INTERNATIONAL REAL ESTATE REVIEW

2023 Vol. 26 No. 2: pp. 173 – 207

Asymmetric Causality between Unemployment Rate and House Prices in Select OECD Economies

Javed Iqbal
School of Economics, Quaid-i-Azam University Islamabad and Fulbright Postdoc Fellow, University of Nebraska at Omaha, USA.
E-mail: javed@qau.edu.pk, javediqbal@unomaha.edu

Misbah Nosheen
Department of Economics, Quaid-i-Azam University Islamabad and Postdoc Fellow, University of Nebraska at Omaha USA.
E-mail: misbah@hu.edu.pk, mnosheen@unomaha.edu

Iqra Rubab
School of Economics, Quaid-i-Azam University, Islamabad.
E-mail: iqra.rubab19@gmail.com

Sareer Ahmad
School of Economics, Quaid-i-Azam University, Islamabad.
E-mail: sareer@eco.qau.edu.pk

Mark Wohar*
University of Nebraska at Omaha, College of Business, Omaha, NE USA.
E-mail: mwohar@unomaha.edu

Previous research on how unemployment influences house prices is limited by employing a symmetric approach to cointegration. The symmetric method masks the underlying link between unemployment and housing prices. This study examines the impact of unemployment on house prices across 20 Organisation for Economic Co-operation and Development (OECD) economies by using an asymmetric approach to cointegration. The current research additionally leverages Hatemi-J causality to bolster the asymmetric causation between unemployment

* Corresponding author

and house prices. According to the symmetric approach, 13 of the 20 OECD economies in the short run and 9 economies in the long run have at least one lagged significant coefficient associated with the LnUN variable. The asymmetric effects demonstrate a significant short- and long-term asymmetric association between unemployment and house prices in the instance of 16 OECD nations. The Hatemi-J causality results demonstrate that in each of the selected economies, there is evidence of an asymmetric bidirectional causal relationship between unemployment and house prices, as shown by at least one significant variable that runs either from unemployment to house prices or from house prices to unemployment.

Keywords

House prices; Hatemi-J; Unemployment; Non-ARDL

1. Introduction

The value of a house is determined by housing supply and demand, according to the neoclassical framework. As a result, any factor that alters supply and demand will affect home prices. The cost of land and construction, as well as the availability of credit to cover these costs, are important factors in determining supply, whereas household income, mortgage rates, and demographics are important factors in determining demand (Gallin 2006; Geerolf and Grjebine 2014; Chen and Patel 1998). The housing market and other areas of the economy, however, may be significantly impacted by the extreme volatility in real estate values. For instance, the Great Recession of 2008 was attributed to the collapse of the American housing market bubble. Housing price increases that are abnormally high must stop, mostly due to excessive lending to illegitimate homebuyers and subprime mortgages. The collapse of the construction sector, which increased unemployment, affected other areas of the economy as well as the overall unemployment rate (Abelson et al. 2005; Apergis 2003; and Apergis, and Rezitis 2003). As a result, many people who were out of work and unable to make their mortgage payments were forced to sell their house or file for foreclosure, further lowering property values. The literature indicates that these two macro elements can impact one another (Katrakilidis and Trachanas 2012; Bhattacharya and Waymire 2009). Since household income and interest rates are the two main factors that influence home prices, almost all studies on the housing market have focused on these two factors. These studies have also attempted to establish both a short-run causal relationship and a long-term relationship between these two variables. Here are a few examples: Katrakilidis and Trachanas (2009); Liu et al. (2016); Gallin (2006); Dröes and van de Minne (2016); Case and Shiller (2003); Abelson et al. (2005); Apergis (2003) and Bahmani-Oskooee and

Ghodsi (2016).[1] The majority of these studies have looked at short- or long-term correlations between house prices and income or other factors other than unemployment rates in various nations.

In several of the recent past research studies, the relationship between housing prices and unemployment has been examined, with most of them based on the assumption of a symmetric relationship between the two factors. For instance, Geerolf and Grjebine (2014) explore the causal association between house price increases and unemployment trends in 34 countries over a 40-year period. When property taxes are employed as an instrument for housing prices, the study finds that a 10% increase in house prices results in a 3.4% drop in unemployment. Byun (2010) forecasts the impact of a housing bubble on employment in the United States (US) and finds that it generated between 1.2 million and 1.7 million jobs in 2005. Geerolf and Grjebine (2014) suggest that rising property prices help to lower the unemployment rate by influencing labor demand. Peek and Wilcox (1991) establish a supply and demand relationship for housing in the US and find that declining unemployment and interest rates contributed to the late 1980s rebound in home values. Apergis (2003) and Apergis and Rezitis (2003) employ Greek data and conclude that the key factors that influence Greek home prices are interest rates, inflation, and employment. Irandoust (2019) finds no direct causal relationship between the rate of unemployment and property values. Branch et al. (2014) suggest that a financial transformation that increases the collateral of a home would raise housing value and decrease unemployment.

One limitation of these studies that investigate a symmetric relationship between house prices and unemployment is that they may fail to capture the complexities of the housing market and labor market. The relationship between housing prices and unemployment is likely to be nonlinear and asymmetric, which means that changes in one variable may not have the same effect as changes in the other variable. For example, Bahmani-Oskooee and Ghodsi (2018) study the asymmetric influence of unemployment on house prices across various states in the US and find that declining house prices increase the unemployment rate in 39 states, while increasing house prices lead to unemployment in only 19 states. Therefore, studies that assume a symmetric relationship may oversimplify the relationship and miss important nuances. Real-world dynamics can be much more complex, and there may be non-linear relationships, lags, and feedback loops between house prices and unemployment (Su and Quigley, 2013). Furthermore, studies that focus on symmetric relationships may not capture the full range of effects that house prices can have on employment. For example, rising house prices may increase construction employment, but also lead to higher costs of living, which could make it more difficult for employers to attract and retain workers. Similarly, falling house prices could reduce demand for new construction, but also make

---

[1] Although this study looks at asymmetric effects, it has also examined the symmetric effects in the case of the US.

homes more affordable, which could stimulate demand for other goods and services and lead to job creation in other sectors. Additionally, many studies have already established an asymmetric relationship between house prices and unemployment (see for example, Capozza and Seguin, 2003; Ihlanfeldt and Mayock, 2010).

There are several potential reasons for the asymmetric relationship between house prices and unemployment, including credit and supply constraints, confidence effects, and interest rates. According to Mian and Sufi (2011), households that face tighter credit constraints during recessions may be more likely to default on their mortgage, thus leading to a decline in house prices. However, during expansions, households may face looser credit constraints, which can lead to an increase in house prices.

Unemployment psychologically affects consumer sentiment and behaviors. When people are unemployed or know someone who is not employed, they feel economically insecure. They may be apprehensive about their own job prospects, which causes them to lose faith in the economy as a whole. Their confidence level may diminish as they become more hesitant to make purchases including new homes (Mueller, 1966). Gyourko et al. (2013) suggest that supply constraints in the housing market can also lead to an asymmetric relationship between house prices and unemployment. During periods of rising unemployment, housing construction may decline, which leads to a decrease in the supply of homes and a subsequent increase in house prices. However, during periods of falling unemployment, housing construction may increase, thus leading to an increase in the supply of homes and a subsequent decrease in house prices. Finally, changes in interest rates can also impact the relationship between house prices and unemployment. During periods of rising unemployment, central banks may lower interest rates to stimulate economic activity, which leads to an increase in demand for homes and a subsequent increase in house prices. Conversely, during periods of falling unemployment, central banks may raise interest rates to prevent inflation, thus leading to a decrease in demand for homes and a subsequent decrease in house prices (Zhao, et.al 2022; Lee and Park, 2022).

The current study adds to the existing literature in several ways. First, instead of focusing on a single country, we analyze the causal relationship between unemployment and housing prices in 20 industrialized economies. Second, we examine the causal link between unemployment and home prices by using both linear and nonlinear autoregressive distributed lag (ARDL) approaches. Finally, this study looks to the Hatemi-J causality test to see if there is bidirectional causation between unemployment and house prices. Theoretical justification for bidirectional causality between house prices and unemployment can be found in Muellbauer and Murphy (1997) who study the housing market in the United Kingdom (UK). They suggest that an increase/decrease in house prices may lead to an increase/decrease in construction and construction-related employment, respectively. This framework implies a causal relationship from house prices to unemployment. Another study by Irandoust (2019) also provides theoretical support for the relationship between house prices and unemployment in the US. They suggest that a rise in house prices may lead to an increase in consumer spending, which may subsequently lead to a decrease in unemployment. Bahmani-Oskooee and Ghodsi (2018) present a causal relationship from house prices to unemployment, but also acknowledge the possibility of bidirectional causality. Therefore, it is reasonable to consider bidirectional causality between house prices and unemployment.

After using the Hatemi-J causality test, we find a significant short-term asymmetric relationship between unemployment and housing prices in the case of 12 industrial economies, but a significant long-term asymmetric association between unemployment and housing prices in the case of 3 economies. The Hatemi-J causality results show that in all of the selected economies, there is evidence of asymmetric bidirectional causality between unemployment and house prices, as evidenced by at least one significant variable that runs from either unemployment to house prices or house prices to unemployment. The rest of the study is structured as follows: Section 2 includes a review of the literature. Section 3 contains the models and methods. In Section 4, we present the empirical results and Section 5 concludes the study.

2. Theoretical Background and Review of Literature

There are several theoretical explanations for an asymmetric relationship between house prices and unemployment that are supported by the following. First, house prices tend to rise faster than they fall, thus leading to asymmetric price adjustment. Sellers are more reluctant to lower prices than buyers are to increase them, which leads to an asymmetric relationship between house prices and unemployment (Case and Shiller, 1990). Second, the wealth effect of house prices on consumer spending is asymmetric, with consumers spending more when house prices rise, but not necessarily cutting back spending to the same extent when they fall (Shen et al., 2015). Third, the relationship between house prices and unemployment is asymmetric due to the role of mortgage default. Falling house prices increase the likelihood of mortgage defaults, which in turn can lead to a rise in unemployment. However, a rise in house prices may not necessarily lead to a corresponding decrease in unemployment (Kuttner and Shim, 2013). Fourth, an asymmetric relationship between house prices and unemployment may exist due to credit constraints. Falling house prices may make it harder for homeowners to refinance their mortgages or obtain new credit, which leads to higher unemployment rates. Rising house prices may not have the expected positive effect on consumer spending if households are constrained in their ability to borrow (Mishkin, 2007; Li and Yao, 2007).

