Investigating the Influencing Factors of Average House Prices in the United Kingdom

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ABSTRACT

This study investigates the relationship between the average house price in the United Kingdom (GBP) and several factors that potentially influence housing prices. Utilizing statistical analysis with SPSS, the study examines the impact of population, total dwellings, GDP per capita (GBP), inflation rate, unemployment rate, interest rate, and GDP in million (GBP) on the average house price in the UK. The conceptual model categorizes these factors into three main groups: economic factors, demographic factors, and housing-related factors. The study hypothesizes that economic factors such as inflation, GDP per capita, and GDP in million (GBP) will positively influence average house prices, while unemployment rates will have a negative effect. Additionally, it is expected that a larger population and fewer dwellings in total will result in higher house prices due to increased demand relative to supply. The interest rate, representing a housing-related factor, is anticipated to impact affordability and availability of mortgage financing, with higher interest rates potentially leading to lower average house prices. The study employs linear regression analysis using SPSS to examine these relationships. By uncovering the factors influencing the average house price in the UK, this research aims to provide insights into the housing market and inform policymakers, investors, and individuals interested in the UK housing sector.

Keywords: Average House Price, SPSS, Population, Total Number of Houses, Per Capita GDP, Inflation Rate, Unemployment Rate, Interest Rate, GDP in Millions.

ÖZ

Bu çalışma, Birleşik Krallık'ta ortalama ev fiyatı ile konut fiyatlarını olası şekillerde etkileyebilecek birkaç faktör arasındaki ilişkiyi araştırmaktadır. İstatistiksel analiz yöntemi olarak SPSS kullanılarak, nüfus, toplam konut, kişi başına Gayri Safi Yurtiçi Hasıla (GSYİH), enflasyon oranı, işsizlik oranı, faiz oranı ve milyon cinsinden GSYİH gibi faktörlerin Birleşik Krallık'taki ortalama ev fiyatına etkisini incelemektedir. Kavramsal model, bu faktörleri ekonomik faktörler, demografik faktörler ve konutla ilgili faktörler olmak üzere üç ana gruba ayırmaktadır. Çalışma, enflasyon, kişi başına GSYİH ve milyon cinsinden GSYİH gibi ekonomik göstergelerin ortalama ev fiyatlarını olumlu yönde etkileyeceğini, işsizlik oranlarının ise olumsuz etki yapacağını hipotez olarak ortaya koymaktadır. Ayrıca, daha büyük bir nüfusun ve toplamda daha az konutun, talebin arzdan daha fazla olduğu durumlar nedeniyle daha yüksek ev fiyatlarına yol açacağı beklenmektedir. Konutla ilgili bir faktörü temsil eden faiz oranının, konut kredisi finansmanının erişilebilirliği ve uygunluğunu etkilemesi ve daha yüksek faiz oranlarının potansiyel olarak daha düşük ortalama ev fiyatlarına yol açması beklenmektedir. Çalışma, bu ilişkileri incelemek için SPSS kullanarak doğrusal regresyon analizi yöntemini kullanmaktadır. Birleşik Krallık'taki ortalama ev fiyatını etkileyen faktörleri ortaya çıkararak, bu araştırma konut piyasasına ve Birleşik Krallık konut sektörüne ilgi duyan politika yapıcılarına, yatırımcılara ve bireylere içgörüler sunmayı amaçlamaktadır.

Anahtar Kelimeler: Ortalama Ev Fiyatı, SPSS, Nüfus, Toplam Konut Sayısı, Kişi Başına GSYİH, Enflasyon Oranı, İşsizlik Oranı, Faiz Oranı, Milyon Cinsinden GSYİH.

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Chapter 1

INTRODUCTION

Housing is a basic necessity for human beings, and the affordability of housing is crucial for social and economic well-being. This study aims to explore the relationship between the average house price in the United Kingdom (GBP) and various factors that may influence this price. Specifically, this study will use statistical analysis using SPSS to analyze the impact of population, dwellings in total, GDP per capita (GBP), inflation rate, unemployment rate, interest rate, and GDP in million (GBP) on the average house price in the UK.

Conceptual Model: The conceptual model for this study will focus on the key variables that may influence the average house price in the United Kingdom. These variables can be categorized into three main groups: economic factors, demographic factors, and housing-related factors.

Economic Factors: The economic factors that may influence the average house price in the United Kingdom include GDP per capita, inflation rate, unemployment rate, and GDP in million (GBP). These variables will be used to measure the overall economic health of the country and the potential impact on the housing market. It is hypothesized that higher inflation, GDP per capita, and GDP in million (GBP) will lead to higher average house prices, while higher unemployment rates will have the opposite effect (Nguyen, 2023).

Demographic Factors: The demographic factors that may influence the average house price in the United Kingdom include population and dwellings in total. These variables will be used to measure the country's housing demand and supply. It is hypothesized that a higher population and fewer dwellings in total will lead to higher average house prices, as demand for housing outstrips supply.

Housing-related Factors: The housing-related factors that may influence the average house price in the United Kingdom include the interest rate. This variable will be used to measure the availability and affordability of mortgage financing, which can significantly impact the demand for housing. Higher interest rates are hypothesized to lead to lower average house prices, as fewer people can afford to buy a house.

By analyzing the relationship between the average house price in the United Kingdom and various economic, demographic, and housing-related factors, this study aims to provide a better understanding of the factors that influence the housing market in the country. By using quantitative data analysis, this study aims to provide empirical evidence of the relationship between these factors and the average house price in the UK. The results of this study will be useful for policymakers, investors, and others who are interested in the UK housing market.

Chapter 2

METHODOLOGY

This study will use quantitative data analysis to examine the relationship between the average house price in the United Kingdom and various economic, demographic, and housing-related factors.

The primary analysis method used in this study will be linear regression analysis. The dependent variable in this analysis will be the average house price in the United Kingdom, while the independent variables will be population, dwellings in total, GDP per capita (GBP), inflation rate, unemployment rate, interest rate, and GDP in million (GBP). By examining the relationship between these variables and the average house price in the UK, this study will provide insight into the factors that impact the affordability of housing in the country. The SPSS program will be used for the analysis mentioned above.

Chapter 3

DATA

Table 1: Data

YEARS	UK average house price (GBP)	Uk population	UK dwellings in total	Gross Domestic Product per capita (GBP)	UK inflation rate	UK unemployment rate	UK interest rate	UK GDP in million (GBP)
2005	150633	60383741	26274000	30,348	,0209	,0475	,0450	1841218
2006	159970	60803700	26516000	30,792	,0246	,0535	,0500	1888797
2007	176758	61260676	26772000	31,328	,0239	,0526	,0550	1931663
2008	185782	61742151	27045000	31,025	,0352	,0562	,0200	1927034
2009	157234	62243378	27269000	29,417	,0196	,0754	,0050	1845186
2010	167469	62760039	27446000	29,893	,0249	,0779	,0050	1884515
2011	167300	63286362	27612000	29,961	,0386	,0804	,0050	1911983
2012	165908	63808727	27767000	30,195	,0257	,0788	,0050	1940087
2013	167716	64302297	27913000	30,553	,0229	,0752	,0050	1976755
2014	178182	64773504	28073000	31,290	,0145	,0611	,0050	2035883
2015	190665	65224364	28269000	31,786	,0037	,0530	,0050	2089276
2016	205464	65655203	28490000	32,208	,0101	,0481	,0025	2136566
2017	215243	66064804	28737000	32,799	,0256	,0433	,0050	2182170
2018	224544	66432993	28993000	33,160	,0229	,0400	,0075	2218196
2019	228314	66778659	29271000	33,510	,0174	,0374	,0075	2255283
2020	231940	67059474	29548000	29,687	,0099	,0470	,0010	2046209
2021	249690	67281039	29684210	31,793	,0252	,0453	,0025	2198473
2022	272833	67508936	*29899867	38,340	,0900	,0370	,0350	2591656

*The value of UK dwellings in total in 2022 is estimated as 29899867 by the trend projection method (microfit 5).
(Lewis, C. 2022; U.K. population 1950-2023 n.d; Dwelling stock by tenure.2022; UK GDP 2022. 2023; GDP per capita in the UK 1955-2022. 2023; Bank of England. n.d; United Kingdom inflation Rate. n.d; United Kingdom unemployment.n.d.-c)

Chapter 4

AVERAGE HOUSE PRICE AND UNEMPLOYMENT RATE

4.1 Literature Review

Despite the importance of housing and unemployment to the macroeconomy, the relationship between the two variables has been the subject of surprisingly little research. Some house price models use the rate of unemployment as an indicator of labor market risk, which reduces the willingness of households to get mortgages and ultimately decreases house prices.

Historically, a rise in unemployment has been accompanied by a decline in UK house prices. For instance, in the 1980s and 1990s, the housing market experienced a significant drop alongside a rise in unemployment rates(Cameron & Muellbauer, 2001). Similarly, during the Global Financial Crisis, house prices declined along with an increase in unemployment. It is important to note that unemployment is a lagging economic indicator and may not necessarily signal a strong housing market(Reinhart & Rogoff, 2009).

According to Zhang Qinghua, a higher unemployment rate leads to a thinner housing market with fewer buyers and sellers, resulting in lower housing prices and sales volume. Also claimed that larger cities experience a smaller percentage change in price in response to a change in the unemployment rate. Overall, the paper demonstrates

that the thick-market effect plays an important role in amplifying the impact of unemployment rate changes on housing market outcomes(Gan & Zhang, 2018).

Mohsen examines the relationship between real house prices and unemployment using state-level data from the US. The authors find that unemployment causes house prices to fall in five states, while house prices cause unemployment in 43 states, supporting the idea that the Great Recession of 2008 was caused by the fall in house prices. They also use non-linear models to find that a fall in house prices causes unemployment in 37 states, while evidence that house prices cause unemployment is limited to 20 states. The authors suggest that the stabilization of house prices could contribute to economic stability and a stable unemployment rate (Bahmani & Ghodsi, 2018).

As those line graphics present when the unemployment rate goes down the house price goes up over 18 years.

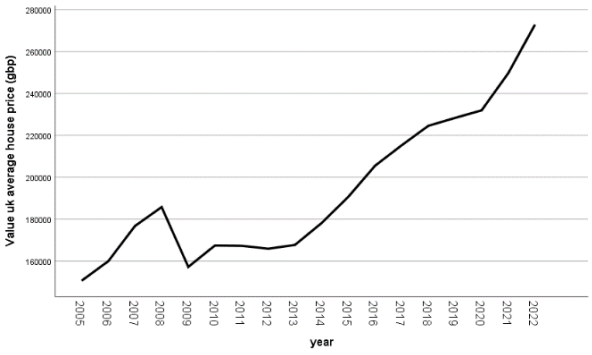

Figure 1: House price

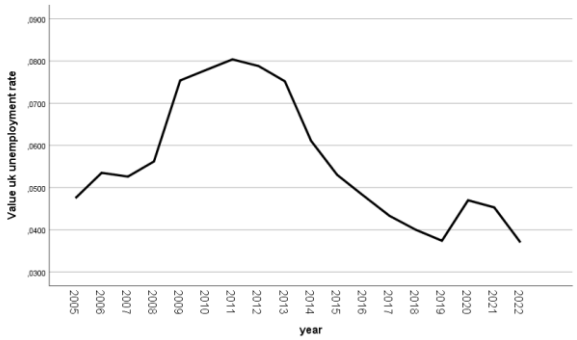

Figure 2: Unemployment rate

4.2 Empirical Result

4.2.1 Correlation between the Variables

Correlations

		uk average house price (gbp)	uk unemployment rate
Pearson Correlation	uk average house price (gbp)	1,000	-,725
	uk unemployment rate	-,725	1,000
Sig. (1-tailed)	uk average house price (gbp)	.	,000
	uk unemployment rate	,000	.
N	uk average house price (gbp)	18	18
	uk unemployment rate	18	18

Figure 3: Correlations (unemployment rate)

Here we saw a significant negative relationship exists between the price and the unemployment rate: R(16)=-,725 P=,000.

4.2.2 R and R^2

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,725[a]	,526	,496	25159,281

a. Predictors: (Constant), uk unemployment rate

Figure 4: Model Summary (unemployment rate)

There is a strong relationship between independent valuables and dependent valuables R=0,725. And our R Square=0,526, meaning that 52.6% of the variance in the house price is explained or can be predicted by the predictor.

