining, the positive net marginal effect of housing on fertility identified in this paper is likely to turn negative.

These results enable the two core hypotheses of this paper to be accepted but illustrate the need for further research into the relative weight of different effects. Hypothesis 1 can be accepted. That is, house prices appear to significantly impact fertility decisions, as illustrated by the statistically significant negative coefficient on *logHP*. In support of Hypothesis 2, this effect becomes more positive as home ownership rates increase, displayed by the positive coefficient on the *logHP \* logHomeOwn2001* interaction term. Whilst these hypotheses appear to hold, the net effect of housing on fertility is an area that requires further investigation. The positive net marginal effect on fertility can be explained with reference to the positive wealth effect, which accrues to home owners, and a combination of negative effects, which impact non home owners. Further

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<sup>4</sup> Author’s calculation made with data from HM Land Registry and the ONS.

qualitative and quantitative research is desirable, in order to disaggregate these various mechanisms and assess their relative strengths.

For the control variables, female employment rates and education are found to exert a significant negative effect on fertility rates, which is in line with the existing literature (Siegel, 2012; Kim, 2016). In contrast with previous findings from the New Home Economics literature (Doepke, Hazan and Maoz, 2015), weekly wages do not appear to significantly impact fertility rates. All of the demographic control variables were found have a statistically significant impact on fertility in Model 4. A deeper breakdown is required to analyse how exactly population shifts and changes in demographic composition are driving fertility rates. Ultimately, these control variables are not to be interpreted causally. Instead, they are included with the goal of reducing omitted variable bias and to help isolate the effect of house prices on fertility.

## *5.2 Temporal disaggregation*

It is important to consider whether the relationship between housing and fertility is the same in periods of rising and declining house prices. The following section splits up the full OLS regressions in Model 4 in Table 3 into two periods of housing boom (2001-2007, 2011-2020) and one period of housing bust (2007-2011). The results are presented below in Table 2.

Table 2. OLS results - temporal disaggregation of the relationship between housing and fertility

	Model 1	Model 2	Model 3
	Housing Boom (2001-2007)	Housing Bust (2007-2011)	Housing Boom (2011-2020)
logHP	-0.19773	0.16669	-1.07513***
logHP * logHomeOwn2001	0.15030**	0.01056	0.26350***
logHomeOwn2001	-0.68937	1.18635	-2.55156***
Wages	-0.00012	0.00013	-0.00012
Education	-0.00101	0.00095	-0.00025
Female Employment Rate	-0.00008	-0.00113	-0.00147*
Foreign Born	0.00341**	0.00495	-0.00189**
Age	-0.03404***	-0.04017**	-0.01300***
Net Population Change	-0.00995**	-0.00105	-0.00549**
Year	Yes	Yes	Yes
Borough	Yes	Yes	Yes
N	192	128	288
Adj R <sup>2</sup>	0.956	0.908	0.968
F	137.441	76.878	250.860

Note: \*, \*\*, and \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

The results in Table 2 indicate that the effects identified in the main regression are driven by the 2011-2020 housing boom. During 2001-2007 and 2007-2011, whilst the key coefficients have the expected sign, there are of a smaller magnitude and are not statistically significant. Linking this to the existing literature, both Dettling and Kearney (2014) and Aksoy (2016) conclude that the link between housing and fertility holds during housing booms, but Dettling and Kearney (2014) found no statistically significant impact of housing on fertility during periods of house price decrease. This finding is supported by this paper. This may be because, during periods of housing decline, other factors, such as broader economic uncertainty may play a bigger role in determining fertility decisions than housing costs (Kreyenfeld, Andersson and Pailhé, 2012; Vignoli et al., 2020). In my analysis, the relationship between housing and fertility does not hold between 2001-2007, when fertility rates increased alongside high house price inflation. Hoorens et al. (2011) argue that a combination of increased confidence in the broader economy and the unintended consequences of the Labour Government's working family tax credits policy can help explain the increase in fertility in this period. Dorling (2014)

adds to this, arguing that a large part of the fertility boom in the early 2000s is due to families having children which they had delayed in the 1990s. The differential impact of house prices on fertility in separate time periods motivates further research into this topic, to investigate whether the relationship between housing and fertility holds across time and geography.

### *5.3 Robustness checks*

A number of robustness checks are used to assess the structural validity of the core estimations presented in this paper (Lu and White, 2014). Further models are estimated below to test some of the assumptions of the main model and to analyse whether the results are robust to alternate specifications.