According to the literature review in Catte et al. (2004), Algieri (2013) and Cheng et al. (2020), there are several factors that contribute to the lead and lag in the causality between house prices and unemployment. These factors include changes in housing supply, credit conditions and demographics, the wealth effect, and the business cycle. Housing supply changes can affect house prices, which in turn, affect demand for labor and unemployment rates. Credit conditions, such as tightening credit availability, can affect both house prices and unemployment rates. Changes in demographics can impact demand for housing and subsequently affect house prices and unemployment rates. The wealth effect from changes in house prices can also impact household consumption and investment decisions, thus resulting in changes in unemployment rates. Finally, the business cycle can impact both house prices and unemployment rates such as during a recession. Overall, the relationship between house prices and unemployment rates is complex and context-specific, with various factors that influence the direction and magnitude of causality.

In the past two decades, several studies have focused on the impact of unemployment on house prices in different regions of the world. The literature also provides a theoretical context that helps to understand the unemployment and housing price nexus. Ahmet (2021) employs a restricted panel data error correction model (ECM). The empirical findings show that unemployment and house prices are negatively correlated in Turkey. Similar results are reported by Abelson et al. (2005) in Australia. Reichart (1990) uses quarterly data from 1975 to 1987 and applies econometric tests such as the Cochrane Orcutt procedure, Durban Watson test, and Chow test. The outcome of his study is that the employment rate has a significant impact on house prices in the US. Peek and Wilcox (1991) show a negative relationship between unemployment and housing prices in the empirical findings. Wilcox (1991) formulates a demand and supply link of house prices, and the model indicates that the unemployment rate is one of the main determinants of housing prices in the US. Additionally, this study also finds that in the 1980s, when house prices recovered, house prices increased along with reduced interest and unemployment rates. Clapp and Giaccotto (1994) observe data from 1981 to 1988 in Connecticut in the US, and use the assessed value (AV) for estimation purposes. They find that a higher unemployment rate reduces house prices; for instance, a 6.09% change in house prices occurs due to a slight 1% change in the unemployment rate. So, the unemployment rate exerts a substantially negative impact on house prices. Apergis and Rezitis (2003) investigate the relationship between these two variables for Greece and apply the error correction vector autoregressive model. The study observes people are deterred from buying when the mortgage rate increases, hence demand for houses decreases. Therefore, a positive/negative change in the mortgage rate decreases/increases house prices, respectively. An increase in the consumer price index (CPI), employment and money supply increases house prices. They conclude that interest rate, inflation, and employment are the main determinants of house prices.

Abelson et al. (2005) estimate a VAR model to investigate the determinants of house price changes in Australia. Their findings indicate that house prices are positively and significantly related to real disposable income and the CPI. Moreover, house prices are negatively related to the unemployment rate, real mortgage rate, equity prices, and housing stock. Similarly, Abelson and Chung (2005) observe a negative relationship among house prices and unemployment rate, mortgage rate, equity price, exchange rate, and housing stock in Australia. They also examine the positive relation between house prices, inflation, and real income. Hence, the coefficient of unemployment shows that unemployment is a negative indicator of economic conditions. For each country, the study uses aggregate housing prices and unemployment rate as the measures. Égert and Mihaljek (2007) use quarterly data from 27 countries in Central and Eastern Europe, and estimate the panel dynamic ordinary of least squares (OLS). Their findings indicate that unemployment and house prices have a negative correlation. The study also uses a graphical method to express the house prices analysis and finds that interest rate, unemployment, household income, and housing construction are essential determinants of house price and negatively related to the house price; similarly, when the unemployment rate falls, then house prices rise. Klyuev (2008) observes that unemployment is an important determinant of house prices in the US, and unemployment is negatively correlated with housing prices. Schnure (2005) finds that when unemployment increases, then housing price decreases in the US. Similarly, Ge (2009) uses quarterly time series data from March 1980 to December 2007 for New Zealand. Multiple regression, the Granger causality test, and a cointegration approach are used for estimation. Xin (2009) estimates that the mortgage and unemployment rates, investment expectations, and building permits are the main determinants of house price. The analysis specifies that a 1% increase in the unemployment rate leads to a 0.001% minor decrease in house price. Xin (2009) also observes that changes in the house price move in a cyclical trend, and wages and inflation increase as a result of a decrease in the unemployment rate thus leading to an increase in house prices. Hence, reduced migration will reduce the house prices due to higher labor costs. The unemployment rate for the next period increases due to a decrease in investment activities.

Lee (2009) determines house prices by utilizing data from eight capital cities in Australia from 1987Q4 to 2007Q4. Exponential generalized autoregressive conditional heteroskedasticity (EGARCH) is used for estimation. Lee (2009) finds that a lower unemployment rate increases house prices which means that there is a negative relationship between unemployment and house price. Deng et al. (2009) examine a data set from 2000 to 2005 taken from 30 Chinese provinces and cities, while using a panel vector autoregression (VAR) model for estimation purposes. The study determines that unemployment is an essential factor that negatively affects house prices, and the unemployment rate explains the variation in house prices. The study also demonstrates that a rise in the unemployment rate leads to a decrease in housing prices. Similarly, Kim and Bhattacharya (2009) use a data set from 1969 to 2004, and estimation is done with a Granger causality test and smooth transition autoregressive model. They find that mortgage rates in the US affect the house price when the housing market is in an upturn. The study concludes that a housing price decrease hurts employment. Ni et al. (2011) use a data set based on 1994M1 to 2010M10 from the US, and house price indexes including the HMI, UMR, FED, CCI, and DWI. They apply a VAR, Johansen cointegration test, and vector ECM. The result shows that house prices and unemployment are moving in the opposite direction; if house price increases, unemployment decreases. Grum and Govekar (2016) use multiple linear regression models for estimation, and the data set is based on real estate markets in Slovenia, Greece, France, Poland, and Norway. They find a strong correlation between unemployment rate and house prices; a high unemployment rate results in low housing price, so the unemployment rate adversely affects house price. Ingholt (2017) uses the Bayesian maximum likelihood to estimate a dynamic stochastic general equilibrium model. He reported that real house prices in the US are positively correlated with mobility, and unemployment is negatively correlated with mobility. Cohen and Karpaviciute (2017) use data from Lithuania for 2001Q1 to 2014Q4, and for estimation, Granger causality, the Breusch-Godfrey test, and augmented Dickey-Fuller test. They show that unemployment is a causal determinant of housing price; if the unemployment rate increases by 1% then house price falls by 0.14%. Stratton (2017) uses the Beginning Postsecondary Survey (BPS) to collect data between 1996 to 2001 in the US. Similarly, the results find that unemployment and housing price are negatively correlated, so lower house prices are associated with a higher unemployment rate. Azmi (2018) examines the relationship between house prices and other variables by collecting data from Asia Pacific countries including Australia, China, Hong Kong, Indonesia, Japan, Korea, Malaysia, New Zealand, Singapore, and Thailand from 2006 to 2015. The study uses panel data to estimate the impact of unemployment rate on house prices. The findings indicate that house prices have a significantly positive relationship with GDP, inflation, household saving, and household debt, but a significantly negative relationship with interest rates and unemployment. Mohan et al. (2019) use a VAR model, with data from Amherst, New York State in the US. Their findings show that the housing price index and interest rate have a significant impact on house prices. A positive change in the unemployment rate tends to decrease house price; in other words, a growing unemployment rate prevents individuals from buying houses. They find that mortgage interest rates influence housing prices, and changes in house prices create variability in future house prices. Wang et al. (2020) examine data sets between 2012 and 2015 for Australia. They conducted an analysis by using OLS and Granger causality to show that unemployment has an insignificant effect on house prices and interest rate has a significantly negative impact on house prices. When the interest rate is low and house price increases, then more houses are purchased. Latif et al. (2020) explore factors that primarily affect house price in Malaysia, namely, the gross domestic product (GDP), foreign direct investment (FDI), unemployment, inflation, and interest rate. The study provides recommendations for the government and policymakers to control these factors that impact house price changes in Malaysia, including increase in affordable housing so that the unemployed can be employed again, and the purchase of expensive properties increases as a result. They find that interest rates are an essential determinant of housing prices but there is no significant relationship between them. They also find that when the unemployment rate increases, job security is reduced, so house prices fall.

3. Models and Methods

There are a number of studies in the literature that explore the relationship between housing prices and unemployment rates that use different variables to identify the impact of unemployment on house prices. Our goal in this paper is to also investigate the causality between housing prices and the unemployment rate in 20 OECD economies. We start from a simple log-linear model which depicts the relationship between two variables:

$$\Delta LnHPt = a + bLnUN + \varepsilon t \tag{1}$$

where HP denotes the real house price for the developed countries, and UN represents the unemployment rate, which is defined in a way that a decrease shows an increase in the demand for houses which leads to an increase in house price. A positive UN coefficient points to a reduction in house prices. On the other hand, a negative UN coefficient means a rise in house prices. Equation (2) specifies the long-run relationship between these two targeted variables. To obtain the long run result, we must rewrite Equation 2 in an ECM format as recommended in Pesaran et al. (2001):

$$\Delta LnHPt = a0 + \sum_{k=1}^{n1} a1_k \Delta LnHPt - k + \sum_{k=0}^{n2} a2_k \Delta LnUNt - k + \beta 0 LnHPt - 1 + \beta 1 LnUNt - 1 + \omega t \tag{2}$$

where the summation symbol denotes the ECM, and on the other side, the second part of the equation demonstrates the long-term relationship between the variables. Equation 2 is estimated by using the OLS method based on the ARDL bound method, where B_0-B_1 represents the long-run coefficients. To determine the joint significance of these lagged-level variables included in the model which demonstrates the cointegration between the variables, Pesaran et al. (2001) recommend an F-test. In this instance, the F-test is conducted by using the newly tabulated critical values from Pesaran et al. (2001). The null hypothesis for the bound test shows no cointegration, whereas the alternative hypothesis shows that cointegration exists. The estimation for the ECM is done by using the following:

$$\Delta LnHPt = a0 + \sum_{k=1}^{n1} a1_k \Delta LnHPt - k + \sum_{k=0}^{n2} a2_k \Delta LnUN - k + \tau ECM_{t-1} + \omega t \tag{3}$$