4.2.3 F-value

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1,123E+10	1	1,123E+10	17,747	,001[b]
	Residual	1,013E+10	16	632989419,0		
	Total	2,136E+10	17			

a. Dependent Variable: uk average house price (gbp)

b. Predictors: (Constant), uk unemployment rate

Figure 5: Anova (unemployment rate)

Independent valuables were a significant predictor of house price, F(1,16)=17.747, p=.000.

4.2.4 T-value

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	290058,499	23514,271		12,335	,000
	uk unemployment rate	-1708832,309	405641,373	-,725	-4,213	,001

a. Dependent Variable: uk average house price (gbp)

Figure 6: Coeffients (unemployment rate)

The unemployment rate significantly predicts average house prices, β=-.725, t(16)=-4.7213, p=.001.

Regression equation:

ŶUK average house price= 290058.499 – 1708832.309(UK unemployment rate)

4.3 Evaluation between Real and Estimated Price

Table 2: Presented below shows the real price, the estimated price, and the difference between them(unemployment rate)

Years	ŶUK average house price(GBP)	real price(GBP)	difference (real-estimated) GBP
2005	208888,964	150633	-58255,964
2006	198635,970	159970	-38665,970
2007	200173,920	176758	-23415,920
2008	194022,123	185782	-8240,123
2009	161212,543	157234	-3978,543
2010	156940,462	167469	10528,538
2011	152668,381	167300	14631,619
2012	155402,513	165908	10505,487
2013	161554,309	167716	6161,691
2014	185648,845	178182	-7466,845
2015	199490,387	190665	-8825,387
2016	207863,665	205464	-2399,665
2017	216066,060	215243	-823,060
2018	221705,207	224544	2838,793
2019	226148,171	228314	2165,829
2020	209743,380	231940	22196,620
2021	212648,395	249690	37041,605
2022	226831,704	272833	46001,296

Average difference:16896,8308 GBP

Figure 7: Estimated price compare to real price (unemployment rate)

The graphic above provides a visual representation of the two prices: the real price and our estimated value. As depicted in the graph, our estimated value closely aligns with the real price between the years 2008 and 2019, indicating a high level of accuracy during that period. However, for the remaining years, our estimation seems to deviate further from the actual price.

These findings are consistent with our previous linear regression analysis, which revealed a strong relationship between the independent variable (unemployment rate) and the dependent variable (house price). The analysis yielded an R-value of 0.725, indicating a substantial correlation between these variables. This means that changes in the unemployment rate can be considered a good predictor for fluctuations in house prices.

Additionally, the R Square value of 0.526 provides further insights into the predictive power of our regression model. This value suggests that approximately 52.6% of the variance observed in house prices can be explained by the predictor variable, the

unemployment rate. While this indicates a moderate level of explanatory ability, it also implies that there are other factors influencing house prices that are not accounted for in our analysis.

Overall, the graphic and regression analysis affirms the effectiveness of the unemployment rate as a significant predictor for house prices. The close match between our estimated value and the real price during the period of 2008-2019, as well as the substantial R-value and R Square value, reinforce the notion the that unemployment rate holds predictive power in determining fluctuations in the housing market. However, it is important to recognize that there may be other factors that contribute to the remaining variance in house prices, highlighting the complexity of the real estate market.

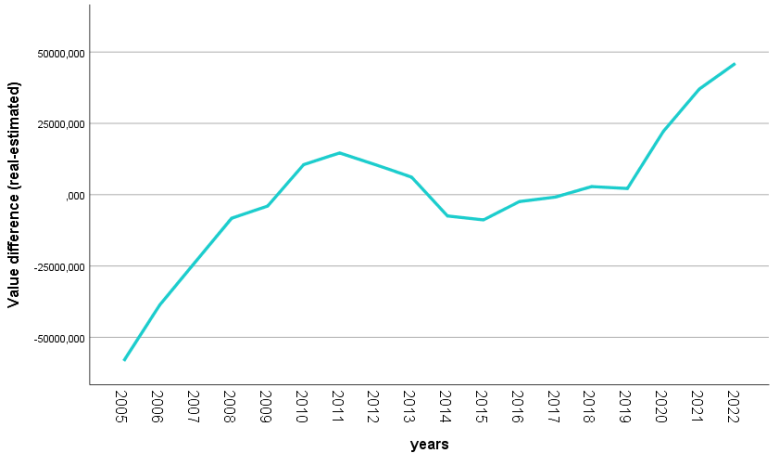

Figure 8: Difference (unemployment rate)

Between 2005 and 2008, we observed a notable trend where our estimated house price consistently exceeded the actual house price. This discrepancy suggests that our estimation model may have overestimated the housing market during that period. It is

crucial to thoroughly examine and refine our approach to ensure greater accuracy in future estimations.

On the other hand, between 2019 and 2022, we noticed a significant difference where the real house price surpassed our estimated value. This disparity indicates that our model may have underestimated the growth and value of the housing market during those years. To enhance the precision of our estimations, it becomes imperative to broaden our analysis beyond the unemployment rate and consider other relevant economic factors that impact house prices.

By incorporating additional economic variables, such as interest rates, employment rates, inflation, and housing market indicators, we can develop a more comprehensive regression model. These factors play crucial roles in shaping the housing market dynamics and can contribute to a more accurate estimation of house prices.

Furthermore, exploring regional or local economic factors can also enhance the precision of our estimations. Factors like population growth, housing supply and demand, government policies, and infrastructure development can significantly influence house prices in specific areas. By incorporating such factors into our analysis, we can tailor our estimations to specific regions and provide more accurate predictions.

It is essential to constantly reassess and update our estimation model to adapt to the changing dynamics of the housing market. By considering a wider range of economic factors and incorporating regional variations, we can improve the accuracy of our estimations and better serve individuals and organizations seeking reliable insights into the real estate market.

Chapter 5

AVERAGE HOUSE PRICE AND POPULATION

5.1 Literature Review

The UK's population has increased over the last 18 years, albeit at a comparatively slow rate. Both natural increases (i.e., the difference between births and deaths) and net migration (i.e., the difference between people moving into the country and those leaving it) have been major factors in the UK's population growth. With net migration accounting for more than half of the UK's population growth over the past ten years, it has been a particularly significant factor (The Impact of Migration on UK Population Growth - Migration Observatory, 2023).

It's important to note that the UK's population growth rate has slowed recently, in part because of declining birth rates. The population of the UK is still anticipated to increase over the following few decades, albeit at a slower rate than in the past (Births in the UK 2021 | Statista, n.d.).

The demand for housing is significantly influenced by population growth. The demand for housing for ownership and rental purposes rises along with the population. The demand for housing in a given area is primarily determined by the area's rapid population growth. When a region experiences rapid population growth, there will likely be a high demand for housing, which could result in rising home prices and rents. On the other hand, when population growth is slow or negative, there may be less

demand for housing, which could result in lower house and rent prices (G. Donald & Winkler, 2002).

Those line graphics below present the trend that house prices are fluctuating but the population is growing steadily over 18 years.

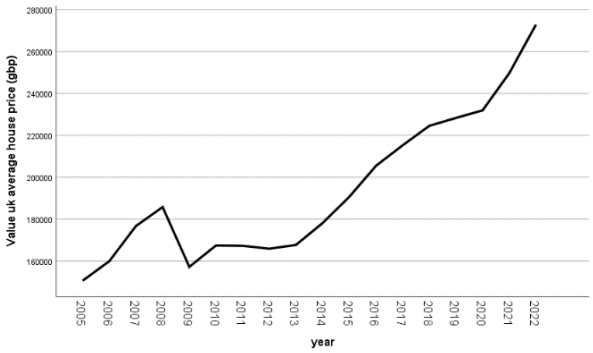

Figure 9: House price

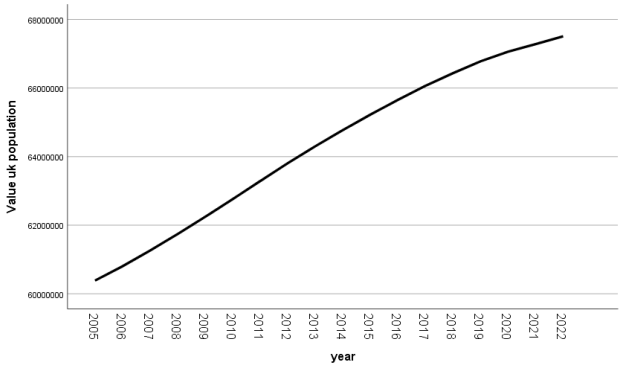

Figure 10: Population

5.2 Empirical Result

5.2.1 Correlation between the Variables

Correlations

		uk average house price (gbp)	uk population
Pearson Correlation	uk average house price (gbp)	1,000	,869
	uk population	,869	1,000
Sig. (1-tailed)	uk average house price (gbp)	.	,000
	uk population	,000	.
N	uk average house price (gbp)	18	18
	uk population	18	18

Figure 11: Correlations (population)

Here we saw a significant positive relationship exists between the price and the population: R(16)=,869 P=,000.

5.2.2 R and R^2

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,869[a]	,755	,739	18094,625

a. Predictors: (Constant), uk population

Figure 12: Model summary (population)

There is a strong relationship between independent valuables and dependent valuables R=0,869. And our R Square=0,755 meaning that 75.5% of the variance in the house price is explained or can be predicted by the predictor.

5.2.3 F-value

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1,612E+10	1	1,612E+10	49,242	,000[b]
	Residual	5238647283	16	327415455,2		
	Total	2,136E+10	17			

a. Dependent Variable: uk average house price (gbp)

b. Predictors: (Constant), uk population

Figure 13: Anova (population)

Independent valuable significantly predicts the house price, F(1,16)=49.242, p=.000.

5.2.4 T-value

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-644612,875	119612,078		-5,389	,000
	uk population	,013	,002	,869	7,017	,000

a. Dependent Variable: uk average house price (gbp)

Figure 14: Coefficients (population)

The population significantly predicts average house prices, β=,869 t(16)=7.017, p=.000.

Regression equation:

ŶUK average house price= -644612.875+0.013(population)

5.3Evaluation between Real and Estimated Price

Table 3: Presented below shows the real price, the estimated price, and the difference between them(population)

Years	ŶUK average house price(GBP)	real price(GBP)	difference (real-estimated) GBP
2005	140375,758	150633	-58255,964
2006	145835,225	159970	-38665,970
2007	151775,913	176758	-23415,920
2008	158035,088	185782	-8240,123
2009	164551,039	157234	-3978,543
2010	171267,632	167469	10528,538
2011	178109,831	167300	14631,619
2012	184900,576	165908	10505,487
2013	191316,986	167716	6161,691
2014	197442,677	178182	-7466,845
2015	203303,857	190665	-8825,387
2016	208904,764	205464	-2399,665
2017	214229,577	215243	-823,060
2018	219016,034	224544	2838,793
2019	223509,692	228314	2165,829
2020	227160,287	231940	22196,620
2021	230040,632	249690	37041,605
2022	233003,293	272833	46001,296

Average difference:15004.7753 GBP

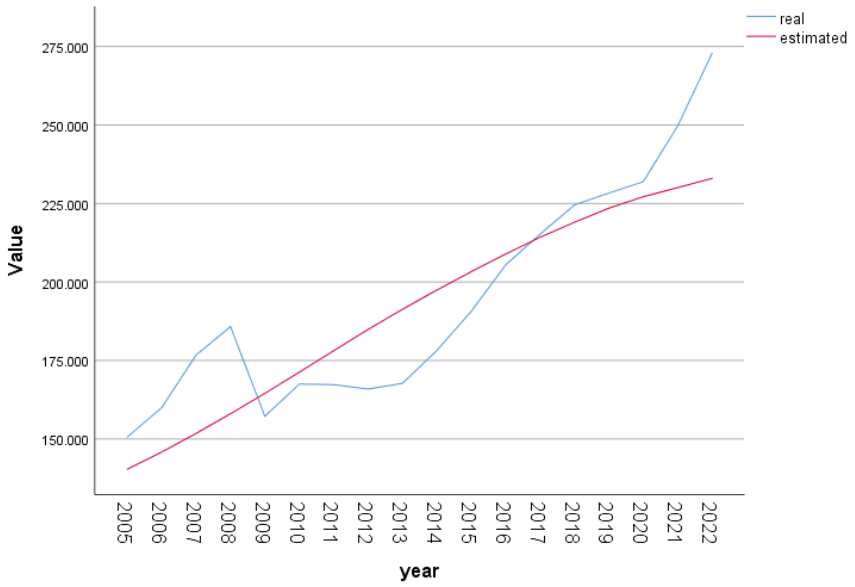

Figure 15: Estimated price compare to real price (population)

The graphic presents the real price and the price we estimated based on population. Our real price fluctuates around the estimated price, indicating a certain level of correlation between the two. Analyzing the data from different periods, we observe distinct patterns.

