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LINKAGES BETWEEN PROPERTY PRICES AND SHADOW RATES: EVIDENCE FROM GERMANY

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Abstract

Following the appearance of the COVID-19 epidemic, there has been a substantial increase in real estate values in Germany. This occurrence was unforeseen due to many macroeconomic factors such as the unemployment rate and gross domestic product indicating a decline in property prices during this timeframe. This offers an exceptional opportunity to experimentally investigate the precise correlation between interest rates and property prices. The objective of this study is to examine the validity of the real interest rate hypothesis and assess the predictive accuracy of shadow rates. This study used a time series regression analysis to investigate the hypothesis. The time series spans from the first quarter of 2010 to the fourth quarter of 2023. The findings validate that shadow interest rates can exert a significant influence on the rate of property price growth, even after accounting for the effects of economic growth and unemployment. In addition, shadow rates appear to be slightly more accurate forecasters than short-term nominal interest rates. The issue of endogeneity has been effectively addressed through the implementation of an experimental design. The findings have extensive practical ramifications for housing policy and strategies to address the issue of housing affordability.

Key words: real estate markets, housing demand, business fluctuations
JEL classification: R31, R21, E32

Introduction

During the global financial crisis, there has been a growing focus on examining the affordability of housing (Wetzstein, 2017; Haffner & Hulse, 2021). Prior to the crisis, macroeconomic models failed to sufficiently account for the interdependencies among the real economy, credit markets, and asset valuations. (Duca et al., 2021). The IMF has identified a link between property prices in various countries, which they attribute to the influence of global interest rate shocks (Hirata et al., 2013; Katagiri, 2018). The COVID-19 pandemic presents a quasi-experimental chance to evaluate their hypothesis.

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Since the beginning of 2020, a highly transmissible disease caused by a novel coronavirus, known as COVID-19 according to the World Health Organization, has been rapidly disseminating over the globe. It has resulted in numerous fatalities and a worldwide economic downturn. Several organizations also encounter substantial challenges in sustaining efficient corporate operations as a result of supply chain issues. Consequently, there has been a substantial decline in economic growth compared to the positive outcomes observed in previous years. The pandemic has led to a significant increase in the unemployment rates of several developed economies, marking the first time in years that such a spike has been observed. According to the Federal Statistical Office (Statistisches Bundesamt), Germany had an increase in the unemployment rate to 6.3% in 2020. Contrary to prevailing assumptions, property prices in several nations, including Germany, have experienced a significant surge instead of a decline during this devastating event.

Opposite to the traditional theoretical prediction of a negative impact of a pandemic on the housing market (Francke & Korevaar, 2021) property prices rose significantly in many countries after the outbreak of COVID, also in Germany. The development was also observed when business operations were disrupted, GDP growth rates were negative and unemployment rates were unprecedentedly high (Wang, 2021).

It is feasible to hypothesize that the paradoxical rise in housing prices globally following the COVID epidemic could be attributed to a synchronized countercyclical reduction in interest rates by central banks. The majority of these events occurred during the initial three months of 2020, when central banks endeavored to support the economy by reducing interest rates, with some reaching unprecedentedly low levels found empirical evidence in 2021 through his examination of the monetary policy hypothesis in the pandemic era. This hypothesis was tested by a cross-border panel regression analysis, as the synchronization of central bank interest rate cuts worldwide after the outbreak of COVID is practically an experiment to test the monetary policy hypothesis. This study looked at five countries where property prices have risen sharply since the outbreak of COVID. These are Australia, Canada, New Zealand, the United Kingdom, and the USA (Yiu, 2021).

In this study, the residential property market in Germany is examined based on Yiu's research design. The paper is organized in the following manner. Section 1 provided a comprehensive analysis of several research that have examined the monetary policy hypothesis. Section 2 provides a detailed description of the study materials and procedures employed. Section 3 presents the findings of the empirical tests which are discussed as well as an analysis of the findings and their potential consequences are shown in Section 4. Finally, section 5 ends with a concluding statement.