In Equation (3), all of the explanatory variables tend to have a symmetric impact on the dependent variable. The symmetric assumption holds that when unemployment rises, housing prices fall. The appreciation of housing prices results in lower unemployment rates (Geerolf and Grjebine 2014). Pinter (2019) also reports a highly negative relationship between house prices and unemployment. We employ the approach in Granger and Yoon (2002) to address the shortcoming of the symmetric approach of cointegration. This approach investigates the hidden cointegration between the components of a series. Even though there may not be linear cointegration in the aggregate level series, the approach enables the investigation and confirmation of long-term cointegration among the negative and positive subcomponents of a series. On the other hand, the asymmetric approach is preferred in that this approach not only makes it possible to examine how changes in the unemployment rate affect changes in house prices but also shows the influence of both positive and negative changes in house prices independently. Granger and Yoon (2002) claim that it is simple to convert a non-linear adjustment mechanism to a linear one without losing any information. If both the positive and negative series are cointegrated, both data series frequently exhibit hidden cointegration. When the simple linear cointegration approach fails to reveal the hidden cointegration relationship, this sort of non-linear cointegration is particularly useful. For instance, suppose Z_t and Y_t are two random walk series:

$$Z_t = Z_{t-1} + \pi_t = z_0 + \sum_{t=1}^{t} \pi_i \tag{4}$$

$$Y_t = Y_{t-1} + \nu_t = Y_0 + \sum_{t=1}^{t} \nu_i \tag{5}$$

where t=1,2, ..., T and Z_0, Y_0 are the initial values, and πi and νi denote mean zero white noise error terms. If the two series Yt and Zt are cointegrated by using a single vector, they are anticipated to have the potential for hidden convergence if both move in an asymmetric fashion. According to Granger and Yoon (2002), both positive and negative changes can be characterized as follows when two series move in an asymmetric way:

$$\pi_i^+ = max(\pi_i, 0), \pi_i^- = min(\pi_i, 0), \nu_i^+ = max(\nu_i, 0), \nu_i^- = min(\text{Ɩ}_i, 0),\ \pi_i = \pi_i^+ + \pi_i^- \ and\ \nu_i = \nu_i^+ + \nu_i^- \tag{6}$$

Hence

$$Z_t = Z_{t-1} + \pi_t = z_0 + \sum_{t=1}^{t} \pi_i^+ \ \sum_{t=1}^{t} \pi_i^- \quad and \ \ Y_t = Y_{t-1} + \nu_t$$
$$= Y_0 + \sum_{t=1}^{t} \nu_i^+ + \sum_{t=1}^{t} \nu_i^- \tag{7}$$

To simplify the notations,

$$Z_i^+ = \sum_{t=1}^{t} \pi_i^+ \ , \ \ Z_i^- = \sum_{t=1}^{t} \pi_i^- \ , \ \ Y_i^+ = \sum_{t=1}^{t} \nu_i^+ \ , \ \ Y_i^- = \sum_{t=1}^{t} \nu_i^- \tag{8}$$

Thus

$$Z_t = z_0 + Z_i^+ + Z_i^- \quad and \quad Y_t = y_0 + Y_i^+ + Y_i^- \tag{9}$$

Subsequently,

$$\Delta Z_t^+ = \pi_t^+, \quad \Delta Z_t^- = \pi_t^-, \quad \Delta Y_t^+ = \nu_t^+, \quad \Delta Y_t^- = \nu_t^-$$

To find the series of both positive and negative changes, i.e., $\Delta Z_t^+ \ and \quad \Delta Z_t^-$, the first difference of these series is calculated as $\Delta Z_t = Z_t - Z_{t-1}$. Both these positive and negative values are transformed to a cumulative sum of positive (negative) changes as $Z_t^+ = \sum \Delta Z_t^+ \ \ and \ Z_t^- = \sum \Delta Z_t^-$. The same procedure is followed for other series: $Y_t^+ = \sum \Delta Y_t^+ \ \ and \ Y_t^- \sum \Delta Y_t^-$. A hidden cointegration is supposed to exist between the Y and Z if the components are cointegrated. Then we replace the Zt series with independent variables. The unemployment rates, Z_t^+ and Z_t^- are replaced with notation NEG and POS for an increase or decrease in house price, respectively.

$$= \sum_{j=1}^{t} \Delta lnUN_j^+ = \sum_{j=1}^{t} max\ (\Delta lnUNj, 0)$$

$$UN_t^- = \sum_{j=1}^{t} \Delta lnUN_j^- = \sum_{j=1}^{t} min\ (\Delta lnUNj, 0)$$

Using these two variables, NEG and POS, we then use the new ECM so that now, the next model is non-linear in which we interchange with variables:

$$\Delta LnHP = a0 + \sum_{k=1}^{n1} a1_k \Delta LnHP + \sum_{k=0}^{n2} a2_k \Delta LnUN - k + \sum_{k=0}^{n3} a_{3k}^{+} \Delta LnUN - k + \sum_{k=0}^{n4} a_{4k}^{-} \Delta LnUN - k + \beta 0 LnHP - 1 + \beta 1 LnUN - 1 + +\beta_2^{+} UN - 1 + \beta_3^{-} UN - 1 + \omega t \tag{10}$$

Here, Equation (10) is the new ECM. ARDL is used to estimate this model. Shin et al. (2014) indicate that the bound testing approach in Pesaran et al. (2001) applies to Equation (10). Since POS and NEG are a new series of variables in this equation, our model will not be linear, which will result in an adjustment process that is presumed to be non-linear. Considering that Equation (10) is a nonlinear ARDL approach, whereas Equation (3) is a linear ARDL approach, we find asymmetry. Short-run asymmetry is established first by using a Wald statistic denoted as Wald-S, followed by long-run asymmetry established by using a Wald statistic denoted as Wald-L. Dynamic movements, however, highlight the adjustment asymmetry. We also consider the ECM to account for the asymmetric impacts of unemployment. The ECM for a non-linear ARDL is as follows:

$$\Delta LnHP_t = a_0 + \sum_{k=1}^{n1} a_k \Delta LnHP + \sum_{k=0}^{n2} a_k \Delta LnUN_{t-k} + \sum_{k=0}^{n3} \delta_k \Delta LnUN_t^{+}{}_{t-k} + \sum_{k=0}^{n4} \delta_k \Delta LnUN_t^{-}{}_{t-k} + \tau ECM_{t-1} + \varpi_t \tag{11}$$

Our results will be misleading if we employ non-stationary data or non-stationary variables for estimation. Therefore, we employ a variety of methods to make our variables stationary to avoid this issue. However, the application of stationary variables allows us to extract short-term information from the data while removing long-term information. A cointegration approach is used to estimate the long-term relationship between the variables. For small data sets, the aforementioned models are not appropriate. The central emphasis of this study is on the asymmetric relationship between unemployment rate and housing prices in a sample of developed nations; we also estimate the symmetric relationship between the unemployment rate and housing prices for comparison. A non-linear ARDL is applied by replacing the variable $LnUN$t (unemployment rate) with the $UN_t{}^{+}$ and UN_t^{-} variables. For non-linearity, we generate the $UN_t{}^{+}$ and UN_t^{-} variables by using a non-linear ARDL model (Shin et al., 2014). According to Pesaran et al. (2001), the bound test is the same for linear and non-linear ARDL; we should therefore handle both variables ($UN_t^{+}UN_t^{-}$) as one variable and use the same critical value of the F-STAT for LnUNt in a linear ARDL. We apply Wald-S for short symmetry and Wald-L for long-run symmetry in the non-linear model.

Twenty (20) developed nations are included in this study by using their annual data from 1970 to 2019. House prices are the dependent variable, while unemployment rate is the independent variable. The data are obtained from the World Development Indicators (WDI) and OECD. The housing markets in the OECD countries exhibit significant heterogeneity, with differences in size, structure, and regulation. One major difference is price volatility, with housing markets in some countries, such as the US and UK, known for their high volatility, while others, such as Sweden and Germany, have more stable price growth (Muellbauer and Murphy, 1997; Miles, 2008). Another significant difference is housing supply, with some countries, such as Austria, the UK, Belgium and France, experiencing a significant housing supply shortage due to limited land availability, strict planning regulations, and high construction costs. In contrast, housing supply in other countries, such as the US and Canada, is more elastic and can be built relatively quickly to meet demand (Caldera and Johansson, 2013; Gyourko and Saiz, 2006).

Housing tenure also varies significantly across OECD countries, with the homeownership rate being high in countries such as Romania, Lithuania, and Hungary, and relatively low in countries such as Germany and Switzerland[2]. Furthermore, the age structure in different countries can affect housing demand and supply, with aging populations in countries such as Japan and Germany leading to a decline in housing demand and young populations in countries such as Mexico and Turkey leading to a surge in demand (Miles, 2008). Thus housing markets across OECD countries have significant implications on the relationship between house prices and unemployment. Markets with limited housing supply and rapid price growth may lead to imbalances and market instability, while markets with more elastic supply and price growth can stimulate new construction and related employment (Miles, 2008).

4. Empirical Results

In order to analyze the symmetric and asymmetric effects of unemployment on housing prices, this section examines the estimated findings of both the non-linear and linear ARDL models for the 20 developed economies that are selected. To identify cointegrating long-run relationships between variables, diagnostic tests and bound test approaches for cointegration are applied. Table 1 reports the results of the unit root testing. Table 2 shows the short and long-term results based on the symmetric approach to cointegration, while Table 3

[2] https://www.oecd.org/els/family/HM1-3-Housing-tenures.pdf

provides the diagnostics related to Table 2. Although our objective is to estimate the nonlinear model (Equation (11)), we also estimate the linear model of Equation (3) to compare and confirm our findings. Before estimating the influence of unemployment on housing values, we first examine the outcomes of the linear model. The findings show that in the case of the linear results, an increase in unemployment is associated with an increase in house prices in five economies, including Australia, France, Italy, Switzerland, and the UK, while an increase in unemployment is associated with a decline in house prices in two of the economies, including New Zealand and Germany. Similarly, there are mixed findings in Canada, Denmark, Japan, and Sweden, where an increase in unemployment is associated with both an increase and a decrease in house prices, as reflected in the significant coefficients associated with the unemployment lag. In the case of the nonlinear results, the findings indicate that of the 20 OECD economies, the LnUN variable has at least one lagged significant coefficient in 13 of the economies in the linear model HP = F (UN) thus indicating the short run asymmetric effect of unemployment on house prices in these 13 economies.