From 2005 to 2009, the real price consistently exceeded the estimated price, suggesting that the actual market value surpassed what was projected based on population data alone. Conversely, between 2009 and 2017, the real price consistently fell below the estimated price, indicating a lower market value compared to the population-based estimate.

However, an interesting trend emerges from 2017 to 2022, as the real price begins to exceed the estimated price once again. This shift suggests that market forces and other factors are exerting influence beyond population-based projections, resulting in a higher real price.

Another notable similarity becomes apparent when comparing specific time frames. For instance, in both the period from 2005 to 2008 and the period from 2018 to 2022, the real price and estimated price move in parallel during their initial two to three years. However, thereafter, the real price experiences a significant upward surge, surpassing and leaving the estimated price behind.

Given this trend, there is a noteworthy possibility that the real price might experience a significant downturn in the year 2024. It could indicate a correction in the market or a potential bubble burst, as the real price aligns itself closer to the estimated value based on population. Further analysis and monitoring of market conditions will be necessary to assess the likelihood of such an event occurring.

Please note that the above interpretation is based on the provided information and general trends. It is essential to conduct more detailed research and analysis specific to the market in question to make accurate predictions or conclusions.

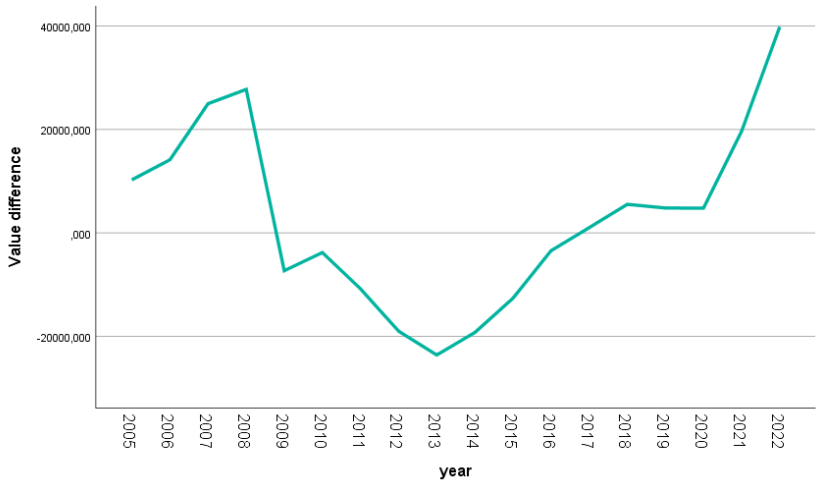

Figure 16: Difference (population)

When we examine the graphic that illustrates the difference between the actual and predicted prices, we observe a noticeable pattern of seasonal fluctuations. Specifically, the data indicates that between 2008 and 2013, the trend was consistently downward, with prices gradually decreasing over time. However, starting in 2013, there was a significant upward shift in prices that persisted until 2022. This finding suggests that there may have been a fundamental shift in market conditions during this period, which could have had important implications for investors and consumers alike.

Chapter 6

AVERAGE HOUSE PRICE AND GDP

6.1 Literature Review

Undoubtedly, the trajectory of overall GDP growth is correlated with the expansion of the real estate sector. The real estate industry experiences a series of beneficial effects as the economy grows. The rise in income levels and the ensuing expansion of employment opportunities are one of the main causes. The need for housing inevitably increases as more people earn higher incomes(Xu, 2017).

A favorable environment for real estate investment is created by the increase in housing demand. Building values rise as a result of incentives given to developers and investors to take advantage of the increasing demand by building new properties. Additionally, during periods of economic expansion, financial institutions are more likely to offer investors and developers loans and financing options, increasing the amount of money that is readily available for real estate projects.

However, it is important to acknowledge that the relationship between GDP growth and the real estate industry is not without complexities. Rapid economic growth can have certain adverse effects on the industry. For instance, when the economy expands too quickly, it can trigger inflationary pressures and subsequently lead to rising interest rates. These factors can dampen the demand for properties as borrowing costs increase, ultimately resulting in lower house prices. Furthermore, an uptick in GDP growth can

also elevate the cost of construction materials and labor. As demand for construction increases, so does the competition for resources, driving up their prices. This rise in building costs can contribute to higher building values and subsequently lead to an increase in house prices(Marcellino, 2008).

When analyzing the real estate sector, it is essential to take into account a number of economic and market variables in addition to GDP growth. The housing market is shaped in part by factors like government regulations, demographic shifts, housing supply and demand dynamics, and investor sentiment(Glaeser, Schuetz & Ward,2006; Phillips & Joseph, C,2017).

In conclusion, while GDP growth undoubtedly exerts a significant influence on the real estate industry, its impact is multifaceted and not always straightforward. It is essential to take into account the interplay of various economic variables to gain a comprehensive understanding of how GDP growth affects house prices and the broader real estate market.

The graphics below show a quite similar trend between house prices and the GDP growth over 18 years.

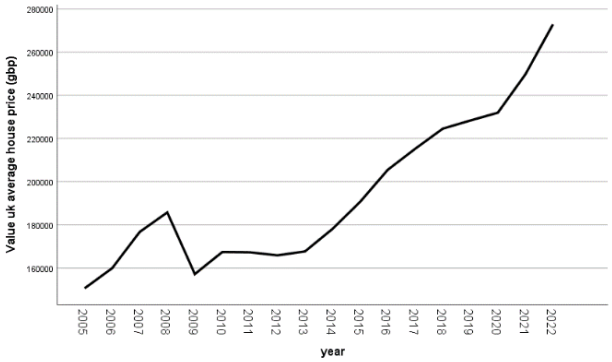

Figure 17: House price

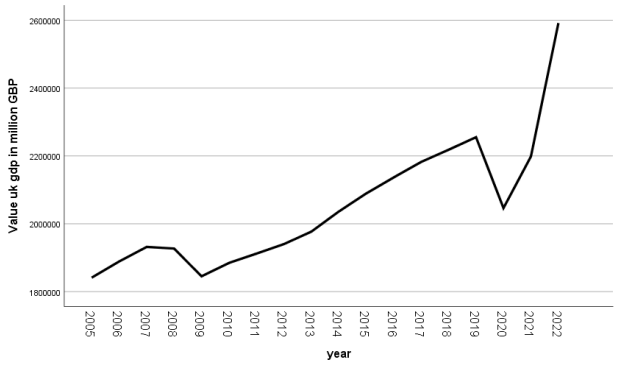

Figure 18: GDP

6.2 Empirical Result

6.2.1 Correlation between the Variables

Correlations

		uk average house price (gbp)	uk gdp in million GBP
Pearson Correlation	uk average house price (gbp)	1,000	,915
	uk gdp in million GBP	,915	1,000
Sig. (1-tailed)	uk average house price (gbp)	.	,000
	uk gdp in million GBP	,000	.
N	uk average house price (gbp)	18	18
	uk gdp in million GBP	18	18

Figure 19: Correlations (GDP)

Here we saw a significant positive relationship between the price and the GDP: R(16)=,915 P=,000.

6.2.2 R and R^2

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,915[a]	,838	,828	14703,312

a. Predictors: (Constant), uk gdp in million GBP

Figure 20: Model summary (GDP)

There is a strong relationship between independent valuables and dependent valuables R=0,915. And our R Square=0,838 meaning that 83.8% of the variance in the house price is explained or can be predicted by the predictor.

6.2.3 F-value

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1,790E+10	1	1,790E+10	82,809	,000[b]
	Residual	3458998093	16	216187380,8		
	Total	2,136E+10	17			

a. Dependent Variable: uk average house price (gbp)

b. Predictors: (Constant), uk gdp in million GBP

Figure 21: Anova (GDP)

Independent valuable is a significant predictor for the house price, F(1,16)=82.809, p=.000.

6.2.4 T-value

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-154966,527	38526,683		-4,022	,001
	uk gdp in million GBP	,170	,019	,915	9,100	,000

a. Dependent Variable: uk average house price (gbp)

Figure 22: Coefficients (GDP)

The GDP significantly predicts average house prices, β=,915 t(16)=9.100, p=.000.

Regression equation:

ŶUK average house price= -154966.527+0.17(GDP)

6.3 Evaluation between Real and Estimated Price

Table 4: Presented below shows the real price, the estimated price, and the difference between them(GDP)

Years	ŶUK average house price(GBP)	real price(GBP)	difference (real-estimated) GBP
2005	158040,533	150633	-7407,533
2006	166128,963	159970	-6158,963
2007	173416,183	176758	3341,817
2008	172629,253	185782	13152,747
2009	158715,093	157234	-1481,093
2010	165401,023	167469	2067,977
2011	170070,583	167300	-2770,583
2012	174848,263	165908	-8940,263
2013	181081,823	167716	-13365,823
2014	191133,583	178182	-12951,583
2015	200210,393	190665	-9545,393
2016	208249,693	205464	-2785,693
2017	216002,373	215243	-759,373
2018	222126,793	224544	2417,207
2019	228431,583	228314	-117,583
2020	192889,003	231940	39050,997
2021	218773,883	249690	30916,117
2022	285614,993	272833	-12781,993

Average difference:9445.15211 GBP

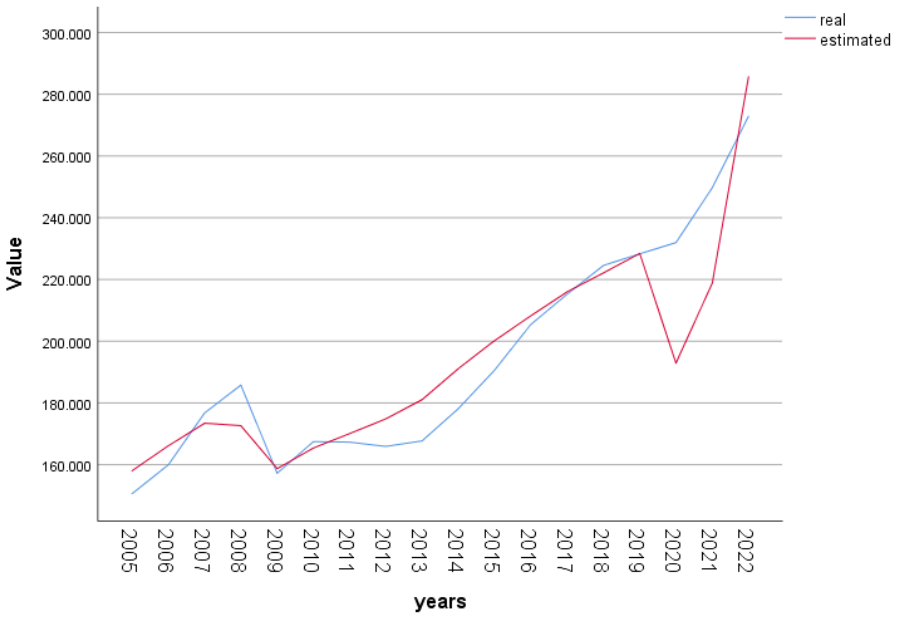

Figure 23: Estimated price compare to real price (GDP)

In the graphic, we observe two distinct values: the real house price and the estimated house price. These values have exhibited a consistent overlap over 18 years, providing further evidence that GDP serves as a reliable predictor for house prices. However, a notable disparity emerged between the two values between 2019 and 2022. During this period, the estimated price experienced a sharp decline, plummeting below the threshold of 200,000 GBP. In contrast, the real price demonstrated stability and even displayed indications of an upward trend.

One intriguing observation is the sharp drop in GDP between 2019 and 2020, followed by a rapid recovery in the subsequent year. This economic fluctuation had a discernible impact on the real house price, albeit to a certain extent. Despite the economic downturn, the real price managed to maintain its stability, suggesting resilience in the housing market.

Interestingly, in 2021, we witnessed a convergence between the estimated price and the real price. The estimated price caught up with its real counterpart, indicating a re-establishment of a closer correlation. Furthermore, in 2022, the estimated price even surpassed the real price, implying a potential overestimation or speculative increase in the housing market.

Overall, the graphic provides insights into the relationship between GDP, estimated house price, and real house price. While GDP remains a valuable predictor, it is crucial to consider other factors that may contribute to discrepancies between estimated and real prices, such as market dynamics, economic fluctuations, and speculative behavior.