Materials and methods

This article analyzes the impact of interest rates, unemployment rate, and real gross domestic product on property prices in Germany. Two distinct interest rates are utilized. The objective of the study is to identify the factors that influence real estate values in Germany. The work is grounded on the subsequent two hypotheses: At first, hypothesis H0 is examined, which assumes that there is a significant negative relationship between property prices and interest

rates. Afterwards hypothesis H1 posits that shadow rates serve as a more accurate predictors of real estate revaluation compared to short-term interest rates.

Data

House price index (HPI): This study utilizes data from the Federal Statistical Office to gather quarterly information on property prices in Germany. Germany is an advanced OECD nation with a market-driven capitalist system. This enhances the efficiency and transparency of the German real estate market. Figure 1 clearly illustrates a discernible trend in property prices. To eradicate a trend in timeseries, we solely analyze the change in house price index. Additionally, HPI change is calculated using logarithmic returns.

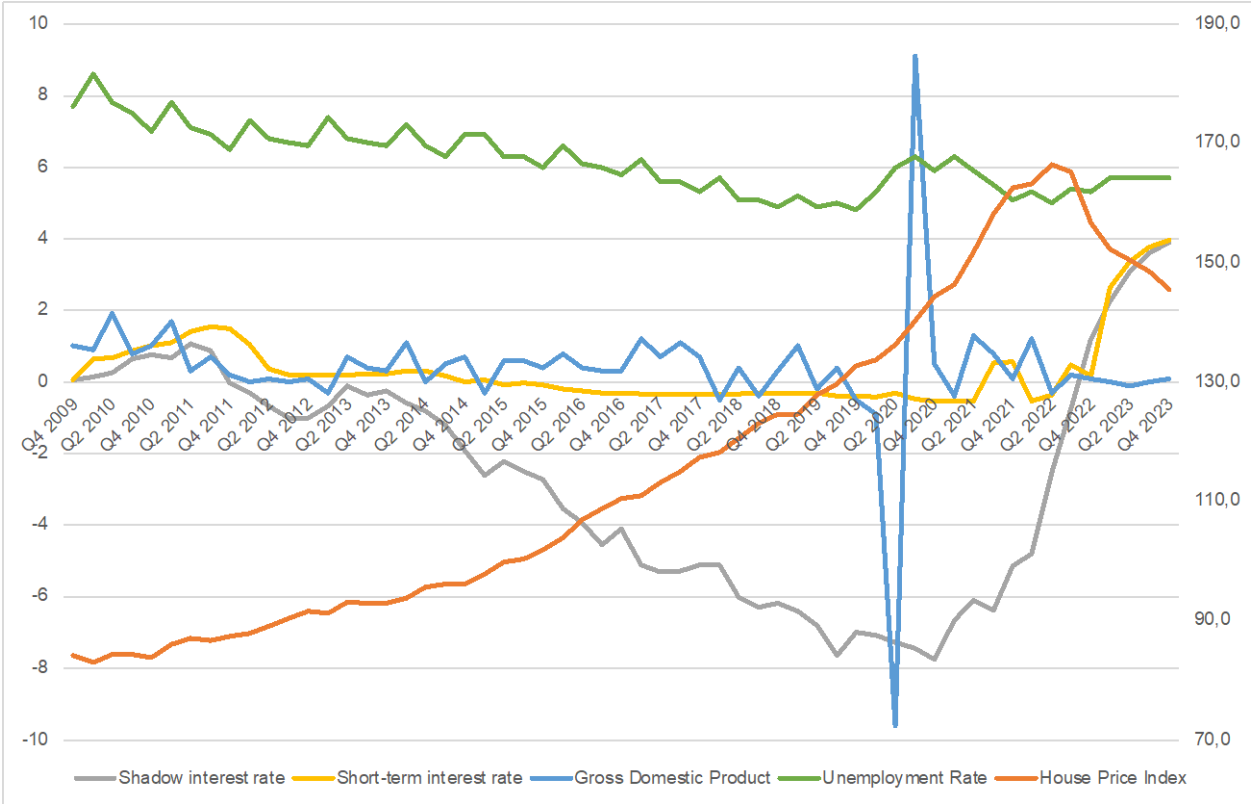

Figure No. 1 - House Price Index, Short-Term and Shadow Interest Rates, 2010Q1–2021Q1
Sources: Federal Statistical Office (Statistisches Bundesamt (Destatis)), Deutsche Bundesbank, own work

Short-term interest rates (STIR): EOINA is the reference interest rate used to refer to the short-term interest rate. Following the discontinuation of EONIA at the end of 2021, the euro will be utilized, along with an additional 8.5 basis point premium (European Central Bank, 2019). There is a potential for distortion when determining short-term interest rates using EONIA and subsequent €ster rates, particularly when nominal interest rates approach the lower limit of zero. Therefore, an alternative interest rate is also employed.

Shadow interest rates (SIR): Second interst rate is defined as the shadow rate. This model was originally elaborated by Fischer Black (1995) in his work "Interest as Options". The shadow interest rate derives from Fischer Black's insight that currencies are an option. The model articulates the following: If a someone possesses money, it can either be used

today or retained for future use. So, if less money was repaid on loans than was originally borrowed, investors will choose to exercise this option and not lend their money. Thus, the nominal short-term interest rate is always greater than or equal to zero. In this model, the nominal short-term shadow interest rate is equal to what the nominal short-term interest rate would be if it were allowed to fall below the lower zero bound. But if the short-term shadow interest rate is negative – as during deflation or a severe recession with low inflation – the nominal short-term interest rate will diverge and remain above