In the long run, unemployment has a significant impact on house value in 9 of the economies. The coefficient of the UN is positive and significant in 8 of the economies including Australia, Finland, France, Japan, Ireland, the Netherlands, Portugal, and the UK, while the coefficient of the UN is negative for Italy only.

The majority of models have a significant F.STAT value, thus confirming that the variables are related over the long term. In order to understand how quickly adjustments lead to equilibrium, we also estimate the ECM. The value of the ECM, which is notably negative, supports the cointegration hypothesis. To examine the long-run connection, additional support is provided by the ECM. We provide the adjusted R-squared value in Table 3 as well. The adjusted R-squared values in the maximal models are higher, which indicates greater variance that is explained by the explanatory variables. The diagnostics related to the short-run and long-run results are shown in Table 3. We also provide other diagnostics such as the Ramsey's regression specification error test (RESET) and Lagrange multiplier (LM) test. Both are carried out by using a chi-square with one degree of freedom. The LM test is employed to determine whether autocorrelation exists. The LM value in the majority of the models is negligible, thus demonstrating the lack of autocorrelation. We calculate CUSUM and CUSUM SQ to validate the stability of the model A stable model is denoted by "S", whereas the unstable model is denoted by "US". CUSUM (CSM) appears to be stable; however, CUSUM squared (CSM^2) appears to be unstable.

Table 1 Unit root test for selected 20 OECD countries

Country	Variable Name	At Level		At 1st difference		Result
		Intercept	Trend and intercept	Intercept	Trend and intercept	
Australia	UN	0.5199	0.9112	0.0012*	0.0016*	I(1)
	HP	0.7689	0.1432	0.0246*	0.1402	I(1)
Belgium	UN	0.0523*	0.0390*	0.0025*	0.1962	I(0)
	HP	0.0056*	0.4039	0.2701	0.566	I(0)
Canada	UN	0.1999	0.2408	0.0018*	0.0087*	I(1)
	HP	0.9859	0.4717	0.0567*	0.0515	I(1)
Denmark	UN	0.1847	0.5056	0.0014*	0.0070*	I(1)
	HP	0.5251	0.1514	0.0160*	0.0599*	I(1)
Finland	UN	0.598	0.128	0.0032*	0.0290*	I(1)
	HP	0.3109	0.6457	0.0025*	0.0096*	I(1)
France	UN	0.4636	0.6185	0.0060*	0.0295*	I(1)
	HP	0.5965	0.1033	0.0461*	0.2596	I(1)
Italy	UN	0.0118*	0.0501*	0.067	0.2248	I(0)
	HP	0.0068*	0.0245*	0.0582*	0.0684	I(0)
Japan	UN	0.4361	0.7622	0.0468*	0.0565*	I(1)
	HP	0.0360*	0.9924	0.2317	0.1097	I(0)
Norway	UN	0.1815	0.4107	0.0332*	0.1001	I(1)
	HP	0.791	0.0515*	0.0047*	0.0271*	I(1)
New Zealand	UN	0.0260*	0.0835	0.0481*	0.1253	I(0)
	HP	0.9951	0.0069*	0.0062*	0.0131*	I(1)
United States	UN	0.0531*	0.1722	0.0216*	0.0836	I(0)
	HP	0.2630	0.0445*	0.1586	0.4089	I(0)
Germany	UN	0.8888	0.5353	0.0112*	0.0103*	I(1)
	HP	0.0355*	0.867	0.9253	0.4669	I(0)
Ireland	UN	0.0343*	0.3004	0.0947	0.2743	I(0)
	HP	0.3482	0.2755	0.0232*	0.0457*	I(1)
Korea	UN	0.0014*	0.0000*	0.0000	0.0236*	I(0)
	HP	0.3482	0.2755	0.0232*	0.0457*	I(1)
The Netherlands	UN	0.0486*	0.1666	0.0101*	0.0543*	I(0)
	HP	0.4084	0.0239*	0.0173*	0.4529	I(0)
Portugal	UN	0.1658	0.3152	0.1021	0.0269*	I(1)
	HP	0.1761	0.0195*	0.1637	0.0011*	I(0)
Spain	UN	0.109	0.0237*	0.1344	0.3480	I(0)
	HP	0.2602	0.6766	0.0575*	0.1163	I(1)
Sweden	UN	0.0016*	0.0087*	0.0052*	0.0318*	I(0)
	HP	0.9572	0.0108*	0.0329*	0.1452	I(0)
Switzerland	UN	0.0149*	0.1349	0.0304*	0.1374	I(0)
	HP	0.4748	0.0322*	0.0410*	0.0866	I(0)
United Kingdom	UN	0.1488	0.0562*	0.3030	0.7682	I(0)
	HP	0.6581	0.1646	0.0480*	0.1074	I(1)

Table 2 Short run and long run results based on linear ARDL model

	Linear ARDL model short run results				Linear ARDL model long run results	
Country	**UN**	**UN t1**	**UN t2**	**UN t3**	**Constant**	**UN**
Australia	-0.71 (-0.44)	3.4** (2.37)			155.90* (5.12)	27.53** (4.22)
Belgium	0.56 (1.66)				21.19** (2.00)	-20.69 (-1.32)
Canada	-1.87*(-1.92)	5.81** (3.56)	-3.39** (-1.95)		-585.59 (-0.64)	68.29 (0.69)
Denmark	-4.72** (-1.96)	2.98* (1.77)	-3.33** (-1.97)	1.81 (1.66)	338.51 (0.99)	-37.17 (-0.72)
Finland	-0.59 (-1.06)				130.01** (9.21)	9.028** (1.97)
France	-1.54 (-1.76)	1.45* (1.82)			270.76** (6.12)	75.18** (2.23)
Italy	-1.29 (-1.76)	-1.44 (-1.31)	2.41** (2.38)	-0.81 (-1.25)	160.56** (5.76)	-5.16* (-1.8)
Japan	-2.09** (-2.44)	4.09** (2.51)	-1.82 (-1.18)	1.82* (1.80)	182.25** (15.04)	118.4* (1.92)
Norway	4.37 (1.54)				497.43 (1.66)	-62.26 (-1.42)
New Zealand	-3.84** (-2.11)	7.07 (1.39)	-4.06** (-2.60)		-80.05 (-0.51)	17.64 (0.81)
United States	0.59** (4.99)				55.36 (1.19)	6.97 (0.91)
Germany	-0.80** (-1.83)	-0.35 (-0.40)	-0.98** (-2.00)		340.02 (1.67)	-30.34 (-1.18)
Ireland	4.68 (1.64)				220.33** (5.99)	39.94** (2.64)
Korea	1.07 (0.98)				55.46 (0.96)	14.68 (0.90)
The Netherlands	-1.54 (-1.60)				98.76 (0.93)	3.18** (0.15)
Portugal	8.20 (0.26)				149.06* (6.23)	32.49** (2.99)
Spain	-0.68* (-1.94)	0.45 (0.22)			0.68 (-1.94)	34.11 (0.224)
Sweden	-1.31 (-1.61)	2.81** (-2.56)	-1.18* (-1.93)		32.48 (0.05)	29.30 (0.23)
Switzerland	-1.67 (-1.61)	-0.30 (-0.22)	1.77* (1.77)		-733.2 (-0.13)	178.8 (0.15)
United Kingdom	0.52** (2.79)	2.67** (2.28)			244.85** (6.15)	99.91** (1.99)

Notes: a) Numbers inside the parentheses next to coefficient estimates are absolute values of t-ratios. *, ** indicate significance at the 10% and 5% levels respectively, b) The upper bound critical value of the F-test for cointegration when there is one exogenous variable (k=1) is 4.78 (5.73) at the 10% (5%) level of significance. These come from Pesaran et al. (2001, Table CI, Case III, p. 300), c) The upper bound critical value of the t-test for significance of ECTt-1 is 2.91 (3.22) at the 10% (5%) level when k =1, and d) All Wald tests are distributed as $\chi 2$ with one degree of freedom. The critical value is 2.71 (3.84) at the 10% (5%) level.

Table 3 Diagnostic results of linear ARDL model

Country	F	LM	ECM	RESET	CSM	CSM2	Adj R2
Australia	5.1	0.52	-0.42	0.24	S	US	0.77
Belgium	7.2	0.31	-0.71	1.71	S	S	0.73
Canada	7.92	0.52	-0.54	0.07	S	S	0.56
Denmark	3.1	1.02	-0.74	0.95	S	S	0.76
Finland	1.8	0.8	-0.67	0	S	US	0.75
France	10.45	0.99	-0.82	3.11	S	US	0.84
Italy	8.86	3.27	-0.79	0.01	S	S	0.87
Japan	3.2	0.21	-0.74	0.79	S	S	0.72
Norway	4.2	0.83	-0.38	1.7	S	S	0.72
New Zealand	5.3	1.87	-0.6	1.49	S	S	0.74
United States	11.57	0.33	-0.8	3.14	S	US	0.80
Germany	47.79	1.39	-0.78	-0.19	S	S	0.84
Ireland	4.58	2.12	-0.7	0.09	S	S	0.82
Korea	1.95	2.44	-0.7	2.3	S	S	0.84
The Netherlands	2.77	1.06	-0.81	1.51	S	S	0.85
Portugal	10.18	0.55	-0.73	0.38	S	S	0.76
Spain	3.73	3.84	-0.87	2.44	S	US	0.78
Sweden	2.11	0.05	-0.47	2.82	S	US	0.71
Switzerland	0.62	1.01	-0.81	0.01	S	S	0.85
United Kingdom	11.189	0.81	-0.65	6.75	S	US	0.79

Notes: a) Numbers inside the parentheses next to coefficient estimates are absolute values of t-ratios. *, ** indicate significance at the 10% and 5% levels respectively, b) The upper bound critical value of the F-test for cointegration when there is one exogenous variable (k=1) is 4.78 (5.73) at the 10% (5%) level of significance. These come from Pesaran et al. (2001, Table CI, Case III, p. 300), c) The upper bound critical value of the t-test for significance of ECMt-1 is 2.91 (3.22) at the 10% (5%) level when k =1, and d) All Wald tests are distributed as $\chi 2$ with one degree of freedom. The critical value is 2.71 (3.84) at the 10% (5%) level.