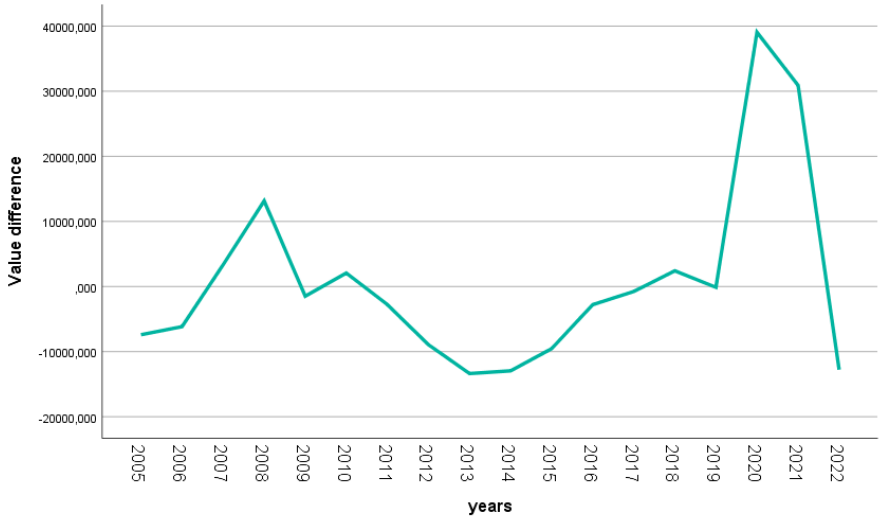

Figure 24: Difference (GDP)

When we meticulously scrutinized the disparity between the estimated and real house prices, an intriguing pattern emerged. From 2005 to 2019, the trend in the value difference exhibited a consistent fluctuation, varying by approximately 100,000 GBP. This indicated a certain level of accuracy in the estimation process during that period, as the gap between the two values remained relatively stable.

However, a notable deviation occurred after 2019, resulting in a significant inaccuracy in the estimation of house prices. The value difference experienced a pronounced shift, diverging from the previously established trend. This deviation could be attributed to various factors, such as changes in market dynamics, unforeseen economic events, or shifts in the underlying predictors used for estimation.

Fortunately, this significant inaccuracy was not a persistent issue. Over the course of the subsequent three years, we observed a gradual correction in the estimation process. The value difference gradually returned to a more typical range, suggesting that adjustments and refinements were made to improve the accuracy of the estimated house prices.

This corrective trend indicates the resilience and adaptability of the estimation model employed. It demonstrates the ability to recognize and rectify inconsistencies, ultimately restoring the alignment between the estimated and real house prices.

It is important to further investigate the causes of the significant inaccuracy during that particular period to ensure that the estimation model can effectively account for unforeseen factors and maintain its reliability in the future. By understanding the underlying reasons for the deviation, we can enhance the accuracy of the estimation process and provide more reliable insights into the housing market.

Chapter 7

AVERAGE HOUSE PRICE AND DWELLINGS IN TOTAL

7.1 Literature Review

The influence of existing housing stock on home prices is a significant aspect of the complex ecosystem that is the housing market. Existing housing, which includes residential properties that have already been built and are for sale, can significantly alter the dynamics of the housing market (Gyourko, 2009).

In any housing market, the interplay between supply and demand is a key driver of house prices. The availability of dwellings is an essential determinant of housing supply. When the supply of dwellings is limited relative to demand, prices tend to rise due to increased competition among buyers. Conversely, an oversupply of dwellings can exert downward pressure on prices as sellers compete to attract buyers. Therefore, the total number of dwellings in a market plays a crucial role in shaping the price dynamics (Phillips & Joseph, 2017).

The demand for homes is significantly influenced by urbanization and population growth. The demand for housing rises as more people move to urban areas. To maintain a balance between supply and demand, the overall number of dwellings must keep up with population growth. If this demand is not met, house prices may rise as more buyers vie for a small number of available homes. On the other hand, if the

housing supply grows faster than population growth, prices may level off or even go down. (Wang Z, Wang C, &Zhang 2015).

This part is going to explore the ways in which existing dwellings can affect house prices. by using the data from the UK over 18 years from 2005 to 2022.

Here we saw the trend for house prices and amount of dwellings in total over 18 years, both of them were ascending but one is steady and another was fructuated.

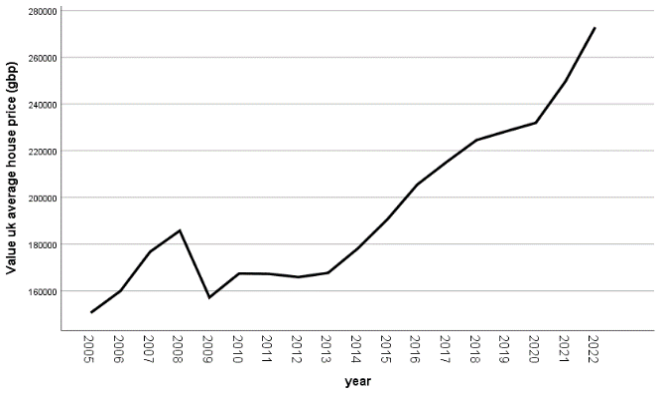

Figure 25: House price

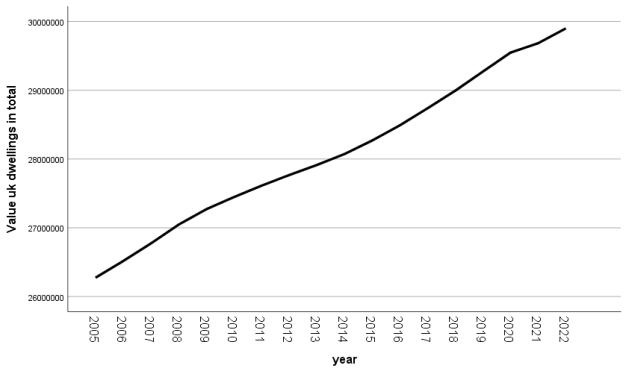

Figure 26: Dwellings in total

7.2 Empirical Result

7.2.1 Correlation between the Variables

Correlations

		uk average house price (gbp)	uk dwellings in total
Pearson Correlation	uk average house price (gbp)	1,000	,915
	uk dwellings in total	,915	1,000
Sig. (1-tailed)	uk average house price (gbp)	.	,000
	uk dwellings in total	,000	.
N	uk average house price (gbp)	18	18
	uk dwellings in total	18	18

Figure 27: Correlations (dwellings in total)

Here we saw a significant positive relationship between the price and the dwellings in total: R(16)=,915 P=,000.

7.2.2 R and R^2

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,915[a]	,837	,827	14734,344

a. Predictors: (Constant), uk dwellings in total

Figure 28: Model summary (dwellings in total)

There is a strong relationship between independent valuables and dependent valuables R=0,915. And our R Square=0,837 meaning that 83.7% of the variance in the house price is explained or can be predicted by the predictor.

7.2.3 F-value

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1,789E+10	1	1,789E+10	82,393	,000[b]
	Residual	3473614497	16	217100906,1		
	Total	2,136E+10	17			

a. Dependent Variable: uk average house price (gbp)

b. Predictors: (Constant), uk dwellings in total

Figure 29: Anova (dwellings in total)

Independent valuable is a significant predictor for the house price, F(1,16)=82.393, p=.000.

7.2.4 T-value

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-629060,777	90763,576		-6,931	,000
	uk dwellings in total	,029	,003	,915	9,077	,000

a. Dependent Variable: uk average house price (gbp)

Figure 30: Coefficients (dwellings in total)

The dwellings in total significantly predict average house prices, β=,915 t(16)=9.077, p=.000.

Regression equation:

ŶUK average house price= -629060.777+0.029(dwellings in total)

7.3 Evaluation between Real and Estimated Price

Table 5: Presented below shows the real price, the estimated price, and the difference between them(dwellings in total)

Years	ŶUK average house price(GBP)	real price(GBP)	difference (real-estimated) GBP
2005	133885,223	150633	16747,777
2006	140903,223	159970	19066,777
2007	148327,223	176758	28430,777
2008	156244,223	185782	29537,777
2009	162740,223	157234	-5506,223
2010	167873,223	167469	-404,223
2011	172687,223	167300	-5387,223
2012	177182,223	165908	-11274,223
2013	181416,223	167716	-13700,223
2014	186056,223	178182	-7874,223
2015	191740,223	190665	-1075,223
2016	198149,223	205464	7314,777
2017	205312,223	215243	9930,777
2018	212736,223	224544	11807,777
2019	220798,223	228314	7515,777
2020	228831,223	231940	3108,777
2021	232781,313	249690	16908,687
2022	239035,366	272833	33797,634

Average difference:12740.4931 GBP

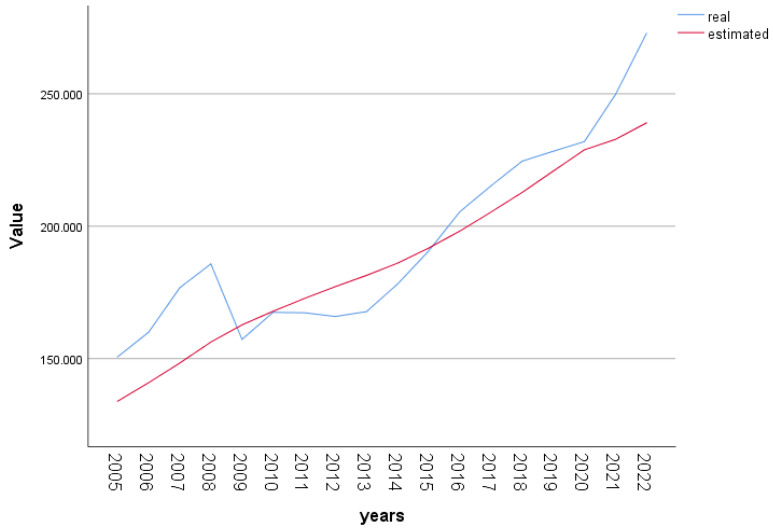

Figure 31: Estimated price compare to real price (dwellings in total)

Here, we present a graphical comparison between the actual and estimated prices of houses. Upon careful examination, distinct patterns emerge. From 2010 to 2020, the real price consistently fluctuates around the estimated price, with the year 2015 appearing as a significant turning point. Although the estimated price does not precisely match the real price, it does demonstrate a trend that aligns with the actual housing market prices.

During the period from 2010 to 2015, both the actual and estimated prices show a gradual upward trend. This indicates a period of steady growth in the housing market, likely driven by factors such as economic recovery, low-interest rates, and increased demand for housing. The estimated price closely follows the general trajectory of the actual price, suggesting that the model used to estimate housing prices captures the underlying trends in the market.

In 2015, a noticeable shift occurs in the relationship between the actual and estimated prices. The actual price experiences a sharp increase, surpassing the estimated price, which continues to rise but at a slower pace. This divergence suggests that there might be other influential factors at play that the model does not fully capture. These factors could include changes in government policies, shifts in market sentiment, or external shocks that affect the housing market dynamics.

From 2015 to 2020, both the actual and estimated prices continue to increase, but the gap between them widens. This indicates that the actual market prices are growing at a faster rate than what the model predicts. Such a scenario could be attributed to various factors, including increased demand due to population growth, supply shortages, or speculative activities in the market.

It is important to note that while the estimated price may not precisely match the actual price, it serves as a valuable tool for understanding the general trend and direction of the housing market. It provides a useful benchmark for evaluating price movements and can aid in making informed decisions related to buying, selling, or investing in real estate.

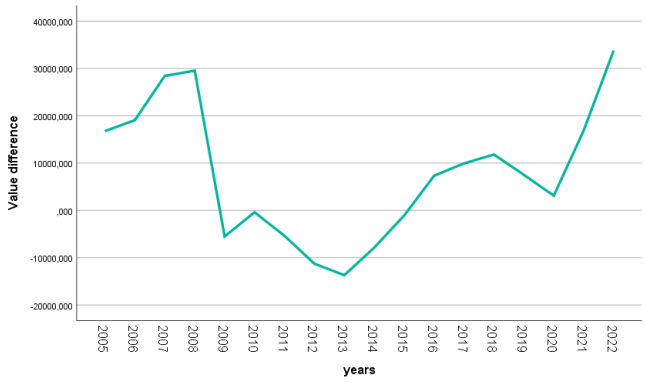

Figure 32: Difference (dwellings in total)

Now, we can see the variation between the real price and the estimated price. Based on the limited data, we observe a noticeable seasonal fluctuation. According to this trend, the real price may converge back to the estimated price trend in the next few years.