zero. In Black's model, long-term nominal interest rates can be well above zero, even if nominal short-term interest rates remain close to zero. Due to the option effect, the shadow interest rate is not directly observable on the market. The value of the shadow interest rate depends on assumptions about how interest rates move, so different models may calculate different values for it. The model by Jing Cynthia Wu and Fan Dora Xia was published in "Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound" and applied in the context of the work (Wu & Xia, 2016; Wu & Zhang, 2019).

Unemployment rate (UNE): The Federal Employment Agency regularly releases significant time series data on the monthly unemployment rate. Given that the study relies on quarterly data, the average of the monthly values is calculated for each quarter. The employment market time series are subject to annual seasonal factors that complicate the assessment of current developments in the labour market. Statistical approaches can be used to minimize seasonal impacts, allowing for a more accurate evaluation of current trends. The statistics of the Federal Employment Agency utilize the Census X-12 ARIMA method for seasonal adjustment, which includes a module for pre-processing the time series and key figures for evaluating the outcomes of the seasonal adjustment. The methodological study outlines the key characteristics of this seasonal adjustment procedure.

Gross Domestic Product (GDP): The gross domestic product is included as a metric to assess the economic performance of an economy. Gross Domestic Product (GDP) quantifies the worth of products and services generated inside a country's borders. It is determined by adjusting for price changes using a method called deflation, which takes into account annually changing prices and the previous year's values. The rate of change in price-adjusted gross domestic product is a standard metric used to gauge economic growth in national accounts. It is considered the primary measure of national accounts and serves as one of the indicators for the International Monetary Fund's dissemination standard. The survey is conducted quarterly using data provided by the Federal Statistical Office (Destatis).

Method

In this study, a quasi-experiment was carried out for the German real estate market. This research examined the effects of certain determinants on property prices. The aim was to conclude which determinants are strongly correlated with real estate prices. Due to the environment of the quasi-experiment, it was possible to investigate correlations but hardly causalities. This method is closely based on the approach of Yiu (2021). Starting from this analysis, multiple linear regression was performed by using the real estate price index as a response variable and the variables GDP growth, unemployment rate, short-term interest rates and shadow interest rates as explanatory variables.