An important contribution of this study is the investigation of an asymmetric effect of unemployment on house prices. Table 4 shows the short-run and long-run effects of both positive and negative changes in unemployment, i.e., ΔPOS and ΔNEG, on house prices. Table 4 provides the short-run outcomes of the nonlinear effect of both increased and decreased unemployment on house prices. Finally, in Table 5, we look at the diagnostics for the nonlinear short-run and long-run models. We summarize the short-run results by stating that in the corresponding nonlinear model, HP = F (POS, NEG), at least one of the two carries significant coefficients in the case of 16 of the economies, which suggest considerably stronger short-run impacts in the nonlinear model. In 3 of the economies, including France, Italy, and Portugal, a positive change in unemployment (ΔPOS) causes a decline in housing value, but causes an increase in housing value in 5 of the economies including Denmark, Finland, Norway, the US and Sweden. On the other hand, a decrease in unemployment (ΔNEG) is associated with a rise in house prices in 3 of the economies including Finland, Spain, and the UK, and a decline in house prices in 3 of the economies including Japan, Ireland, and the Netherlands. Finally, in 5 of the economies: Belgium, Canada, Denmark, Norway, and the US, a decrease in employment is associated with both positive and negative changes in house prices.

Table 4 also shows the long-term asymmetric impact of increasing and decreasing unemployment rates on housing values/prices in the 20 OECD economies. The findings indicate that changes in unemployment have long-run asymmetric effects on house prices in 16 of the economies. Positive changes in unemployment have a significantly negative impact on 7 of the economies. Finally, positive changes in unemployment have a significantly positive influence on 8 of the economies. On the other hand, negative changes in unemployment have a significantly negative impact on 11 of the economies, but a significantly positive influence on one (01) economy. In the end, we demonstrate cointegration between the variables to support the validity of the long-run estimates. For more reliable findings, we additionally estimate the ECM. Finally, we turn to the diagnostics in Table 5 that pertain to the long-run estimates of the nonlinear model. The positive and negative changes in unemployment affect house prices differently, as discussed above. We apply Wald-S and Wald-L tests to further corroborate the asymmetry effects. To determine if the impact is asymmetric or increased unemployment is equal to decreased unemployment, Wald tests for the short-run and long-run results are utilized (Bahmani-Oskooee and Aftab 2017). The short-run results are shown as Wald-S, whereas the long-run results are shown as Wald-L. Table 5 shows that the coefficient of Wald-S is significant for 15 of the economies including Australia, Belgium, Denmark, Finland, France, Italy, Japan, New Zealand, the US, Germany, Ireland, the Netherlands, Portugal, Sweden, and Switzerland. Wald-L is significant for 14 of the economies. Thus, the findings confirm that the short-run asymmetry effect is more prevalent than the long-run asymmetry effect.

Table 4 Non-linear ARDL model

	Short run results								Long run results		
Country	**UN Pos**	**UN pos t1**	**UN Pos t2**	**UN Pos t3**	**UN Neg**	**UN Neg t1**	**UN Neg t2**	**UN Neg t3**	**Constant**	**UN Pos**	**UN Neg**
Australia	1.68 (0.75)	8.18** (3.13)	-5.03*** (-2.05)		-7.06** (-2.68)				12.74** (2.59)	8.25** (3.57)	-6.76** (-5.14)
Belgium	1.68 (0.75)	-0.69 (-0.71)	1.82** (2.14)	-5.49** (-2.68)	1.24 (1.66)	-0.12** (-1.65)	-0.45 (-0.57)	2.02** (2.82)	82.20** (2.36)	-4.06 (-0.49)	-9.34 (-1.49)
Canada	-2.70* (-1.95)	6.76** (3.28)	-2.54 (-1.70)		0.43 (0.18)	6.23 (1.50)	-6.67* (-1.91)	6.50** (2.90)	1.33 (0.03)	28.85* (1.92)	15.33 (1.04)
Denmark	6.03** (2.46)					0.79 (0.27)	-19.85** (-2.68)	7.80** (4.81)	36.42** (2.50)	1.17 (0.49)	-5.06 (-1.74)
Finland	0.28 (0.23)	3.48** (3.46)			-0.26 (-0.30)	-4.92 (0.35)	-0.68 (-0.65)	2.46** (3.32)	99.13** (6.59)	-9.59** (-3.68)	-40.97** (-2.64)
France	-8.30** (-2.68)	2.02 (1.21)	1.18 (1.21)		-0.72 (0.76)	0.70 (0.54)	1.16 (0.96)	2.61 (1.59)	72.96** (7.98)	-18.84** (-2.88)	-100.17** (-2.68)
Italy	-6.70** (-2.68)				-1.02 (-1.41)				106.04** (16.22)	-14.65 (-0.68)	-19.98** (-2.68)
Japan	-7.44** (-2.68)	4.01** (3.42)			-3.79** (-2.68)				166.54** (15.10)	-141.58** (-4.68)	-8.54* (-1.89)
Norway	3.46** (1.06)				-20.52** (-2.68)	-2.40(- 1.24)	3.61** (2.57)		18.53(1.67)	-0.06* (-1.86)	-14.13** (-2.30)
New Zealand	-0.23 (-0.09)				-2.61 (-0.80)	2.32 (0.70)	1.25 (0.38)	-3.26 (-1.49)	-2.13 (-0.15)	6.86** (4.44)	-19.78** (-2.68)
United States	2.48** (2.65)				-0.35 (-0.13)	-38.8** (-2.68)	7.83** (4.49)		80.51** (19.42)	3.56 (1.70)	-0.08 (-0.03)

(Continued…)

(Table 4 Continued)

	Short run results								Long run results		
	UN Pos	**UN pos t1**	**UN Pos t2**	**UN Pos t3**	**UN Neg**	**UN Neg t1**	**UN Neg t2**	**UN Neg t3**	**Constant**	**UN Pos**	**UN Neg**
Germany	-0.85 (-0.85	0.13 (0.08)	0.42 (0.27)	1.77 (1.48)	-0.96 (-1.03)				106.63** (13.45)	7.35** (2.07)	11.56** (2.96)
Ireland	-2.30* (-1.89)	2.96* (1.81)	8.03** (-2.68)		-4.39** (-2.68)				47.89** (-2.68)	-16.75* (-1.83)	-38.15** (-2.68)
Korea	1.01 (0.96)				-1.19 (-0.81)				55.46 (0.96)	4.85 (0.93)	-5.72 (-0.94)
The Netherlands	-0.13** (-10.09)	1.07 (0.56)	2.71* (1.91)		-6.51** (-3.62)				30.65** (3.36)	36.13** (12.68)	-82.68** (-2.68)
Portugal	-6.08** (-2.68)	-0.69 (-0.52)	2.50** (2.30)		-1.65 (-1.36)				129.09** (76.50)	-51.91** (-3.68)	-45.48** (-2.68)
Spain	-1.06 (-1.31)	1.48 (1.36)	1.03 (1.06)	3.31** (-2.68)	1.25 (1.43)	-1.19 (-1.14)	-0.66 (-0.55)	3.31** (3.29)	105.79** (14.16)	-9.25** (-2.68)	-30.79** (-2.68)
Sweden	1.02** (2.19)				-0.35 (-0.71)				-16.01 (-0.74)	6.77** (2.15)	-2.33 (-0.78)
Switzerland	-0.85 (-1.10)				-0.83 (-1.22)				5.39 (0.43)	14.05** (4.33)	-6.79 (-1.16)
United Kingdom	-1.20 (-0.38)	10.86** (2.62)	4.93 (0.78)	-6.98** (-1.97)	0.40 (0.13)	0.22 (0.07)	-0.93 (-0.27)	4.64* (1.95)	29.70** (3.58)	11.43** (2.60)	0.12 (0.03)

Notes: a) Numbers inside the parentheses next to coefficient estimates are absolute values of t-ratios. *, ** indicate significance at the 10% and 5% levels respectively, b)The upper bound critical value of the F-test for cointegration when there is one exogenous variable **(k=1) is 4.78** (5.73) at the 10%** (5%) level of significance. These come from Pesaran et al. **(2001, Table CI, Case III, p. 300), c) The upper bound critical value of the t-test for significance of ECMt-1 is 2.91 **(3.22) at the 10% **(5%) level when k =1, and d) All Wald tests are distributed as $\chi 2$ with one degree of freedom. The critical value is 2.71 **(3.84) at the 10% **(5%) level.

Table 5 Diagnostic results of non-linear ARDL model

Country	F	LM	ECM	RESET	CSM	CSM2	Adj. R2	Wald-S	Wald-L
Australia	3.23	1.46	-0.44	1.71	S	S	0.46	5.48*	4.79*
Belgium	3.89	2.47	-0.73	0.04	S	S	0.75	4.35*	2.68
Canada	1.23	1.62	-0.56	0.54	S	S	0.58	2.27	2.87
Denmark	8.35	4.18*	-0.76	2.05	S	S	0.78	6.60*	5.60*
Finland	11.37	7.05*	-0.69	0.12	S	S	0.71	4.38*	3.47*
France	9.21	0.81	-0.84	0	S	S	0.86	6.22*	5.40*
Italy	1.47	0.5	-0.81	0.006	S	S	0.83	4.33*	5.32*
Japan	6.71	1.92	-0.76	2.12	S	S	0.78	5.50*	3.71*
Norway	3.97	0.54	-0.4	0.35	S	S	0.42	2.77	2.91
New Zealand	7.47	1.95	-0.62	2.3	S	S	0.64	5.33*	4.66*
United States	8.17	5.28*	-0.82	1.37	S	S	0.84	6.01*	7.09*
Germany	5.37	0.33	-0.8	3.26	S	S	0.82	4.32*	3.30*
Ireland	4.58	4.37*	-0.72	1.4	S	S	0.74	8.60*	12.62*
Korea	3.46	2.31	-0.72	0.03	S	S	0.74	2.22	2.62
The Nether-lands	4.99	1.32	-0.83	0.02	S	S	0.85	5.92*	3.94*
Portugal	10.14	1.81	-0.75	2.84	S	S	0.77	6.91*	6.65*
Spain	9.44	7.77*	-0.89	0.36	S	S	0.91	2.23	2.23
Sweden	4.62	0.14	-0.49	0.13	S	S	0.51	5.11*	7.23*
Switzer-land	14.19	0.03	-0.83	1.49	S	S	0.85	8.22*	12.22*
United Kingdom	4.73	2.74	-0.67	0.11	S	S	0.69	3.10	4.14

Notes: a) Numbers inside the parentheses next to coefficient estimates are absolute values of t-ratios. *, ** indicate significance at the 10% and 5% levels respectively, b)The upper bound critical value of the F-test for cointegration when there is one exogenous variable **(k=1) is 4.78 **(5.73) at the 10% **(5%) level of significance. These come from Pesaran et al. **(2001, Table CI, Case III, p. 300), c) The upper bound critical value of the t-test for significance of ECMt-1 is 2.91 **(3.22) at the 10% **(5%) level when k =1, and d) All Wald tests are distributed as $\chi 2$ with one degree of freedom. The critical value is 2.71 **(3.84) at the 10% **(5%) level.