Chapter 8

AVERAGE HOUSE PRICE AND INTEREST RATE

8.1 Literature Review

In the fields of economics and finance, the connection between interest rates and home prices is a crucial one. The monetary policy-determined interest rate has a significant impact on the housing market. The affordability of mortgages, housing demand, supply dynamics, investor behavior, and market psychology are all impacted by changes in interest rates.

The impact of interest rates on home prices and other aspects of the housing market are examined in this essay. The affordability of mortgages is one of the main ways that interest rates have an impact on home prices. For homebuyers, lower interest rates mean lower borrowing costs. People find it more affordable to buy a home or move up to a larger property as the cost of getting a mortgage declines. Because housing is now more accessible, demand for housing is increasing, which raises prices. Interest rate variations also affect investor activity and housing demand.

Because borrowing is less expensive when interest rates are low, prospective homebuyers are encouraged to enter the market. This increased demand exerts upward pressure on house prices, particularly in regions with limited housing supply.

Furthermore, real estate investors looking for greater returns on their investments may be drawn to low-interest rates. Investors may look to the housing market for potentially higher returns as alternative investments, like bonds or savings accounts, offer lower yields. As demand from investors and homebuyers converge as a result of this increased investor activity, house prices are rising.

Beyond factors affecting demand, interest rates also have an impact on the housing supply. Lower interest rates can encourage new housing project development and increase construction activity. When borrowing costs are lower, builders and developers find it more financially feasible to start new projects. The housing supply grows as construction activity rises, which can moderate home price increases or even result in price decreases in some areas.

It is important to keep in mind that the effect on supply dynamics may change depending on regional zoning laws, building costs, and other factors influencing the ease of bringing new housing stock to the market (Ferrero, 2015; McQuinn & O'Reilly, 2008).

According to our linear regression analysis, there is a low correlation between house prices and interest rates, a low correlation between house prices and interest rates implies that changes in interest rates explain only a small portion of the variation in house prices.

There can be several reasons for this such as: House prices are influenced by a multitude of factors beyond interest rates; Time Lag, and The impact of interest rates

on house prices may not be immediate. It can take time for changes in interest rates to fully permeate the housing market.

The lag between changes in interest rates and their effect on house prices may contribute to a lower observed correlation. All in all, it's important to note that a low correlation does not necessarily imply a lack of relationship between house prices and interest rates. There could still be other forms of association, such as nonlinear or lagged relationships, that may exist but are not adequately captured by linear regression analysis alone.

Here we saw the trend for house prices and interest rates over 18 years.

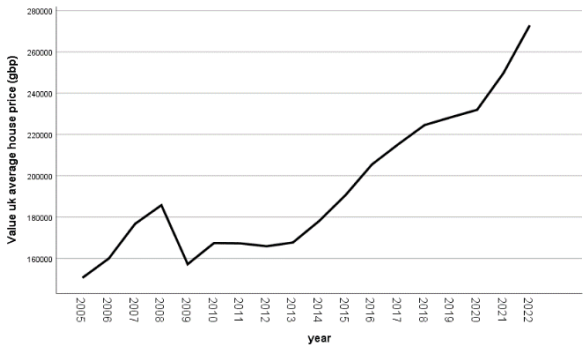

Figure 33: House price

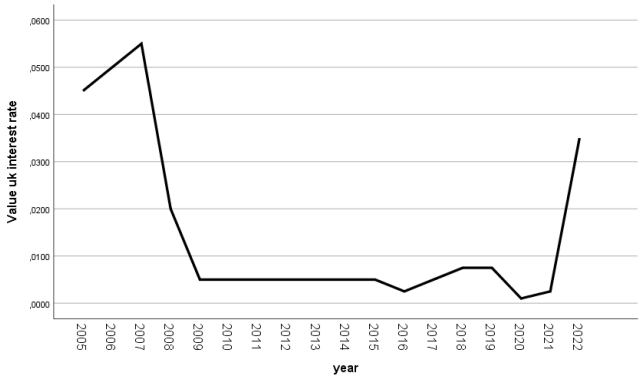

Figure 34: Interest rate

8.2 Empirical Result

8.2.1 Correlation between the Variables

Correlations

		uk average house price (gbp)	uk interest rate
Pearson Correlation	uk average house price (gbp)	1,000	-,191
	uk interest rate	-,191	1,000
Sig. (1-tailed)	uk average house price (gbp)	.	,224
	uk interest rate	,224	.
N	uk average house price (gbp)	18	18
	uk interest rate	18	18

Figure 35: Correlations (interest rate)

Here we saw a nonsignificant negative relationship between the price and the interest rate: R(16)= -,191 P=,224.

8.2.2 R and R^2

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,191[a]	,036	-,024	35868,545

a. Predictors: (Constant), uk interest rate

Figure 36: Model summary (interest rate)

There is a weak relationship between independent valuables and dependent valuables R=0,191. And our R Square=0,036 meaning that 3.6% of the variance in the house price is explained or can be predicted by the predictor.

8.2.3 F-value

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	776380958,3	1	776380958,3	,603	,449[b]
	Residual	2,058E+10	16	1286552516		
	Total	2,136E+10	17			

a. Dependent Variable: uk average house price (gbp)

b. Predictors: (Constant), uk interest rate

Figure 37: Anova (interest rate)

According to our analysis, independent valuable is not a significant predictor for the house price, F(1,16)=.603, p=.449.

8.2.4 T-value

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	199719,648	11041,555		18,088	,000
	uk interest rate	-373340,847	480597,857	-,191	-,777	,449

a. Dependent Variable: uk average house price (gbp)

Figure 38: Coeffients (interest rate)

The interest rate does not significantly predict average house prices, β=-,191 t(16)= -.777, p=.449.

Regression equation:

ŶUK average house price= 199719.648 - 373340.847(interest rate)

8.3 Evaluation between Real and Estimated Price

Table 6: Presented below shows the real price, the estimated price, and the difference between them(interest rate)

Years	ŶUK average house price(GBP)	real price(GBP)	difference (real-estimated) GBP
2005	182919,310	150633	-32286,310
2006	181052,606	159970	-21082,606
2007	179185,901	176758	-2427,901
2008	192252,831	185782	-6470,831
2009	197852,944	157234	-40618,944
2010	197852,944	167469	-30383,944
2011	197852,944	167300	-30552,944
2012	197852,944	165908	-31944,944
2013	197852,944	167716	-30136,944
2014	197852,944	178182	-19670,944
2015	197852,944	190665	-7187,944
2016	198786,296	205464	6677,704
2017	197852,944	215243	17390,056
2018	196919,592	224544	27624,408
2019	196919,592	228314	31394,408
2020	199346,307	231940	32593,693
2021	198786,296	249690	50903,704
2022	186652,718	272833	86180,282

Average difference:28084.9173 GBP

Figure 39: Estimated price compare to real price (interest rate)

When we examine this graphic, we notice that the estimated price differs significantly from the actual price. The real price experiences fluctuations, both rising and falling, while the estimated price, which is based on the interest rate, remains relatively stable at around $200,000. It's crucial to note that the estimated price does not accurately reflect the real market conditions. Market dynamics, such as supply and demand, location factors, economic indicators, and other variables, can heavily influence the actual price. These factors can cause the price to fluctuate, both upward and downward, over time.

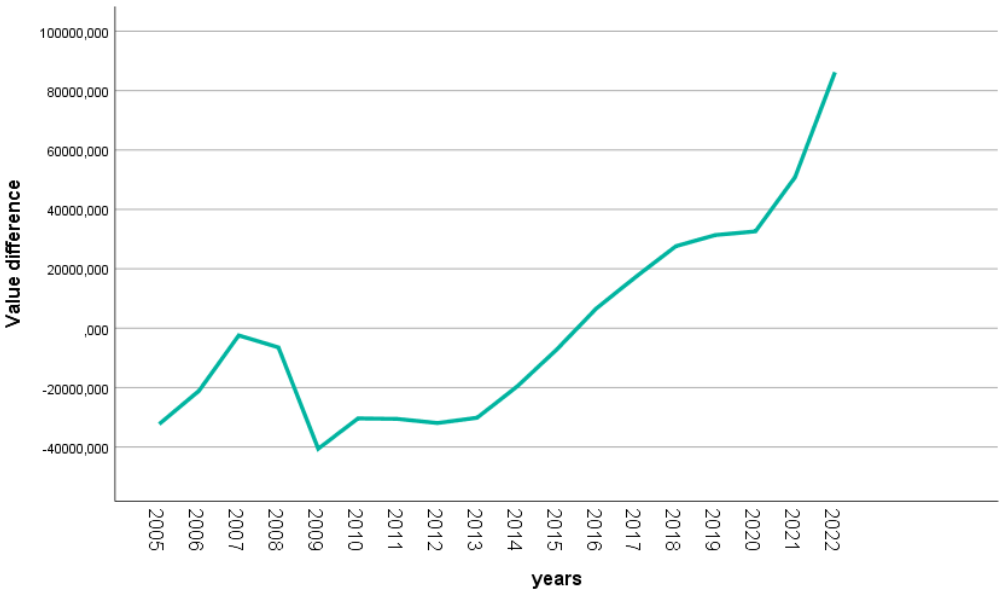

Figure 40: Difference (interest rate)

When we examine the differences, we observe that apart from the year 2007, the remaining values are not even close to zero. This graphic further confirms the findings of the previous regression analysis.

Chapter 9

AVERAGE HOUSE PRICE AND INFLATION RATE

9.1 Literature Review

Inflation and its effect on various economic indicators have long been subjects of interest for economists and policymakers. Among the sectors susceptible to the influence of inflation, the housing market holds a prominent position. This essay delves into the relationship between inflation and house prices, exploring how inflation can impact the housing market while also shedding light on instances where this correlation may not hold. As the general price level of goods and services continues to rise over time, inflation can be regarded as a contributing factor because it can pressure the housing market in a variety of ways. First off, the price of construction will increase as a result of increases in labor, materials, and other costs. These elements have a direct impact on the costs related to home construction or renovation. House prices may rise as a result of developers and builders passing on rising construction costs to prospective homeowners. During periods of high inflation, individuals tend to invest their money in real assets to hedge against the eroding value of the currency. This increased demand and limited supply can lead to a definite increase in house prices if the supply cannot catch up in time (Kuang & Liu, 2015).

Another factor that becomes apparent during times of high inflation is the response of central banks. Inflation often prompts central banks to increase interest rates to curb rising prices(Mishkin, 1992). Higher mortgage interest rates can make borrowing more

expensive, reducing housing affordability and dampening demand. Consequently, this can lead to a slowdown in the housing market and potentially stabilize or lower house prices(McQuinn & O'Reilly, 2008). While there are several ways that inflation can affect the housing market, as our analysis has already shown, relying solely on inflation as a predictor of changes in house prices has limitations. The relationship between inflation and house prices can be significantly impacted by other economic factors, regional differences, and time lags. A wider range of factors and how they interact must be taken into account to fully comprehend the housing market. To make well-informed decisions and predictions, policymakers, economists, and market participants should examine the complex interactions between inflation, economic variables, and regional dynamics. By doing this, it is possible to gain a more precise understanding of the housing market's complexity, facilitating better forecasting and the development of policy.

The graphic below represents the trend for house prices and inflation rates over 18 years.

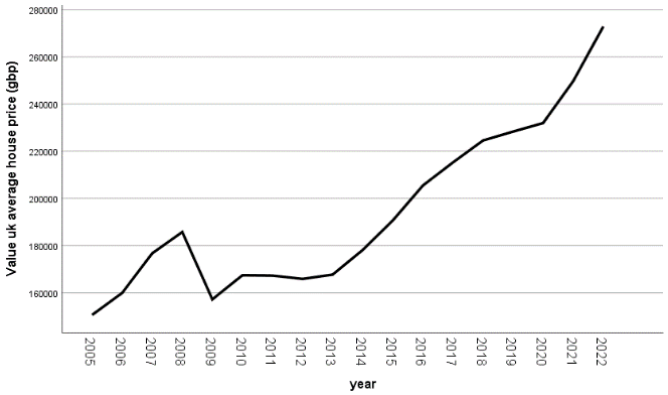

Figure 41: House price

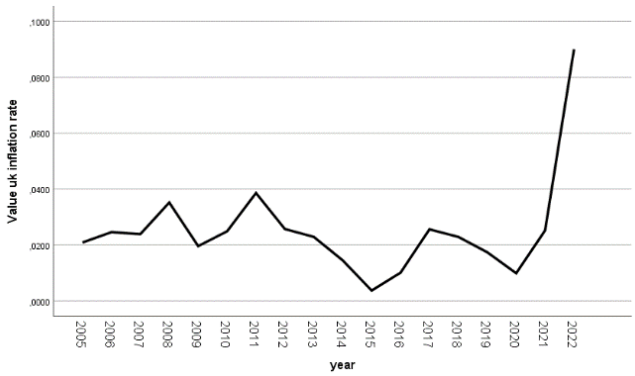

Figure 42: Inflation rate

9.2 Empirical Result

9.2.1 Correlation between the Variables

Correlations

		uk average house price (gbp)	uk inflation rate
Pearson Correlation	uk average house price (gbp)	1,000	,393
	uk inflation rate	,393	1,000
Sig. (1-tailed)	uk average house price (gbp)	.	,053
	uk inflation rate	,053	.
N	uk average house price (gbp)	18	18
	uk inflation rate	18	18

Figure 43: Correlations (inflation rate)

Here we saw a nonsignificant positive relationship between the price and the inflation rate: R(16)=,393 P=,053.