#### *5.3.1 Alternative lag effects of house price*

Whilst it appears intuitive that house prices in the year of conception,  $t-1$ , is the best measure of how the housing market might impact fertility, it could be the case that house prices in other years prior to conception are also important if household's fertility decisions are 'based on longer time horizon or on longer terms averages' (Dettling and Kearney, 2014). In Table 3 below, Column (1) is the full regression model used in this paper, which uses one-year lagged house prices. Columns (2) and (3) use house prices lagged by two and three years respectively. Columns (4) and (5) use three-year and five-year moving average of house prices respectively as the independent variable in the regression model.

Table 3. OLS results - temporal variation in house price measure

	(1)	(2)	(3)	(4)	(5)
	t-1 HP	t-2 HP	t-3 HP	AvHP t-3	AvHP t-5
log t-1 HP	-1.13170***				
log t-1 HP * logHomeOwn2001	0.29834***				
log t-2 HP		-1.01987***			
log t-2 HP * logHomeOwn2001		0.28370***			
log t-3 HP			-0.94071***		
log t-3 HP * logHomeOwn2001			0.26715***		
log AvHp t-3				-1.05367***	
log AvHP t-3 * logHomeOwn2001				0.29406***	
log AvHp t-5					-1.01614***
log AvHP t-5 * logHomeOwn2001					0.29173***
logHomeOwn2001	-2.62752***	-2.23544***	-1.93415***	-2.35252***	-2.18806***
Wages	0.00003	0.00004	0.00004	0.00004	0.00005
Education	-0.00139*	-0.00129*	-0.00111	-0.00129*	-0.00098
Female Employment Rate	-0.00201***	-0.00226***	-0.00232***	-0.00217***	-0.00213***
Foreign Born	0.00313***	0.00354***	0.00347***	0.00341***	0.00333***
Age	-0.01308***	-0.01228***	-0.01139***	-0.01202***	-0.01099***
Net Population Change	-0.01129***	-0.01051***	-0.01075***	-0.01065***	-0.01095***
Year	Yes	Yes	Yes	Yes	Yes
Borough	Yes	Yes	Yes	Yes	Yes
N	608	608	608	608	608
Adj R <sup>2</sup>	0.933	0.932	0.933	0.933	0.934
F	143.619	148.281	153.917	150.292	156.938

Note: \*, \*\*, and \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

In these alternate models, the results of the two hypotheses of this paper continue to hold, as illustrated by the negative coefficient on *logHP* and the positive coefficient on the *logHP \* logHomeOwn2001* interaction term. Dettling and Kearney (2014) also find that the signs on these two key coefficients hold with similar temporal variation of house prices. Aksoy (2016) supports this but finds that these effects disappear in year *t-3*. In this

paper, both the negative coefficient on house prices, and the positive interaction between house prices and home ownership decrease in magnitude when house prices from older periods are considered. This indicates that, whilst general trends in prices are important, as expected, it is prices in the year of conception that have the largest impact on fertility decisions.

### *5.3.2 Alternate measures of house prices and home ownership*

The main regression model in this paper uses price paid data from the UK Land Registry as house price measure. The robustness checks in Table 4 below employ alternate measures of house prices as the independent variable in the regressions, such as the HM Land Registry's House Price Index (Column 2), the ratio of house prices to earnings, constructed by the ONS (Column 3). Additionally, home ownership has been kept fixed at a 2001-baseline in the main regressions in this paper to reduce endogeneity concerns. Column (4) uses an alternate fixed measure of home ownership from 2011, to investigate whether this impacts the results.

Table 4. OLS results - alternate measures of house prices and home ownership

	(1)	(2)	(3)	(4)
	Core Regression	House Price Index	HP Earnings Ratio	2011 Home Ownership
logHP	-1.13170***			
logHP * logHomeOwn2001	0.29834***			
log (House Price Index)		-1.13170***		
log (House Price Index) * logHomeOwn2001		0.29834***		
log (HP Earning Ratio)			-1.32243***	
log (HP Earning Ratio) * logHomeOwn2001			0.33573***	
log (2011 Home Ownership)				-1.00308***
log (2011 Home Ownership) * logHomeOwn2001				0.27231***
logHomeOwn2001	-2.62752***	-0.08938	0.26365*	-2.16188***
Wages	0.00003	0.00003	0.00008	-0.00001
Education	-0.00139*	-0.00139*	-0.00161**	-0.00143*
Female Employment Rate	-0.00201***	-0.00201***	-0.00275***	-0.00207***
Foreign Born	0.00313***	0.00313***	0.00340***	0.00340***
Age	-0.01308***	-0.01308***	-0.01499***	-0.01355***
Net Population Change	-0.01129***	-0.01129***	-0.01066***	-0.01152***
Year	Yes	Yes	Yes	Yes
Borough	Yes	Yes	Yes	Yes
N	608	608	608	608
Adj R <sup>2</sup>	0.933	0.933	0.928	0.931
F	143.619	143.619	131.600	140.050