The majority of the models have a significant F.STAT value, thus validating the cointegration of the variables in the long run. We estimate the ECM to understand how quick adjustments lead to equilibrium. The significantly negative value of the ECM supports cointegration. The ECM provides special support in examining the long-run relationship. Table 5 also includes the adjusted R-squared values which are higher in the maximal models, thus suggesting that the models are a good fit. Both are calculated by using a chi-square with one degree of freedom. An LM is employed to determine whether autocorrelation exists. The LM value in the majority of the models is negligible, thus demonstrating the lack of autocorrelation. We calculate the CUSUM and CUSUM SQ to verify the stability of the model. A stable model is denoted by "S" whereas an unstable model is denoted by "US". CUSUM (CSM) appears to be stable in all the models.

In summary, this study aims to investigate the asymmetry effects of both the positive and negative changes in house prices both in the short and long runs. The significant Wald-S and Wald-L coefficient values are evidence of both short-run and long-run asymmetry effects in 16 of the economies. This study utilizes the recently deviated Hatemi-J (2012) causality test to check the asymmetric course of the causal relationship between unemployment and house price in developed countries. The results of the non-linear causality are presented in Table 6. The results show a bidirectional Granger causality between negative UN shocks and positive HP in the case of Australia, Canada, and Japan. On the other hand, there is evidence of a bidirectional Granger causality between negative UN and negative HP in the case of Italy. There is also a unidirectional Granger causality between negative UN and negative HP for Denmark, Finland, Germany, Spain, the UK, Ireland, Netherlands, Portugal, Sweden, and the US.

Likewise, the study finds evidence of a unidirectional Granger causality between negative HP and positive UN for Australia, Belgium, Italy, and Spain, Ireland, Netherlands, and the US, and a bidirectional Granger causality between negative HP and positive UN for Germany, Belgium, Spain, and Sweden. In the case of Australia, Canada, and Japan, a bidirectional Granger causality is found between positive HP and negative UN. A unidirectional causality is evident between positive HP and negative UN for Belgium, Spain, Denmark, Finland, and Portugal. There is evidence of a significant bidirectional causality between positive UN and positive HP in the case of France, the Netherlands, and Sweden, while a unidirectional causality between positive UN and positive HP is observed for Belgium, Spain, the UK, Denmark, Ireland, Finland, Italy, Portugal, and the US. Finally, there is no evidence of a unidirectional or bilateral Granger causality between HP- and UN- in the case of Australia, Belgium, Canada, Korea, France, Japan, and New Zealand. Similarly, between HP- and UN+, there is no bilateral or unilateral causality in the case of Canada, Finland, Korea, France, the UK, New Zealand, and Switzerland. The findings indicate evidence of Hatemi-J asymmetric causality for all 20 OECD economies as evidenced by at least one significant impact between negative (positive) UN and negative (positive) HP variables.

Table 6 Asymmetric Hatemi-J Causality Test

Asymmetric causality test for Australia				**Asymmetric causality test for Germany**			
Null Hypothesis	Fisher Statistic	P-Value	Decision	Null Hypothesis	Fisher Statistic	P-Value	Decision
UN-Aus≠> HP-Aus	0.683	0.515	Accept	UN-Ger≠> HP-Ger	0.57	0.573	Accept
HP-Aus ≠> UN-Aus	0.656	0.529	Accept	HP-Ger≠> UN-Ger	3.093**	0.06	Reject
UN+Aus ≠> HP-Aus	3.101**	0.066	Reject	UN+Ger≠> HP-Ger	3.602*	0.044	Reject
HP-Aus ≠> UN+Aus	0.248	0.782	Accept	HP-Ger≠> UN+Ger	3.492*	0.048	Reject
UN-Aus ≠> HP+Aus	3.049**	0.068	Reject	UN-Ger≠> HP+Ger	2.409	0.113	Accept
HP+Aus ≠> UN-Aus	2.750**	0.086	Reject	HP+Ger≠> UN-Ger	0.09	0.913	Accept
UN+Aus ≠> HP+Aus	5.810*	0.009	Reject	UN+Ger ≠> HP+Ger	0.418	0.663	Accept
HP+Aus ≠> UN+Aus	2.443	0.111	Accept	HP+Ger ≠> UN+Ger	0.332	0.72	Accept
Asymmetric causality test for Belgium				**Asymmetric causality test for Spain**			
Null Hypothesis	Fisher Statistic	P-Value	Decision	Null Hypothesis	Fisher Statistic	P-Value	Decision
UN-Bel≠> HP-Bel	1.555	0.234	Accept	UN-Spain≠> HP-Spa	1.964	0.164	Accept
HP-Bel ≠> UN-Bel	1.506	0.244	Accept	HP-Spain≠> UN-Spa	4.973*	0.016	Reject
UN+Bel ≠> HP-Bel	3.242*	0.059	Reject	UN+Spain≠> HP-Spa	5.665*	0.01	Reject
HP-Bel≠> UN+Bel	0.216	0.807	Accept	HP-Spain≠> UN+Spa	1.36	0.277	Accept
UN-Bel ≠> HP+Bel	6.424*	0.006	Reject	UN-Spain≠> HP+Spa	8.375*	0.002	Reject
HP+Bel ≠> UN-Bel	1.393	0.27	Accept	HP+Spain≠> UN-Spa	0.127	0.881	Accept
UN+Bel ≠> HP+Bel	0.47	0.631	Accept	UN+Spain ≠> HP+Spa	4.818*	0.018	Reject
HP+Bel ≠> UN+Bel	5.700*	0.01	Reject	HP+Spain ≠> UN+Spa	17.478	0.305	Accept

(Continued…)

(Table 6 Continued)

Asymmetric causality test for Canada				**Asymmetric causality test for the United Kingdom**			
Null Hypothesis	Fisher Statistic	P-Value	Decision	Null Hypothesis	Fisher Statistic	P-Value	Decision
UN-Can≠> HP-Can	2.546	0.102	Accept	UN-UK≠> HP-UK	0.928	0.41	Accept
HP-Can≠> UN-Can	1.785	0.192	Accept	HP-UK≠> UN-UK	4.719*	0.019	Reject
UN+Can ≠> HP-Can	0.788	0.467	Accept	UN+UK≠> HP-UK	8.942*	0.001	Reject
HP-Can≠> UN+Can	0.329	0.722	Accept	HP-UK≠> UN+UK	11.370*	0	Reject
UN-Can ≠> HP+Can	3.297*	0.056	Reject	UN-UK≠> HP+Uk	2.331	0.12	Accept
HP+Can ≠> UN-Can	3.798*	0.039	Reject	HP+UK≠> UN-Uk	0.462	0.635	Accept
UN+Can ≠> HP+Can	3.228*	0.059	Reject	UN+UK≠> HP+UK	0.496	0.615	Accept
HP+Can ≠> UN+Can	2.137	0.142	Accept	HP+UK ≠>UN+UK	10.501*	0	Reject
Asymmetric causality test for Denmark				**Asymmetric causality test for Ireland**			
Null Hypothesis	Fisher Statistic	P-Value	Decision	Null Hypothesis	Fisher Statistic	P-Value	Decision
UN-Den≠> HP-Den	1.332	0.285	Accept	UN-Irl≠> HP-Irl	1.384	0.271	Accept
HP-Den≠> UN-Den	4.269*	0.027	Reject	HP-Irl≠> UN-Irl	4.489*	0.023	Reject
UN+Den ≠> HP-Den	3.027**	0.069	Reject	UN+Irl≠> HP-Irl	6.157*	0.007	Reject
HP-Den≠> UN+Den	16.807	0.549	Accept	HP-Irl≠> UN+Irl	0.713	0.501	Accept
UN-Den ≠> HP+Den	0.895	0.423	Accept	UN-Irl≠> HP+Irl	2.231	0.131	Accept
HP+Den≠> UN-Den	7.728*	0.003	Reject	HP+Irl≠> UN-Irl	0.22	0.804	Accept
UN+Den ≠> HP+Den	0.677	0.518	Accept	UN+Irl≠> HP+Irl	0.501	0.612	Accept
HP+Den ≠> UN+Den	8.710*	0.001	Reject	HP+Irl ≠>UN+Irl	7.854*	0.002	Reject

(Continued…)

(Table 6 Continued)

Asymmetric causality test for Finland				**Asymmetric causality test for Korea**			
Null Hypothesis	Fisher Statistic	P-Value	Decision	Null Hypothesis	Fisher Statistic	P-Value	Decision
UN-Fin≠> HP-Fin	3.305*	0.056	Reject	UN-Kor≠> HP-Kor	1.915	0.171	Accept
HP-Fin≠> UN-Fin	2.207	0.134	Accept	HP-Kor≠> UN-Kor	0.02	0.979	Accept
UN+Fin ≠> HP-Fin	0.088	0.915	Accept	UN+Kor≠> HP-Kor	0.904	0.419	Accept
HP-Fin≠> UN+Fin	6.451*	0.006	Accept	HP-Kor≠> UN+Kor	0.064	0.937	Accept
UN-Fin ≠> HP+Fin	0.487	0.621	Accept	UN-Kor≠> HP+Kor	1.621	0.22	Accept
HP+Fin≠> UN-Fin	3.947*	0.035	Reject	HP+Kor≠> UN-Kor	1.978	0.162	Accept
UN+Fin ≠> HP+Fin	0.071	0.931	Accept	UN+Kor≠> HP+Kor	0.956	0.399	Accept
HP+Fin ≠> UN+Fin	5.467*	0.012	Reject	HP+Kor ≠>UN+Kor	0.34	0.715	Accept
Asymmetric causality test for France				**Asymmetric causality test for The Netherlands**			
Null Hypothesis	Fisher Statistic	P-Value	Decision	Null Hypothesis	Fisher Statistic	P-Value	Decision
UN-Fra≠> HP-Fra	0.791	0.466	Accept	UN-Nld≠> HP-Nld	1.724	0.201	Accept
HP-Fra≠> UN-Fra	1.821	0.186	Accept	HP-Nld≠> UN-Nld	2.920**	0.075	Reject
UN+Fra≠> HP-Fra	0.993	0.386	Accept	UN+Nld≠> HP-Nld	5.949*	0.008	Reject
HP-Fra≠> UN+Fra	1.935	0.169	Accept	HP-Nld≠> UN+Nld	1.138	0.338	Accept
UN-Fra ≠> HP+Fra	13.614*	0	Accept	UN-Nld≠> HP+Nld	1.528	0.239	Accept
HP+Fra≠> UN-Fra	0.807	0.459	Accept	HP+Nld≠> UN-Nld	0.998	0.384	Accept
UN+Fra ≠> HP+Fra	3.703*	0.041	Reject	UN+Nld≠> HP+Nld	2.812**	0.081	Reject
HP+Fra ≠> UN+Fra	12.585*	0	Reject	HP+Nld ≠>UN+Nld	5.133*	0.014	Reject