9.2.2 R and R^2

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,393[a]	,155	,102	33596,610

a. Predictors: (Constant), uk inflation rate

Figure 44: Model summary (inflation rate)

There is a weak relationship between independent valuables and dependent valuables R=0,393. And our R Square=0,155 meaning that 15.5% of the variance in the house price is explained or can be predicted by the predictor.

9.2.3 F-value

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3301505531	1	3301505531	2,925	,107[b]
	Residual	1,806E+10	16	1128732230		
	Total	2,136E+10	17			

a. Dependent Variable: uk average house price (gbp)

b. Predictors: (Constant), uk inflation rate

Figure 45: Anova (inflation rate)

According to our analysis, independent valuable is not a significant predictor for the house price, F(1,16)=2.925, p=.107.

9.2.4 T-value

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	174838,828	13816,563		12,654	,000
	uk inflation rate	765026,555	447317,572	,393	1,710	,107

a. Dependent Variable: uk average house price (gbp)

Figure 46: Coefficients (inflation rate)

The inflation rate does not significantly predict average house prices, β=.393 t(16)= 1.710, p=.107.

Regression equation:

ŶUK average house price= 174838.828 + 765026.555(inflation rate)

9.3 Evaluation between Real and Estimated Price

Table 7: Presented below shows the real price, the estimated price, and the difference between them(inflation rate)

Years	ŶUK average house price(GBP)	real price(GBP)	difference (real-estimated) GBP
2005	190827,883	150633	-40194,883
2006	193658,481	159970	-33688,481
2007	193122,963	176758	-16364,963
2008	201767,763	185782	-15985,763
2009	189833,348	157234	-32599,348
2010	193887,989	167469	-26418,989
2011	204368,853	167300	-37068,853
2012	194500,010	165908	-28592,010
2013	192357,936	167716	-24641,936
2014	185931,713	178182	-7749,713
2015	177669,426	190665	12995,574
2016	182565,596	205464	22898,404
2017	194423,508	215243	20819,492
2018	192357,936	224544	32186,064
2019	188150,290	228314	40163,710
2020	182412,591	231940	49527,409
2021	194117,497	249690	55572,503
2022	243691,218	272833	29141,782

Average difference: 29256,104 GBP

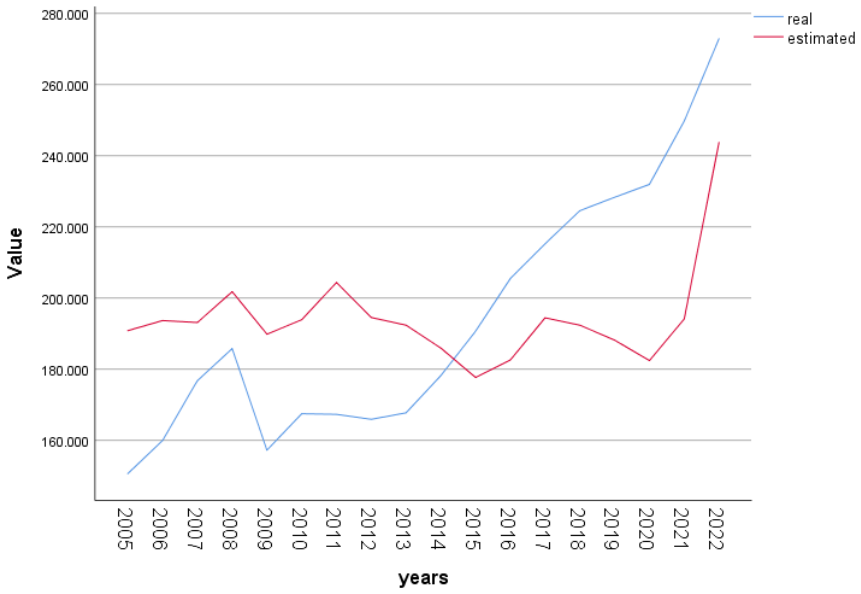

Figure 47: Estimated price compare to real price (inflation rate)

The real price and the estimated price are illustrated above. As we concluded from regression analysis, inflation may influence the house price to some extent, but it cannot be considered an accurate predictor. Examining the years between 2005 to 2014, we observed that the real price experienced fluctuations, rising and falling, but consistently remained below the estimated price. During this period, various factors such as market conditions, economic fluctuations, and local influences played significant roles in shaping the housing market. However, a notable shift occurred after 2014 when the real price started to exceed the estimated price. This change suggests a significant shift in the housing market dynamics, where other influential factors likely came into play. It is crucial to analyze these factors to understand the forces driving the real estate market and the subsequent deviations from the estimated price. While inflation can contribute to changes in house prices, it is essential to consider a broader range of variables that affect the real estate market. Factors such as supply and demand, interest rates, demographic trends, government policies, and local economic

conditions all have the potential to impact housing prices. To accurately predict and understand the fluctuations in house prices, a comprehensive analysis incorporating multiple variables and their interplay is necessary. By examining the complex relationships between these factors, we can enhance our ability to forecast and interpret housing market trends more effectively.

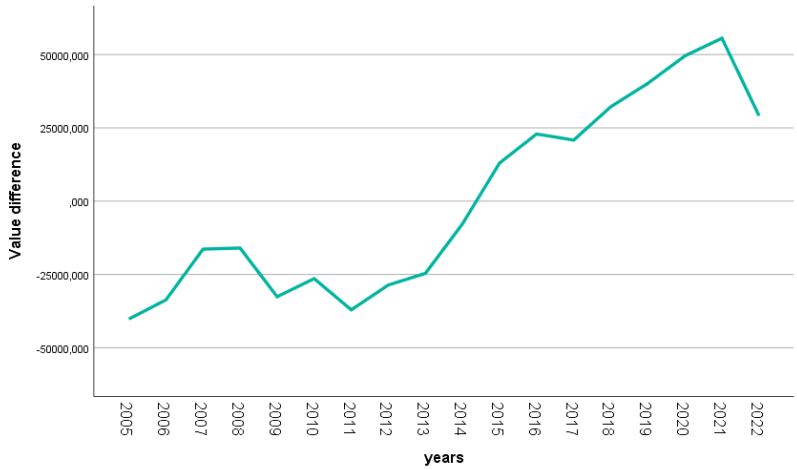

Figure 48: Difference (inflation rate)

Here we are observing the difference between the real and estimated prices based on inflation. The results indicate that the inflation rate alone is not a good predictor of real house prices. Over 18 years, the trend remained close to zero for an extended period. The value difference was approximately -25000 GBP from 2005 to 2014. However, within the 18-year timeframe, the trend fluctuated within a range of 50000 GBP, both negatively and positively.

Chapter 10

AVERAGE HOUSE PRICE AND GDP PER CAPITA

10.1 Literature Review

The complex relationship between GDP per capita and home prices has drawn a lot of interest from economists, researchers, and even policymakers. The GDP per capita, a metric of economic prosperity, is crucial in determining how housing markets develop. This section examines the potential effects of changes in real house prices on changes in GDP per capita as well as the implications of these findings. A country's income distribution and rate of economic growth can be accurately predicted by looking at its GDP per capita. When the GDP per capita increases, people frequently benefit from higher wages, better job prospects, and greater purchasing power. As a result, as more people strive to become homeowners or seek higher standards of living, there may be an increase in housing demand. Home prices will increase as a result of the increased demand.

Additionally, investor confidence and general market stability are influenced by GDP per capita. A growing economy with a higher GDP per person attracts both domestic and foreign investment. Investors look for chances to place their money in markets that offer promising returns. The stability and expansion brought on by a higher GDP per capita promote real estate investment, resulting in increased demand and a subsequent increase in home prices. The study of Balázs Égert and Dubravko Mihaljek indicates that GDP per capita plays a significant role in explaining house prices in both

OECD and CEE countries. GDP per capita shows a strong positive relationship with house prices, while real interest rates and housing credit also have robust relationships with house prices in both groups of countries(Égert & Mihaljek, 2007).

And Steven C. Bourassa discusses the relationship between land prices, house prices, and land leverage in the residential real estate market. It highlights that land in desirable residential locations is relatively inelastic in supply, while structures (houses) are more elastically supplied(Bourassa, Hoesli, Scognamiglio, & Zhang, 2011). Therefore, changes in residential land prices primarily result from changes in demand factors like per capita GDP, whereas changes in house prices are influenced by supply costs.

The following two graphics illustrate the 18-year trend in house prices and GDP per capita in the UK.

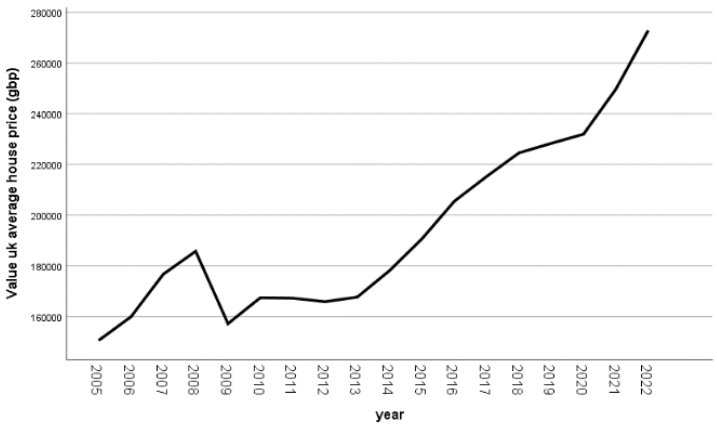

Figure 49: House price

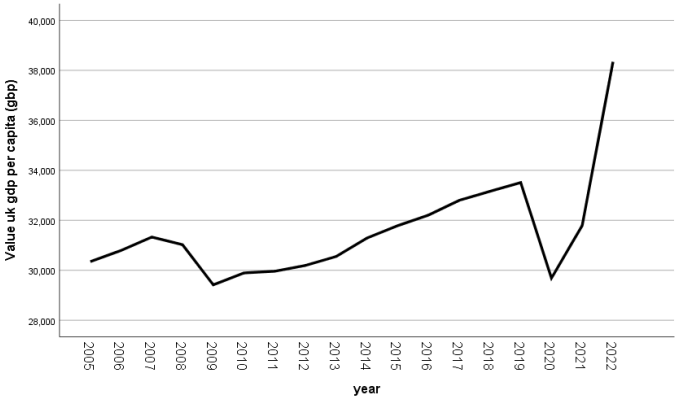

Figure 50: GDP per capita

10.2 Empirical Result

10.2.1 Correlation between the Variables

Correlations

		uk average house price (gbp)	uk gdp per capita (gbp)
Pearson Correlation	uk average house price (gbp)	1,000	,757
	uk gdp per capita (gbp)	,757	1,000
Sig. (1-tailed)	uk average house price (gbp)	.	,000
	uk gdp per capita (gbp)	,000	.
N	uk average house price (gbp)	18	18
	uk gdp per capita (gbp)	18	18

Figure 51: Correlations (GDP per capita)

Here we saw a significant positive relationship between the price and the GDP per capita: R(16)=,757 P=,000.

10.2.2 R and R^2

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,757[a]	,574	,547	23853,859

a. Predictors: (Constant), uk gdp per capita (gbp)

Figure 52: Model summary (GDP per capita)

There is a strong relationship between independent valuables and dependent valuables R=0,757. And our R Square=0,574 meaning that 57.4% of the variance in the house price is explained or can be predicted by the predictor.