Conducting linear regression starts by importing the dataset and conducting a Principal Component Analysis so that the variables to be included in the regression model can be obtained by looking at the factors in the Prin matrix. Moreover, to conduct the linear regression in SPSS, the data importation procedure plays a crucial role and after the importation, the selection of response and explanatory variables was done as in the regression analysis. The design enabled to get the coefficients which include the R squared values as well as the p-value to determine which variables were significant and would be included in the regression equation to predict HPI. Since two different interest rates are examined, namely the short-term interest rate and the shadow interest rate, two linear regressions were performed.

Controls by Quasi-Experiment

The pandemic situation creates the environment of a quasi-experiment. The recession phase (continuous negative GDP growth rates) controls the positive effect of economic growth and the negative effect of unemployment on property prices. Historically, for example, there have been periods of real estate price growth that coincided with economic growth and negative real interest rates. Since the explanatory variables are not independent but linked to each other, their individual effects on real estate prices cannot be easily distinguished.

In this study, the period of global recession after the outbreak of COVID was used as a quasi-experiment to investigate the monetary policy hypothesis in Germany. The pandemic has caused a global recession. It is a unique situation in which the GDP growth rates of many countries, including Germany, have been negative, unemployment rates have increased, and central banks have significantly lowered interest rates in a concerted action to save economies. In other words, after the outbreak of COVID, two of the three main factors (recession and unemployment) drove property prices down, and only one factor (the real interest rate) caused property prices to rise.

Results

Based on the regression model, House Price Index was the response variable and when it was regressed against the explanatory variables (STIR, SIR, Gross Domestic Product, Unemployment Rate). The results showed that efficient to explain the variations, but the variance influence factor (VIF) was higher by 1.413 for interest rates and the unemployment rate. Furthermore, the unemployment rate was positively correlated with the House Price Index, possibly indicating overfitting. For this reason, a correlation table was prepared as shown in table 1 in order to be able to check the correlations.

Correlations

		HPI%	Shadow interest rate	Short-term interest rate	GDP%	Unempl. Rate
HPI%	Pearson Correlation	1	-.638	-.531	.092	-.110
	Sig. (2-tailed)		<.001	<.001	.498	.419
	N	56	56	56	56	56

SIR	Pearson Correlation	-.638**	1	.787**	.035	.539**
	Sig. (2-tailed)	<.001		<.001	.798	<.001
	N	56	56	56	56	56
STIR	Pearson Correlation	-.531**	.787**	1	-.023	.199
	Sig. (2-tailed)	<.001	<.001		.867	.141
	N	56	56	56	56	56
GDP%	Pearson Correlation	.092	.035	-.023	1	.143
	Sig. (2-tailed)	.498	.798	.867		.294
	N	56	56	56	56	56
UNR	Pearson Correlation	-.110	.539**	.199	.143	1
	Sig. (2-tailed)	.419	<.001	.141	.294	
	N	56	56	56	56	56

Table No. 1 - Correlation table
Sources: Own work

In the correlation table, unemployment rate is negatively correlated with -0.111, which fits with the basic assumption that real estate prices fall as the unemployment rate increases. However, the unemployment rate and the house price index are hardly correlated in terms of transfer at -0.111, so that the backward elimination method was used in the regression analysis to rule out UNR.

Hypothesis:
H0: There is a significant negative relationship between property prices and shadow interest rates.
H1: When comparing interest rates, shadow interest rates are a better predictor of property price developments than short-term interest rates.