(Continued…)

(Table 6 Continued)

Asymmetric causality test for Italy				Asymmetric causality test for Portugal			
Null Hypothesis	Fisher Statistic	P-Value	Decision	Null Hypothesis	Fisher Statistic	P-Value	Decision
UN-Ita≠> HP-Ita	3.696*	0.042	Reject	UN-Prt≠> HP-Prt	1.993	0.16	Accept
HP-Ita≠> UN-Ita	6.641*	0.005	Reject	HP-Prt≠> UN-Prt	5.550*	0.011	Reject
UN+Ita ≠> HP-Ita	10.036*	0	Reject	UN+Prt≠> HP-Prt	1.147	0.335	Accept
HP-Ita≠> UN+Ita	0.085	0.918	Accept	HP-Prt≠> UN+Prt	4.246*	0.027	Reject
UN-Ita≠> HP+Ita	1.458	0.255	Accept	UN-Prt≠> HP+Prt	28.825**	0.073	Reject
HP+Ita≠> UN-Ita	2.431	0.112	Accept	HP+Prt≠> UN-Prt	0.439	0.65	Accept
UN+Ita ≠> HP+Ita	2.019	0.157	Accept	UN+Prt≠> HP+Prt	4.659*	0.02	Reject
HP+Ita ≠> UN+Ita	4.281*	0.027	Reject	HP+Prt ≠>UN+Prt	1.143	0.337	Accept
Asymmetric causality test for Japan				**Asymmetric causality test for Sweden**			
Null Hypothesis	Fisher Statistic	P-Value	Decision	Null Hypothesis	Fisher Statistic	P-Value	Decision
UN-Jpn≠> HP-Jpn	2.259	0.129	Accept	UN-Swe≠> HP-Swe	3.219*	0.059	Reject
HP-Jpn≠> UN-Jpn	2.42	0.113	Accept	HP-Swe≠> UN-Swe	2.049	0.152	Accept
UN+Jpn ≠> HP-Jpn	1.807	0.188	Accept	UN+Swe≠> HP-Swe	8.033*	0.002	Reject
HP-Jpn≠> UN+Jpn	1.442	0.258	Accept	HP-Swe≠> UN+Swe	6.211*	0.007	Reject
UN-Jpn≠> HP+Jpn	5.969*	0.008	Reject	UN-Swe≠> HP+Swe	1.629	0.218	Accept
HP+Jpn≠> UN-Jpn	6.261*	0.007	Reject	HP+Swe≠> UN-Swe	2.282	0.125	Accept
UN+Jpn ≠> HP+Jpn	5.252*	0.014	Reject	UN+Swe≠> HP+Swe	3.302*	0.055	Reject
HP+Jpn ≠> UN+Jpn	0.106	0.899	Accept	HP+Swe ≠>UN+Swe	6.851*	0.004	Reject

(Continued…)

(Table 6 Continued)

Asymmetric causality test for Norway				Asymmetric causality test for New Zealand			
Null Hypothesis	Fisher Statistic	P-Value	Decision	Null Hypothesis	Fisher Statistic	P-Value	Decision
UN-Nor≠> HP-Nor	4.060*	0.032	Reject	UN-Nzl≠> HP-Nzl	1.358	0.278	Accept
HP-Nor≠> UN-Nor	0.379	0.688	Accept	HP-Nzl≠> UN-Nzl	2.308	0.124	Accept
UN+Nor ≠> HP-Nor	1.247	0.307	Accept	UN+Nzl≠> HP-Nzl	0.362	0.7	Accept
HP-Nor≠> UN+Nor	2.549	0.102	Accept	HP-Nzl≠> UN+Nzl	20.243	1.053	Accept
UN-Nor≠> HP+Nor	0.202	0.818	Accept	UN-Nzl≠> HP+Nzl	0.819	0.454	Accept
HP+Nor≠> UN-Nor	1.733	0.201	Accept	HP+Nzl≠> UN-Nzl	2.213	0.134	Accept
UN+Nor ≠> HP+Nor	0.372	0.693	Accept	UN+Nzl≠> HP+Nzl	3.620*	0.044	Reject
HP+Nor ≠> UN+Nor	4.924*	0.017	Reject	HP+Nzl≠>UN+Nzl	3.884*	0.036	Reject
Asymmetric causality test for Switzerland				**Asymmetric causality test for the United States**			
Null Hypothesis	Fisher Statistic	P-Value	Decision	Null Hypothesis	Fisher Statistic	P-Value	Decision
UN-Swt≠> HP-Swt	0.549	0.585	Accept	UN-USA≠> HP-USA	1.604	0.224	Accept
HP-Swt≠> UN-Swt	4.032*	0.032	Reject	HP-USA≠> UN-USA	7.887*	0.002	Reject
UN+Swt ≠> HP-Swt	0.988	0.388	Accept	UN+USA≠> HP-USA	1.889	0.175	Accept
HP-Swt≠> UN+Swt	0.027	0.972	Accept	HP-USA≠> UN+USA	15.966*	0.056	Reject
UN-Swt≠> HP+Swt	2.059	0.151	Accept	UN-USA≠> HP+USA	2.037	0.155	Accept
HP+Swt≠> UN-Swt	0.05	0.95	Accept	HP+USA≠> UN-USA	0.463	0.635	Accept
UN+Swt ≠> HP+Swt	7.897*	0.002	Reject	UN+USA≠> HP+USA	2.165	0.139	Accept
HP+Swt ≠> UN+Swt	0.055	0.946	Accept	HP+USA≠>UN+USA	6.335**	0.007	Reject

Notes: a) Numbers inside the parentheses next to coefficient estimates are absolute values of t-ratios. *, ** indicate significance at the 10% and 5% levels respectively, b)The upper bound critical value of the F-test for cointegration when there is one exogenous variable **(k=1) is 4.78 **(5.73) at the 10% **(5%) level of significance. These come from Pesaran et al. **(2001, Table CI, Case III, p. 300), c) The upper bound critical value of the t-test for significance of ECMt-1 is 2.91 **(3.22) at the 10% **(5%) level when k =1, and d) All Wald tests are distributed as $\chi 2$ with one degree of freedom. The critical value is 2.71 **(3.84) at the 10% **(5%) level.

Our findings are in line with the findings of previous studies. Several previous studies have investigated the asymmetric causal relationship between house prices and unemployment, with some finding evidence of such relationships in various economies. For example, Bahmani-Oskooee and Ghodsi (2017), provide empirical evidence for identifying the asymmetric causality between house prices and unemployment rates in each state of the United States. They find that home price declines indeed cause unemployment in 39 states. Only 19 states have data that indicate rising home prices contribute to job loss.

Similarly, according to Katrakilidis and Trachanas (2012), the responses of house prices to positive or negative changes in the explanatory variables are significantly different for both the long-run and short-run time horizons indicating asymmetrical time horizons. The study shows that evidence of asymmetries found may be critical for more accurate policymaking and forecasting in the Greek housing market. The results are also in line with the findings of Karamelikli (2016) who find an asymmetric relationship between unemployment and house prices in the case of Turkey. The findings are also in line with the findings of Alqaralleh (2019) who examines asymmetries in the housing price cycle with other macro variables, including unemployment, at the regional and national levels in the UK. The author highlights significant differences in asymmetric patterns of housing prices across regions, with some areas exhibiting asymmetric responses to changes in house prices to macro variables. According to Lütkepohl and Krätzig (2004), the empirical results of the study reveal that there are significant variations in the impact of unemployment on home prices across the 20 OECD countries examined. While unemployment has a significant impact on house prices in the long term for 9 of the economies, the direction and strength of this relationship vary. In the short term, at least one significant variable is associated with the unemployment variable in 12 of the economies, with greater impacts observed in the nonlinear model. The study finds overwhelming evidence in favor of the asymmetric effect of unemployment on house prices, with evidence of an asymmetric bidirectional causal relationship between unemployment and house prices in all of the selected economies. The findings suggest that unemployment is a significant indicator of housing market strength, and while it may experience a rise or fall during a recession or boom, the changes may affect house prices asymmetrically. The observed heterogeneity in the housing markets of the sample OECD countries may be attributed to a range of economic, demographic, and market-specific factors that influence the direction and strength of the relationship between house prices and unemployment.

Various factors can affect the direction and strength of causality between house prices and unemployment, even in the same time period and using the same methodology. Economic conditions, such as interest rates and economic growth, can influence the relationship between house prices and unemployment, as can demographic factors like population growth and age distribution. The characteristics of the housing market, including housing supply and credit availability, can also impact this relationship. Additionally, differences in data quality and reliability can lead to varying results in studies of this relationship. In terms of positive and negative effects, the direction of the causality can depend on the specific context and time period. While rising house prices may lead to short-term job creation, long-term housing affordability issues and economic instability may arise. Conversely, falling house prices may lead to lower household wealth and reduced consumer spending, but may also increase affordability and stimulate economic growth in the long term. (Camacho and Perez-Quiros, 2014; Case and Shiller, 1990; Glaeser et al., 2008; Kelly et al., 2012; Poterba and Sinai, 2008). There could be other possible explanations for the observed asymmetries between housing prices and unemployment would add value to the study. There are several studies that have explored these hypotheses in the context of OECD economies; see for example, Jordan et al. (2018), Mian and Sufi (2014), Cuestas and Tang (2015), and Lütkepohl and Krätzig (2004). Possible explanations for such asymmetric relationships could be attributed to several factors, including the lag time of the impact of changes in unemployment on the housing market. As suggested by Eita and Jordaan (2007), the lag time between unemployment and house prices may be longer than that between house prices and unemployment, which could explain the asymmetric relationship. Another possible explanation could be related to market imperfections, such as the presence of search and transaction costs in the housing market, which could result in a delayed response of housing prices to changes in unemployment.