10.2.3 F-value

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1,226E+10	1	1,226E+10	21,541	,000[b]
	Residual	9104105695	16	569006606,0		
	Total	2,136E+10	17			

a. Dependent Variable: uk average house price (gbp)

b. Predictors: (Constant), uk gdp per capita (gbp)

Figure 53: Anova (GDP per capita)

According to our analysis, independent valuable is a significant predictor for the house price, F(1,16)=21.541, p=.000.

10.2.4 T-value

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-214256,997	88185,664		-2,430	,027
	uk gdp per capita (gbp)	12942,202	2788,513	,757	4,641	,000

a. Dependent Variable: uk average house price (gbp)

Figure 54: Coefficients (GDP per capita)

The GDP per capita does significantly predict average house prices, β=.757 t(16)= 4.641, p=.000.

Regression equation:

ŶUK average house price= -214256.997 + 12942.202(GDP per capita)

10.3 Evaluation between Real and Estimated Price

Table 8: Presented below shows the real price, the estimated price, and the difference between them(GDP per capita)

Years	ŶUK average house price(GBP)	real price(GBP)	difference (real-estimated) GBP
2005	178512,949	150633	-27879,949
2006	184259,287	159970	-24289,287
2007	191196,307	176758	-14438,307
2008	187274,820	185782	-1492,820
2009	166463,759	157234	-9229,759
2010	172624,247	167469	-5155,247
2011	173504,317	167300	-6204,317
2012	176532,792	165908	-10624,792
2013	181166,101	167716	-13450,101
2014	190704,504	178182	-12522,504
2015	197123,836	190665	-6458,836
2016	202585,445	205464	2878,555
2017	210234,286	215243	5008,714
2018	214906,421	224544	9637,579
2019	219436,192	228314	8877,808
2020	169958,154	231940	61981,846
2021	197214,431	249690	52475,569
2022	281947,028	272833	-9114,028

Average difference: 15651,112 GBP

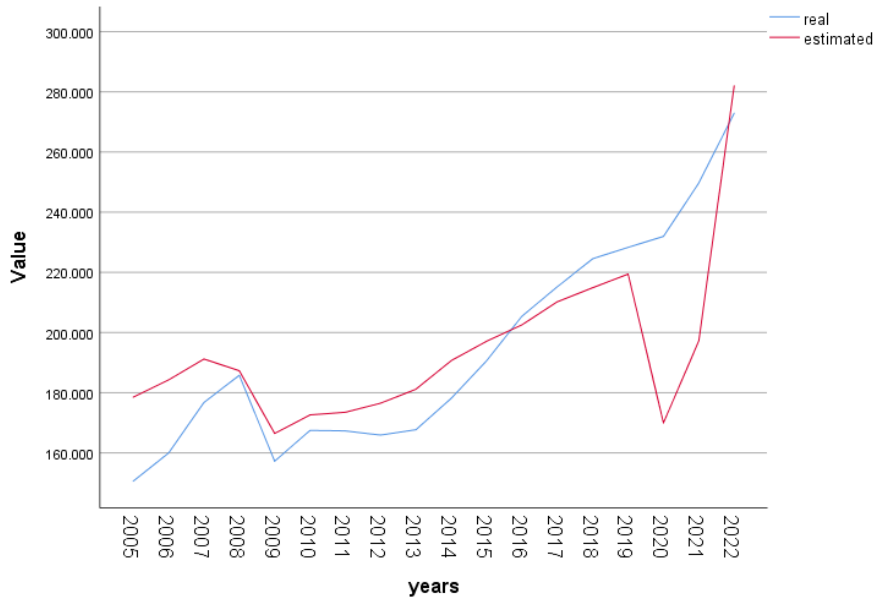

Figure 55: Estimated price compare to real price (GDP per capita)

Most of the time, our estimated price was close to the real price, indicating the effectiveness of our linear regression analysis. We found that GDP per capita serves as a reliable predictor for house prices. However, during the period between 2019 and 2021, a significant disparity emerged between the real price and our estimated price. This discrepancy can be attributed to the sharp fluctuations in GDP per capita during this time. The sudden drop followed by a rapid rebound in GDP per capita greatly impacted the housing market.

The significant drop and subsequent rebound in GDP per capita played a pivotal role in causing this notable difference. These abrupt changes in economic indicators had a cascading effect on the housing market. As GDP per capita experienced a sharp decline, it directly impacted people's purchasing power and confidence in real estate investments. Consequently, the real estate market faced a downturn, leading to a trend of stagnation.

However, the actual market trend did not align with our initial assumptions. Despite the expected stagnation, the recovery of GDP in the following year had a surprising effect on the housing market. As a consequence, instead of stabilizing, house prices actually increased. The renewed economic growth and improved GDP per capita seemed to have instilled confidence among buyers and investors, leading to a surge in demand for houses and subsequently driving up prices.

In summary, the fluctuations in GDP per capita between 2019 and 2021 had a significant impact on the housing market. The sharp changes resulted in a notable difference between the estimated and real prices. While a period of stagnation was initially anticipated, the recovery of GDP led to an upward trend in house prices. This unexpected outcome highlights the dynamic nature of the housing market and the influence of economic factors on its trajectory.

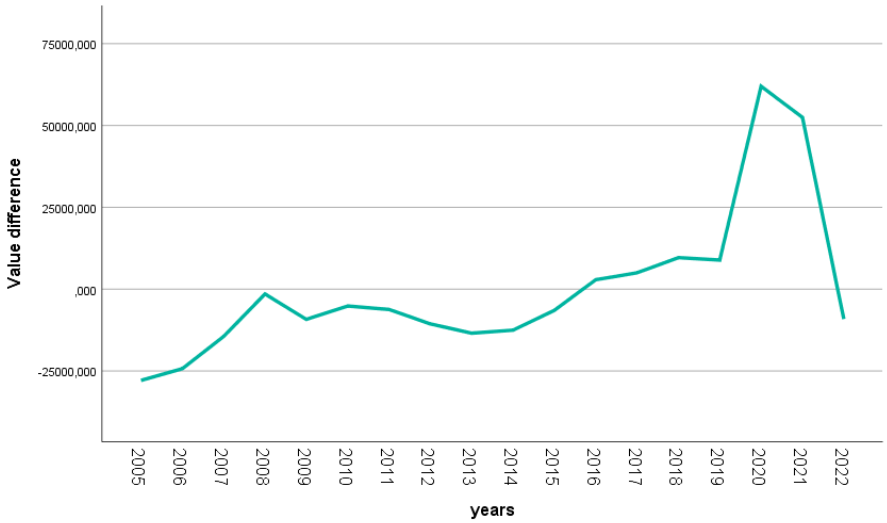

Figure 56: Difference (GDP per capita)

This graphic represents the comparison between two values, specifically regarding house prices. It reveals that between 2007 and 2019, the differences between our

estimated and real prices were minimal. This indicates that our estimations were closely aligned with the actual prices, which further supports the validity of our previous linear regression analysis.

However, there were two distinct periods where significant differences were observed. The first period, spanning from 2005 to 2007, demonstrated that the house prices we estimated were higher than the actual prices. The second period, from 2019 to 2022, exhibited a sudden increase followed by a sudden drop in the difference between estimated and real prices.

This highlights the significance of GDP per capita as a predictor for real house prices. It suggests that GDP per capita draws a logical trend that can aid in predicting the circumstances of the housing market to some extent. However, it also emphasizes that GDP per capita alone is insufficient for making precise estimations. To achieve a more accurate estimation, it is necessary to consider other factors and variables in addition to GDP per capita.

Chapter 11

REGRESSION ANALYSIS (ALL INDEPENDENT VALUABLE)

11.1 Empirical Result

11.1.1 Correlation between the Variables

Correlations

		uk average house price (gbp)	uk population	uk dwellings in total	uk gdp per capita (gbp)	uk inflation rate	uk unemployment rate	uk interest rate	uk gdp in million GBP
Pearson Correlation	uk average house price (gbp)	1,000	,869	,915	,757	,393	-,725	-,191	,915
	uk population	,869	1,000	,988	,570	,126	-,479	-,576	,830
	uk dwellings in total	,915	,988	1,000	,596	,213	-,501	-,517	,848
	uk gdp per capita (gbp)	,757	,570	,596	1,000	,671	-,667	,180	,929
	uk inflation rate	,393	,126	,213	,671	1,000	-,121	,336	,519
	uk unemployment rate	-,725	-,479	-,501	-,667	-,121	1,000	-,261	-,682
	uk interest rate	-,191	-,576	-,517	,180	,336	-,261	1,000	-,115
	uk gdp in million GBP	,915	,830	,848	,929	,519	-,682	-,115	1,000
Sig. (1-tailed)	uk average house price (gbp)	.	,000	,000	,000	,053	,000	,224	,000
	uk population	,000	.	,000	,007	,309	,022	,006	,000
	uk dwellings in total	,000	,000	.	,005	,198	,017	,014	,000
	uk gdp per capita (gbp)	,000	,007	,005	.	,001	,001	,238	,000
	uk inflation rate	,053	,309	,198	,001	.	,316	,086	,014
	uk unemployment rate	,000	,022	,017	,001	,316	.	,147	,001
	uk interest rate	,224	,006	,014	,238	,086	,147	.	,324
	uk gdp in million GBP	,000	,000	,000	,000	,014	,001	,324	.
N	uk average house price (gbp)	18	18	18	18	18	18	18	18
	uk population	18	18	18	18	18	18	18	18
	uk dwellings in total	18	18	18	18	18	18	18	18
	uk gdp per capita (gbp)	18	18	18	18	18	18	18	18
	uk inflation rate	18	18	18	18	18	18	18	18
	uk unemployment rate	18	18	18	18	18	18	18	18
	uk interest rate	18	18	18	18	18	18	18	18
	uk gdp in million GBP	18	18	18	18	18	18	18	18

Figure 57: Correlation between the variables (all)

Here the correlation is well analyzed:

- A strong significant positive relationship exists between the price and the population: R(16)=,869 P=,000.
- There is a strong significant positive relationship between price and dwellings in total R(16)=,915 P=,000.
- There is a significant positive relationship between price and GDP per capita R(16)=,757 P=,000.
- The weak nonsignificant positive relationship finds in between price and inflation rate R(16)=,393 P=,053.
- But a significant negative relationship exists between the price and the unemployment rate: R(16)=-,725 P=,000.
- The negative relationship between price and interest rate is weak and is not statistically significant: R(16)=-,191 P=,224.
- There is a strong significant positive relationship between price and GDP R(16)=,915 P=,000.

11.1.2 R and R^2

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,992[a]	,984	,973	5865,057

a. Predictors: (Constant), uk gdp in million GBP, uk interest rate, uk inflation rate, uk unemployment rate, uk dwellings in total, uk population, uk gdp per capita (gbp)

Figure 58: Model summary (all)

There is a strong positive relationship between independent valuables and dependent valuables R=0,992 and R Square=0,984, meaning that 98.4% of the variance in the house price is explained or can be predicted by predictors.

11.1.3 F-value

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2,102E+10	7	3002461761	87,284	,000[b]
	Residual	343988892,0	10	34398889,20		
	Total	2,136E+10	17			

a. Dependent Variable: uk average house price (gbp)

b. Predictors: (Constant), uk gdp in million GBP, uk interest rate, uk inflation rate, uk unemployment rate, uk dwellings in total, uk population, uk gdp per capita (gbp)

Figure 59: Anova (all)

Independent valuables were a significant predictor of house price, F(7,10)=87.284, p=.000, R^2=.984.

11.1.4 T-value

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	249458,617	629227,651		,396	,700
	uk population	-,020	,010	-1,354	-2,072	,065
	uk dwellings in total	,043	,018	1,336	2,404	,037
	uk gdp per capita (gbp)	-14611,235	16564,293	-,855	-,882	,398
	uk inflation rate	185727,342	240738,384	,095	,771	,458
	uk unemployment rate	-709326,496	260536,709	-,301	-2,723	,021
	uk interest rate	-138466,700	217744,346	-,071	-,636	,539
	uk gdp in million GBP	,267	,286	1,438	,934	,372

a. Dependent Variable: uk average house price (gbp)

Figure 60: Coefficients (all)

The coefficient table looks at each independent valuable individually. Surprisingly we see that only the unemployment rate and total dwelling are statistically significant, but other predictors are not, since their p-value is higher than .05.

The reason is our predictor is correlated with each other to such a degree, in such a situation that none of them present any significant amount of unique variance in explaining the dependent variable. To make analyses more accurate I will extract some predictors such as UK GDP per capita, inflation rate, and UK interest rate, in the next part. But now let's see how close our estimated price is compared to the real price.