Note: \*, \*\*, and \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

The pattern of a negative coefficient on *logHP* and a positive coefficient on *logHP \* logHomeOwn2001* appears robust to these alternate measures of house prices and home ownership rates. The magnitude of the effect is larger when the house price earnings ratio is used as the independent variable, which illustrates that concerns over local affordability might shape the relationship between housing and fertility.

### *5.3.3 Instrumental variable strategy*

To address the endogeneity and reverse causality problem, Aksoy (2016) uses county-wide variation in planning stringency as an instrument for house prices. His primary measure of planning stringency is a three-year moving average refusal rate for major residential development projects. Higher refusal rates are indicative of stricter planning rules, which are linked to higher house prices (Hilber and Vermeulen, 2016), and importantly remain unrelated to fertility rates. Building on this approach, this paper uses the average rejection rate for major residential developments throughout the entire sample period (2001-2020) as the instrumental variable. This modification reflects differences in data availability and institutional context. A long-term average measure mitigates short-term fluctuations and measurement noise that could bias the instrument, while still capturing persistent cross-borough variation in planning stringency. It thus provides a stable and credible proxy for local planning constraints that influence house prices but are unlikely to be directly correlated with fertility outcomes.

First-stage regression and second-stage regression were presented in Appendix C. The instrument variable, which takes the average refusal rate for each borough across the sampling period, exhibits a strong, positive correlation with house prices, with a coefficient of 0.9788 following log-log transformations, and this is significant at the 1% level. When the second-stage regressions were performed with this instrument, the results remain statistically significant, which indicates that the relationship between house prices and fertility rates is robust to potential endogeneity concerns. This confirms that Aksoy's (2016) approach can be successfully extended to London Boroughs.

## **6. Conclusion and policy implications**

### *6.1 Conclusion*

The two core hypotheses of this paper can be accepted. In accordance with Hypothesis 1, house prices are found to impact fertility. As with the existing literature, when tenure is not accounted for, this relationship is found to be negative. However, accounting for tenure patterns reveals a more nuanced relationship between housing and fertility rates. As posited by Hypothesis 2, higher levels of home ownership are associated with a more

positive impact of house price inflation on fertility. The results of this paper indicate that house price increases depress fertility amongst renters, but when borough-level home ownership rates pass 44.4%, the marginal effect of an increase in house prices on fertility turns positive. When estimated at the 2001 mean home ownership level, the net effect of a 1% rise in house prices is a 0.0511% increase in fertility rates. It is possible that, if home ownership rates continue to fall in London, this net effect will decline and may turn negative. Finally, the link identified between housing and fertility in London Boroughs is primarily driven by the 2012-2020 boom and further research is required to substantiate this relationship across space and different time periods. The findings of this paper have implications for three key areas of policy.

### *6.2 Policy Implications*

First of all, developing an understanding of how the housing market impacts urban population dynamics can help planners design better cities. Allmendinger (2017), elaborating on the work of McLoughlin (1969), explains that understanding the drivers of population and fertility is essential to accurately model the built environment. For London, anticipating changes in demand for public services such as healthcare, transport, and education depends on these demographic factors. By recognising the interaction between housing, fertility, and home ownership, planners can design urban spaces better suited to future needs.

The findings of this paper also highlight important equity considerations that require attention from policymakers. The results of this paper support those of Dettling and Kearney (2014) and Aksoy (2016) and indicate that a rise in house prices is likely to have a negative impact on the fertility of renters. Renters tend to be of a lower socioeconomic status than home owners (DLUHC, 2022; JRF, 2023). Therefore, increases in house prices may be regressive, and could disproportionately impede those in lower incomes (who are more likely to live in rented accommodation) from realising their fertility aspirations. This is a fairness issue and motivates policy action to address the UK's housing affordability crisis, which is particularly acute in London.

Finally, the findings of this paper can help policymakers better predict population dynamics, which in turn helps inform migration policy. With declining home ownership and fertility, the UK risks an ageing population and a rising dependency ratio. London's young workforce is sustained by in-migration, unlike many UK regions (House of Commons Library, 2022). As Vollset *et al.* (2020) argue, without liberal immigration policies, fertility alone will not maintain population stability by 2100. Policymakers must therefore consider the housing-fertility nexus when addressing demographic challenges.