The result of the correlation confirms most likely the result that, as shown in table No. 2, shadow interest rates are significantly negatively correlated with the house price index at -0.319.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.075	.223		.336	.739		
	SIR	-.321	.052	-.642	-6.141	<.001	.999	1.001
	GDP%	.100	.091	.115	1.098	.277	.999	1.001
2	(Constant)	.117	.220		.531	.598		
	SIR	-.319	.052	-.638	-6.095	<.001	1.000	1.000

a. Dependent Variable: HPI%

Table No. 2 - Regression model shadow rates
Sources: own work

The significance of the results of shadow rates provides to a great extent evidence for the monetary policy hypothesis in the form of a quasi-experiment. The model found most probably a negative correlation between short rates and house price changes. Therefore, since interest rates were lowered during this particular period and the economic growth effect and the unemployment effect were controlled to have a negative impact on house price changes, the relationship between shadow rates and house price changes implies presumably a causal relationship between real interest rates and house price changes. The hypothesis H0 was thus confirmed.

Subsequently, a regression analysis was also performed with the same design, but with short-term interest rates instead of shadow interest rates. The results are shown in table No. 3.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	1.429	1.401		1.020	.312		
	STIR	-.829	.189	-.526	-4.398	<.001	.958	1.044
	GDP%	.072	.103	.083	.700	.487	.977	1.024
	UNR	-.032	.228	-.017	-.142	.888	.939	1.065
2	(Constant)	1.232	.200		6.151	<.001		
	STIR	-.835	.183	-.529	-4.566	<.001	.999	1.001
	GDP%	.070	.101	.080	.693	.492	.999	1.001
3	(Constant)	1.259	.196		6.432	<.001		
	STIR	-.838	.182	-.531	-4.605	<.001	1.000	1.000

a. Dependent Variable: HPI%

Table No. 3 - Regression model short-term interest rates
Sources: own work

The regression analysis of the short-term interest rates also shows a significant negative correlation to the house price index. However, in order to verify or falsify hypothesis H1, it is necessary to examine which interest rate is the better predictor. Table No. 1 already shows that the shadow rate is more negatively correlated. As a further measure of the quality of the analyses, the Coefficient of determination (r square) in table 4 is considered.

Model Summary Shadow interest rate

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.649[a]	.421	.399	1.261084	
2	.638[b]	.408	.397	1.263483	1.447

a. Predictors: (Constant), GDP%, SIR
b. Predictors: (Constant), SIR
c. Dependent Variable: HPI%

Model Summary Short-term interest rate					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.537[a]	.289	.248	1.410832	
2	.537[b]	.288	.262	1.397730	
3	.531[c]	.282	.269	1.390980	1.437
a. Predictors: (Constant), UNR, GDP%, STIR					
b. Predictors: (Constant), GDP%, STIR					
c. Predictors: (Constant), STIR					
d. Dependent Variable: HPI%					

Table No. 4 - Coefficient of determination
Sources: own work

The examination of the coefficient of determination validates the correlation displayed in the correlation table. As an illustration, the shadow rate has a coefficient of determination (r^2) of 0.408, but the short-term interest rate has a lower r^2 of only 0.282. The study highlights that the shadow rate might be a more accurate predictor of property prices in comparison to the short-term interest rate. This also validates hypothesis H1.

Discussion

This study is the initial endeavor to employ a quasi-experiment in order to examine the monetary policy hypothesis in Germany. It deviates from prior research that utilizes econometric techniques to mitigate confusion and endogeneity effects. In a similar vein to Yiu's research, the period following the onset of the COVID-19 pandemic, characterized by a detrimental impact on the world economy, is employed instead. Central banks in the majority of countries implemented coordinated efforts to simultaneously reduce interest rates, along with other measures aimed at stimulating the economy. In Germany, the interest rates controlled by the central bank have stayed unchanged. Consequently, property prices experienced a significant increase, most likely due to a robust and steady growth, including in Germany. These occurrences provided a distinct chance to experimentally examine the monetary policy theory in relation to shadow rates. This hypothesis suggests that an expansionary monetary policy, namely a negative real interest rate, all other determinants being equal, likely leads to an increase in real estate prices. However, employing a quasi-experimental approach during this time can eliminate the possibility that economic growth is the cause, as the global economy has been severely impacted by the epidemic and many wealthy nations saw economic downturns and significant levels of unemployment in 2020. In addition, there has been a minor increase in the unemployment rate, which could possibly warrant an exclusion in this case.