Regression equation:

ŶUK average house price= 249458.617 - 0.02(UK population) + 0.043(UK dwellings in total) – 14611.235(GDP per capita) +185727.342(inflation rate)-709326.496(unemployment rate)- 138466.7(interest rate) + 0.267(UK GDP in million)

11.2 Evaluation between Real and Estimated Price

Table 9: Presented below shows the real price, the estimated price, and the difference between them(all)

Years	ŶUK average house price(GBP)	real price(GBP)	difference (real-estimated) GBP
2005	183706,935	150633	-33073,935
2006	187668,858	159970	-27698,858
2007	192966,989	176758	-16208,989
2008	202659,228	185782	-16877,228
2009	189468,724	157234	-32234,724
2010	189503,437	167469	-22034,437
2011	193226,518	167300	-25926,518
2012	192267,996	165908	-26359,996
2013	195267,669	167716	-27551,669
2014	206183,619	178182	-28001,619
2015	216342,867	190665	-25677,867
2016	228700,097	205464	-23236,097
2017	240607,479	215243	-25364,479
2018	250089,132	224544	-25545,132
2019	260740,858	228314	-32426,858
2020	259769,095	231940	-27829,095
2021	274917,836	249690	-25227,836
2022	302375,626	272833	-29542,626

Average difference: 26156,554 GBP

Figure 61: Estimated price compare to real price (all)

In the analysis of the estimated and real house prices over 18 years, a clear trend emerges. Although the estimated price never coincided exactly with the real price, their trends were consistently parallel. This indicates that, to some extent, by considering all the factors discussed earlier, we can estimate a logical trend for house prices.

However, it's important to note that relying solely on the factors previously mentioned might not be sufficient to achieve an accurate price estimation. To improve the accuracy of predictions, additional predictors need to be considered. In this case, factors such as GDP per capita, inflation rate, and interest rate should be removed.

In the analysis of these additional predictors, it is found that the inflation rate and interest rate do not have a significant impact on house prices. This conclusion is based on the p-values obtained from the previous linear regression analysis, which are higher than the common significance level of 0.05. Therefore, these two factors may not provide valuable information for accurately predicting house prices.

Regarding the removal of GDP per capita as a predictor, this decision is influenced by the strong significant positive relationship observed between GDP per capita and GDP. Given that GDP is an indicator of overall economic activity and includes various factors that influence house prices, it is reasonable to remove GDP per capita from the predictor set to avoid redundancy or collinearity issues.

In summary, while the trends of estimated and real prices show a parallel pattern, further refinement of the price estimation model is necessary. To improve accuracy, predictors such as GDP per capita should be removed, while considering that factors like inflation rate and interest rate may not be significant predictors for house prices based on the previous analysis so those two will be removed too.

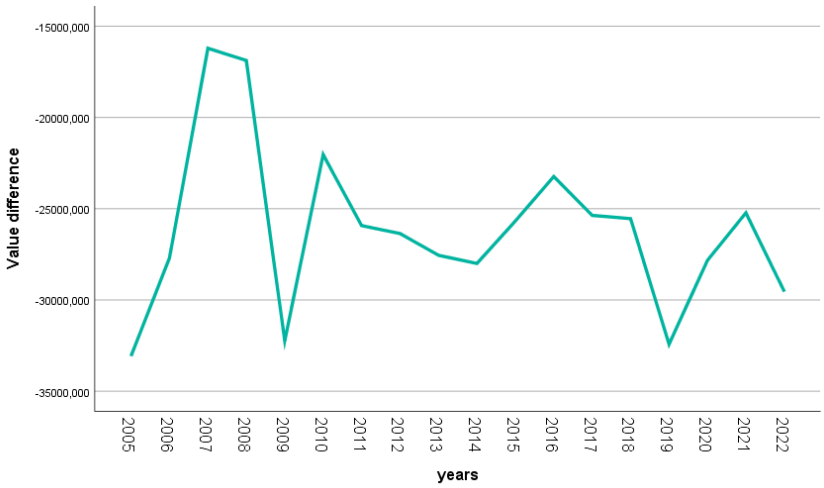

Figure 62: Difference (all)

In this graphic, we can observe the variations in the difference between the estimated price and the real price over the years. By analyzing this data, we can identify the years with the smallest differences and the years with the largest gaps between the estimated and real prices.

By removing GDP per capita, inflation rate, and UK interest rate from the analysis, we aim to explore the impact of these factors on the observed gaps. This step allows us to investigate whether these variables contribute significantly to the differences we observe in price estimates.

Upon removing these predictors, we may discover interesting patterns. For instance, in certain years, the gaps between the estimated and real prices may decrease significantly. This suggests that GDP per capita, inflation rate, and UK interest rate strongly influence the estimated prices during those periods. By removing these factors, we can observe a closer alignment between the estimated and real prices, indicating that other factors may have a more substantial impact on price estimation accuracy during those years.

Conversely, there may be years where removing GDP per capita, inflation rate, and interest rate does not have a considerable effect on the observed gaps. This suggests that other unaccounted factors or complexities in the housing market play a more prominent role in driving the differences between the estimated and real prices during those particular periods.

By analyzing the gaps between estimated and real prices, both with and without the inclusion of GDP per capita, inflation rate, and interest rate, we can gain deeper insights into the factors influencing price estimation accuracy. This analysis enables us to refine our models, identify additional factors that contribute to the gaps, and enhance the precision of future price predictions.

Chapter 12

REGRESSION ANALYSIS (WITHOUT GDP PER CAPITA, INFLATION RATE AND INTEREST RATE)

12.1 Empirical Result

12.1.1 R and R^2

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,991[a]	,982	,976	5509,056

a. Predictors: (Constant), uk gdp in million GBP, uk unemployment rate, uk population, uk dwellings in total

Figure 63: Model summary (without UK GDP per capita, inflation rate, and UK interest rate)

Here we saw a strong positive relationship between independent valuables and dependent valuable R=0,991 and R Square=0,982, meaning that 98.2% of the variance in the house price is explained or can be predicted by predictors.

12.1.2 F-value

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2,097E+10	4	5241668789	172,709	,000[b]
	Residual	394546060,3	13	30349696,95		
	Total	2,136E+10	17			

a. Dependent Variable: uk average house price (gbp)

b. Predictors: (Constant), uk gdp in million GBP, uk unemployment rate, uk population, uk dwellings in total

Figure 64: Anova (without UK GDP per capita, inflation rate, and UK interest rate)

Independent valuables were a significant predictor of house price, $F(4,13)=127.709$, $p=.000$, $R^2=.982$.

12.1.3 T-value

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-298456,565	47649,245		-6,264	,000
	uk population	-,019	,004	-1,279	-5,121	,000
	uk dwellings in total	,060	,008	1,860	7,088	,000
	uk unemployment rate	-587798,317	124328,643	-,249	-4,728	,000
	uk gdp in million GBP	,043	,016	,229	2,669	,019

a. Dependent Variable: uk average house price (gbp)

Figure 65: Coefficients (without UK GDP per capita, inflation rate, and UK interest rate)

- The UK population is a significant predictor of average house prices, $\beta=-1.279$, $t(16)=-5.121$, $p=.000$.
- The UK dwellings in total is a significant predictor of average house prices, $\beta=1.860$, $t(16)=7.088$, $p=.000$.

- The unemployment rate significantly predicts average house prices, β=-.249, t(16)=-4.728, p=.000.
- The GDP is a significant predictor of average house prices, β=,229 t(16)=2,669 p=.019.

Regression equation:

ŶUK average house price= -298456.565 - 0.019(UK population) + 0.06(UK dwellings in total) – 587798.317(UK unemployment rate) + 0.043(UK GDP in million)

12.2 Evaluation between Real and Estimated Price

Table 10: Presented below shows the real price, the estimated price, and the difference between them(without UK GDP per capita, inflation rate, and UK interest rate)

Years	ŶUK average house price(GBP)	real price(GBP)	difference (real-estimated) GBP
2005	181944,310	150633	-31311,310
2006	187004,196	159970	-27034,196
2007	196053,909	176758	-19295,909
2008	200970,763	185782	-15188,763
2009	190082,258	157234	-32848,258
2010	191107,350	167469	-23638,350
2011	190778,841	167300	-23478,841
2012	192302,856	165908	-26394,856
2013	195377,824	167716	-27661,824
2014	206855,351	178182	-28673,351
2015	217106,076	190665	-26441,076
2016	227093,817	205464	-21629,817
2017	238913,802	215243	-23670,802
2018	250767,063	224544	-26223,063
2019	264002,426	228314	-35688,426
2020	260653,895	231940	-28713,895
2021	272163,369	249690	-22473,369
2022	302558,341	272833	-29725,341

Average difference: 26116,191 GBP

Figure 66: Estimated price compare to real price (without UK GDP per capita, inflation rate, and UK interest rate)

Although the estimated price in our analysis still follows a parallel trend with the real price after removing GDP per capita, inflation rate, and interest rate, it is important to note that achieving an exact overlap between predicted values and real values is not always feasible or expected in statistical modeling.

While our previous analysis indicated that the independent variables (GDP per capita, inflation rate, and interest rate) were strong predictors, with high R-squared, adjusted R-squared, F-test, and ANOVA values, these measures alone do not guarantee a perfect overlap between predicted and real values. There could be other factors or considerations that influence the difference between the two trends.

The high R-squared value of 0.982 suggests that 98.2% of the variance in the house price can be explained or predicted by the selected predictors. However, it also means that there is still 1.8% of the variance that remains unexplained or influenced by factors beyond our model.

Factors such as market fluctuations, changes in consumer preferences, macroeconomic events, or other unaccounted variables may contribute to the observed differences between the predicted and real values.

While it is desirable to have predicted values closely aligned with real values, the parallel trend observed in the graphic suggests that the model captures the general direction of the housing market. It provides valuable insights and a reasonable estimation, but it is important to recognize that there will always be some level of uncertainty and unexplained factors in predicting complex phenomena such as house prices.

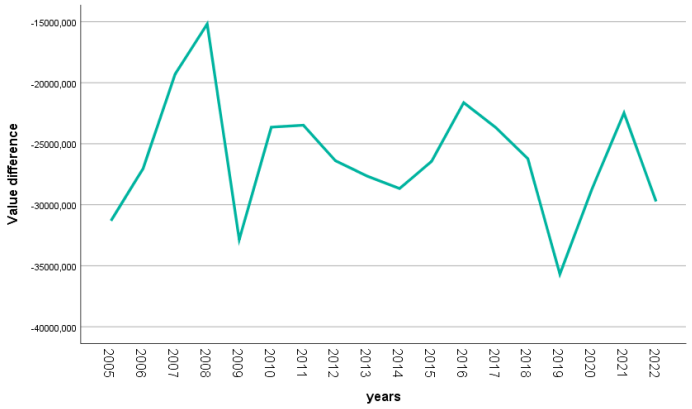

Figure 67: Difference (without UK GDP per capita, inflation rate, and UK interest rate)

We can understand that the estimated price is not perfectly parallel to the real price, as the difference between them was fluctuating. However, when comparing it to the previous analysis, we can see that even though there is not a significant difference between them, the average mean of the current difference is slightly less than the previous one.

Chapter 13

CONCLUSION

In conclusion, our analysis reveals a parallel trend between estimated and real house prices over 18 years. Although the estimated prices do not perfectly match the real prices, the consistent parallel pattern indicates that, to some extent, we can estimate a logical trend for house prices by considering the factors discussed. However, relying solely on these factors may not be sufficient for accurate price estimation.

To improve prediction accuracy, additional predictors should be considered. In our analysis, we found that factors such as GDP per capita, inflation rate, and interest rate did not significantly impact house prices. Therefore, we removed these variables from the predictor set and got a more accurate trend.

It is important to note that achieving an exact overlap between predicted and real values is not always feasible in statistical modeling. While our previous analysis showed strong predictive power for the selected variables, there may be other factors or considerations influencing the differences between the predicted and real trends.

The high R-squared value indicates that a significant portion of the variance in house prices can be explained by the selected predictors. However, there is still unexplained variance influenced by factors beyond our model. Market fluctuations, consumer preferences, macroeconomic events, and other unaccounted variables can contribute to the observed differences.

While the model captures the general direction of the housing market, it is essential to acknowledge the presence of uncertainty and unexplained factors in predicting complex phenomena like house prices. The parallel trend provides valuable insights and a reasonable estimation, but it should be interpreted with caution, considering the limitations of the model and the potential influence of unaccounted variables.

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