## Appendix A

Table A. Contributors to the relationship between house prices and fertility rates

Contributors to the relationship between house prices and fertility rates	Impact of an increase in house prices on demand for children	
	Existing Home Owners	Non-Home Owners
<p><b>Negative substitution effect</b> - having a child requires additional space - an increase in the price of space increases the price of children relative to other goods, causing households to substitute away from children.</p>	Negative	Negative
<p><b>Home ownership as a prerequisite for family formation</b> - depending on cultural values, owning a home may be perceived as a necessary precondition for childbearing. Therefore, if the price of housing rises, renters may struggle to afford a home, decreasing their demand for children.</p>	N/A	Negative
<p><b>Competition between the prospect of home ownership and childbearing decisions</b> - if home ownership is a major aspiration for families (as it is in the UK), renters may prefer to set aside funds for saving for a deposit rather than spending on bringing up a child. New home owners may have also spent a large sum on a deposit and may continue to service mortgage payments. Therefore, higher house prices mean families may be forced to commit more money to purchasing or saving for a home, reducing their financial capacity to raise a child.</p>	N/A Potentially negative for recent buyers	Negative
<p><b>Negative income effect</b> - an increase in rental payments decreases the disposable income of tenants. Consequently, if children are a normal good, rental inflation will exert downward pressure on fertility.</p>	N/A	Negative
<p><b>Positive wealth effect</b> - house price inflation increases the wealth of existing home owners. This should increase demand for children, either through equity release, which increases family income, or if increases of housing wealth contribute to a feeling of greater financial stability.</p>	Positive	N/A

## Appendix B

Table B. Variable definitions and descriptive statistics

Variable	Obs	Mean	Std.Dev	Min	Max	Label	Source
<i>A: House Prices</i>							
HP Price Paid	640	358,356	193,869	88,664	1,363,802	Yearly Average House Price Paid (constructed from monthly data)	HM Land Registry
HP Index	640	80.7	26.7	30.3	136.7	Yearly Average UK House Price Index (constructed from monthly data)	HM Land Registry
HP Earnings Ratio	640	11.2	4.9	3.9	44.0	Ratio of median house prices to median workplace-based annual earnings	Yearly Housing Bulletin, ONS
<i>B: Home Ownership Rates</i>							
HomeOwn2001	32	55.3	16.3	27.4	78.8	% of the borough who either owned their home outright, or with a mortgage, in 2001	2001 National Survey
HomeOwn2011	32	48.5	15.1	23.8	73.8	% of the borough who either owned their home outright, or with a mortgage, in 2011	2011 National Survey
<i>C: Total Fertility Rates</i>							
TFR	640	1.8	0.3	1.0	3.2	Average number of live births per woman	Annual Birth Releases, ONS
<i>D: Control Variables</i>							
Age	640	39.0	6.4	25.9	53.6	Percentage of the borough aged between 18-40	Population Estimates Unit, ONS
Education	640	42.9	13.5	8.6	72.9	Percentage of the borough with a university degree or higher (NVQ4+)	Annual Population Survey, ONS
Foreign Born	640	33.8	11.1	4.9	58.8	Percentage of the borough born outside the UK	Annual Population Survey, ONS

Female Employment Rate	640	63.6	7.4	40.0	85.9	Female employment rate 16-64 in the borough	Annual Population Survey, ONS
Wages	640	566.1	94.8	297.5	954.4	Average weekly earnings	Annual Population Survey, ONS
Net Internal Migration	640	-2.4	2.3	-10.9	2.2	Net population change for each borough	Migration Statistics Unit, ONS
Planning Stringency	640	31.2	10.3	7.8	46.4	Average Rejection Rate for Major Residential Development Projects 2001-2020	Department of Levelling Up, Housing and Communities

## Appendix C

Table C. First-stage and second-stage IV regressions

Variable	First-stage	Second-stage
logAverageRefR	0.98249***	
logHP		-2.14319**
logHP * logHomeOwn2001		0.47897**
logHomeOwn2001	-3.61659***	-6.10772**
Wages	-0.00016*	-0.00026***
Education	0.00343***	-0.00230
Female Employment Rate	0.00384***	-0.00056
Foreign Born	-0.00625***	0.00237***
Age	-0.00652***	-0.01128***
Net Population Change	-0.00806***	-0.01429***
Year	Yes	Yes
Borough	Yes	Yes
N	608	608
Adj R <sup>2</sup>	0.985	0.763885
p	0.000	0.000

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

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