Implementing a time delay would be advantageous in order to broaden the scope of the analysis. It is reasonable to predict that the shift in interest rates will primarily affect the real estate market. The level of transparency in the real estate market is comparatively lower than that of the stock market. Additionally, there are specific legal time limits that must be taken into account while acquiring real estate in Germany. By using this approach, it is possible to

attain a higher level of accuracy. Moreover, the duration of the study could be prolonged. By following this approach, the assumed correlation can be further reinforced.

Furthermore, this study could not exclude additional explanatory factors, including business-cycle shocks and demography. Tsatsaronis and Zhu (2004) discovered that home prices are predominantly influenced by inflation, the yield curve, and bank credit. Similarly, Égert and Mihaljek (2007) demonstrated that house prices are affected by GDP per capita, real interest rates, housing credit, and demographic considerations, among others. Algieri (2013) asserted that fluctuations in real income, long-term interest rates, stock prices, and inflation are factors influencing housing prices. Vogiazas and Alexiou (2017) discovered that house prices are influenced by real gross domestic product, bank credit expansion, long-term bond rates, and the real effective exchange rate. In summary, an agreement on the monetary policy hypothesis remains elusive. These studies fail to account for confounding bias or endogeneity among variables and do not employ an experimental intervention to regulate one or more variables. Their findings may exhibit bias and, at most, demonstrate correlations between the variables rather than causation. An experimental intervention method is superior for testing causal relationships, and endogeneity may be mitigated by experimental design (Antonakis et al., 2014).

Commonly, there is a prevailing belief that inexpensive credit and lenient lending rules ought to enhance the economy amongst the pandemic. Furthermore, it is widely assumed that this has enticed investors to return to the market. In theory, Ryan-Collins (2019) argued that when unlimited credit and money flow into a naturally finite supply of real estate, it causes rising house prices. Empirically, there is some evidence that unusually low real interest rates may be associated with high real estate prices (Yiu, 2009), but causality has not been proven until this study.

Conclusions

This study used a time series regression model to examine the hypothesis regarding the impact of short-term and shadow interest rates on the fluctuation in property prices, both pre and post the COVID-19 pandemic. The pandemic served as a quasi-experiment to examine a theory by eliminating two significant elements linked to a rise in property prices: Favorable economic growth and a low unemployment rate. The surge in property values in Germany at the onset of the COVID-19 pandemic indicates that it was probably triggered by a sudden event rather than a shortage of real estate and building plots or other specific variables like tax policy or stimulus efforts. The pandemic crisis has resulted in negative real interest rates in Germany and nearly all developed economies. This presented a distinct chance to examine the real interest rate hypothesis by employing a time series regression model as an intervention method in a quasi-experimental setting.

Moreover, solid proof has been discovered indicating that shadow interest rates are a more accurate predictor of property prices in Germany, as compared to short-term interest rates. The regression model indicates that the real interest rate has a detrimental effect on property price trends. This successfully achieves the objective of the investigation, which is to confirm the real interest rate hypothesis. The findings of this study possess significant

political and practical significance. Nevertheless, incorporating all local factors in a single-country analysis proves to be challenging.

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References

1. Algieri, B. (2013). House Price Determinants: Fundamentals and Underlying Factors. *Comparative Economic Studies*, *55*(2), 315–341. https://doi.org/10.1057/ces.2013.3
2. Antonakis, J., Bendahan, S., Jacquart, P., & Lalive, R. (2014). *Causality and endogeneity: Problems and solutions*. https://serval.unil.ch/resource/serval:bib_5e5cc6c39143.p001/ref.pdf
3. Black, F. (1995). Interest Rates as Options. *The Journal of Finance*, *50*(5), 1371–1376. https://doi.org/10.1111/j.1540-6261.1995.tb05182.x
4. Duca, J. V., Muellbauer, J., & Murphy, A. (2021). What Drives House Price Cycles? International Experience and Policy Issues. *Journal of Economic Literature*, *59*(3), 773–864. https://doi.org/10.1257/jel.20201325
5. Égert, B., & Mihaljek, D. (2007). Determinants of House Prices in Central and Eastern Europe. *Comparative Economic Studies*, *49*(3), 367–388. https://doi.org/10.1057/palgrave.ces.8100221
6. European Central Bank (2019). Report by the working group on euro risk-free rates on the transition from EONIA to ESTER. https://www.ecb.europa.eu/paym/pdf/cons/euro_risk-free_rates/ecb.eoniatransitionreport201812.en.pdf
7. Francke, M., & Korevaar, M. (2021). Housing Markets in a Pandemic: Evidence from Historical Outbreaks. *Journal of Urban Economics*, 1–12. https://doi.org/10.2139/ssrn.3566909
8. Haffner, M. E. A., & Hulse, K. (2021). A fresh look at contemporary perspectives on urban housing affordability. *International Journal of Urban Sciences*, *25*(sup1), 59–79. https://doi.org/10.1080/12265934.2019.1687320
9. Hirata, H., Kose, M. A., Otrok, C., & Terrones, M. E. (2013). Global House Price Fluctuations: Synchronization and Determinants. *NBER International Seminar on Macroeconomics*(9), 119–166. https://doi.org/10.2139/ssrn.2295211
10. Katagiri, M. (2018). *House Price Synchronization and Financial Openness: A Dynamic Factor Model Approach.*
11. Ryan-Collins, J. (2019). *Why can't you afford a home? The future of capitalism series*. Polity. https://doi.org/Josh
12. Tsatsaronis, K., & Zhu, H. (2004). *What Drives Housing Price Dynamics: Cross-Country Evidence.*
13. Vogiazas, S., & Alexiou, C. (2017). Determinants of Housing Prices and Bubble Detection: Evidence from Seven Advanced Economies. *Atlantic Economic Journal*, *45*(1), 119–131. https://doi.org/10.1007/s11293-017-9531-0
14. Wang, B. (2021). How Does COVID-19 Affect House Prices? A Cross-City Analysis. *JRFM*, *14*(2), 1–15. https://econpapers.repec.org/article/gamjjrfmx/v_3a14_3ay_3a2021_3ai_3a2_3ap_3a47-_3ad_3a486223.htm
15. Wetzstein, S. (2017). The global urban housing affordability crisis. *Urban Studies*, *54*(14), 3159–3177. https://econpapers.repec.org/article/saeurbstu/v_3a54_3ay_3a2017_3ai_3a14_3ap_3a3159-3177.htm
16. Wu, J. C., & Xia, F. D. (2016). Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound. *Journal of Money, Credit and Banking*, *48*(2-3), 253–291. https://doi.org/10.1111/jmcb.12300
17. Wu, J. C., & Zhang, J. (2019). A shadow rate New Keynesian model. *Journal of Economic Dynamics and Control*, *107*, 103728. https://doi.org/10.1016/j.jedc.2019.103728

18. Yiu, C. Y. (2021). Why House Prices Increase in the COVID-19 Recession: A Five-Country Empirical Study on the Real Interest Rate Hypothesis. *Urban Science*, *5*(4), 77. https://doi.org/10.3390/urbansci5040077
19. Yiu, C. Y. E. (2009). *Negative Real Interest Rate and Housing Bubble Implosion - An Empirical Study in Hong Kong.* https://doi.org/10.2139/ssrn.1434312

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