5. Conclusion

This study looks at the symmetric and asymmetric effects of unemployment on home prices in 20 OECD countries while relying both on linear and non-linear ARDL models. The findings indicate that in the short run, at least one significant variable is associated with the unemployment variable in 12 of the OECD economies. Over the long term, unemployment has a significant impact on house prices in 9 of the economies, with the coefficient of unemployment being significant and positive in 8 of the economies, including Australia, Finland, France, Japan, Ireland, the Netherlands, Portugal, and UK, while having a negative effect in the case of Italy alone. The short-run findings are summed up by the fact that in the comparable nonlinear model, (HP = F (POS, NEG), at least one of the two carries significant coefficients in the case of 16 of the economies, including Australia, Belgium, Canada, Denmark, Finland, France, Italy, Japan, Norway, the US, Ireland, Netherlands, Portugal, Spain, Sweden, and the UK. The findings indicate significantly greater short-run impacts in the nonlinear model. The same number of economies evidence at least one significant coefficient associated with positive or negative unemployment in the long run. Overall, the findings show overwhelming evidence in favor of an asymmetric effect of unemployment on house prices. According to the Hatemi-J causality results, there is evidence of an asymmetric bidirectional causal relationship between unemployment and house prices in all of the selected economies, as shown by at least one significant variable that runs either from unemployment to house prices or vice versa. The findings indicate that unemployment is a significant indicator of housing market strength while unemployment may experience a rise or fall during a recession or boom, and this fall or rise may affect house prices asymmetrically.

References

Abelson, P., & Chung, D. (2005). The real story of housing prices in Australia from 1970 to 2003. *Australian Economic Review,* 38(3), 265-281.

Abelson, P., Joyeux, R., Milunovich, G., and Chung, D. (2005). Explaining house prices in Australia: 1970–2003. *Economic Record*, 81, S96-S103.

Ahmet, U. (2021). The Impact of Economic Activity and Unemployment Rate on Housing Demand: Estimating a Vector Error Correction Model for Turkey. *Gümüşhane Üniversitesi Sosyal Bilimler Dergisi,* 12(3), 1157-1168.

Algieri, B. (2013). House price determinants: Fundamentals and underlying factors. *Comparative Economic Studies*, 55, 315-341.

Alqaralleh, H. (2019). Asymmetric sensitivities of house prices to housing fundamentals: evidence from UK regions. *International Journal of Housing Markets and Analysis,* 12(3), 442-455.

Apergis, N. (2003). Housing prices and macroeconomic factors: prospects within the European Monetary Union. *International Real Estate Review*, *6*(1), 63-74.

Apergis, N., & Rezitis, A. (2003). Housing prices and macroeconomic factors in Greece: prospects within the EMU. *Applied economics letters*, 10(9), 561-565.

Azmi, N. A. (2018). The determinants of house price behaviour in Asia Pacific countries. [student project unpublished] https://ir.uitm.edu.my/id/eprint/21134/

Bahmani-Oskooee, M., and Ghodsi, S. H. (2017). Asymmetric causality and asymmetric cointegration between Income and house prices in the United States of America. *International Real Estate Review*, 20(2), 127-165.

Bahmani-Oskooee, M., and Ghodsi, S. H. (2016). Do changes in the fundamentals have symmetric or asymmetric effects on house prices? Evidence from 52 states of the United States of America. *Applied Economics,* 48(31), 2912-2936.

Bahmani-Oskooee, M., and Ghodsi, S. H. (2018). Asymmetric causality between the US housing market and its stock market: Evidence from state level data. *The Journal of Economic Asymmetries*, 18, e00095.

Bhattacharya, R. N., and Waymire, E. C. (2009). *Stochastic processes with applications*. Society for Industrial and Applied Mathematics. New York: Wiley

Branch, W. A., Petrosky-Nadeau, N., and Rocheteau, G. (2016). Financial frictions, the housing market, and unemployment. *Journal of Economic Theory*, 164, 101-135.

Byun, K. J. (2010). The US housing bubble and bust: impacts on employment. *Monthly Lab. Rev.*, *133*, 3.

Caldera, A., and Johansson, Å. (2013). The price responsiveness of housing supply in OECD countries. *Journal of Housing Economics*, 22(3), 231-249.

Camacho, M., and Perez-Quiros, G. (2014). Commodity prices and the business cycle in Latin America: Living and dying by commodities?. *Emerging Markets Finance and Trade,* 50(2), 110-137.

Case, K. E., and Shiller, R. J. (1990). Forecasting prices and excess returns in the housing market. *Real Estate Economics,* 18(3), 253-273.

Case, K. E., and Shiller, R. J. (2003). Is there a bubble in the housing market?. *Brookings papers on economic activity*, *2003*(2), 299-362.

Catte, P., Girouard, N., Price, R., and André, C. (2004). Housing markets, wealth and the business cycle. Available at: https://www.oecd-ilibrary.org/economics/housing-markets-wealth-and-the-business-cycle_534328100627.

Chen, M. C., and Patel, K. (1998). House price dynamics and Granger causality: an analysis of Taipei new dwelling market. *Journal of the Asian real estate society*, *1*(1), 101-126.

Cheng, P., Lin, Z., and Liu, Y. (2020). Price discovery with heterogeneous sellers in real estate. *Journal of Real Estate Research*, 42(3), 341-364.

Capozza, D. R., and Seguin, P. J. (2003). Expectations, efficiency, and euphoria in the housing market. *Journal of Real Estate Literature*, 11(2), 107-120.

Clapp, J. M., and Giaccotto, C. (1994). The influence of economic variables on local house price dynamics. *Journal of Urban Economics*, 36(2), 161-183.

Cohen, V., and Karpaviciute, L. (2017). The analysis of the determinants of housing prices. *Independent Journal of Management & Production*, 8(1), 49-63.

Cuestas, J. C., and Tang, B. (2017). Asymmetric exchange rate exposure of stock returns: empirical evidence from Chinese industries. S*tudies in Nonlinear Dynamics & Econometrics,* 21(4), 20160042.

Deng, C., Ma, Y., and Chiang, Y. M. (2009). The dynamic behavior of Chinese housing prices. *International Real Estate Review*, 12(2), 121-134.

Dröes, M., and van de Minne, A. (2016). Do the determinants of house prices change over time? Evidence from 200 years of transactions data (No. eres2016_227). *European Real Estate Society (ERES)*. Available at: https://www.aeaweb.org/conference/2017/preliminary/paper/7NHnQiSz

Égert, B., and Mihaljek, D. (2007). Determinants of house prices in central and eastern Europe. Comparative economic studies, 49(3), 367-388.

Gallin, J. (2006). The long-run relationship between house prices and income: evidence from local housing markets. *Real Estate Economics*, *34*(3), 417-438.

Ge, X. J. (2009). Determinants of house prices in New Zealand. *Pacific Rim Property Research Journal*, 15(1), 90-121.

Geerolf, F., and Grjebine, T. (2014). Assessing house price effects on unemployment dynamics (Working Papers 2014-25), CEPII research center.

Glaeser, E. L., Gyourko, J., and Saiz, A. (2008). Housing supply and housing bubbles. *Journal of Urban Economics*, 64(2), 198-217.

Granger, C. W., and Yoon, G. (2002). Hidden cointegration. U of California, Economics Working Paper, (2002-02). Available at: https://ssrn.com/abstract=313831

Grum, B., and Govekar, D. K. (2016). Influence of macroeconomic factors on prices of real estate in various cultural environments: Case of Slovenia, Greece, France, Poland and Norway. *Procedia Economics and Finance*, 39, 597-604.

Gyourko, J., and Saiz, A. (2006). Construction costs and the supply of housing structure. *Journal of Regional Science*, 46(4), 661-680.

Gyourko, J., Mayer, C., and Sinai, T. (2013). Superstar cities. *American Economic Journal: Economic Policy*, 5(4), 167-199

Ingholt, M. M. (2017). *House prices, geographical mobility, and unemployment.* Discussion Papers 17-06, Department of Economics, University of Copenhagen.

Ihlanfeldt, K. R., and Mayock, T. (2010). Panel data estimates of the effects of different types of transfer payments on the employment status of men. *Journal of Human Resources*, 45(1), 239-269.

Irandoust, M. (2019). House prices and unemployment: an empirical analysis of causality. *International Journal of Housing Markets and Analysis*. *12*(1), 148-164.

Jordan, L. M. (2018). Can recent property price dynamics still be justified by fundamentals or are they indicating house price bubbles? (Doctoral dissertation). Available at: https://run.unl.pt/handle/10362/36374

Katrakilidis, C., and Trachanas, E. (2012). What drives housing price dynamics in Greece: New evidence from asymmetric ARDL cointegration. *Economic Modelling*, *29*(4), 1064-1069.

Kim, S. W., and Bhattacharya, R. (2009). Regional housing prices in the USA: an empirical investigation of nonlinearity. *The Journal of Real Estate Finance and Economics*, 38(4), 443-460.

Klyuev, V. (2008). What goes up must come down? House price dynamics in the United States (No. 2008/187). International Monetary Fund.

Karamelikli, H. (2016). Linear and nonlinear dynamics of housing price in Turkey. Ekonomia. Rynek, Gospodarka, Społeczeństwo, (46), 81-98

Kelly, R., McCarthy, Y., and McQuinn, K. (2012). Impairment and negative equity in the Irish mortgage market. *Journal of Housing Economics*, 21(3), 256-268.

Kuttner, K. N., and Shim, I. (2013). Can non-interest rate policies stabilise housing markets? Evidence from a panel of 57 economies. BIS Working Papers 433, Bank for International Settlements. Available at https://www.bis.org/publ/work433.pdf

Latif, N. S. A., Majeed, K. M. R., Rozzani, N., and Saleh, S. K. (2020). Factors affecting housing prices in Malaysia: a literature review. *International Journal of Asian Social Science*, 10(1), 63-68.

Lee, C. L. (2009). Housing price volatility and its determinants. *International Journal of Housing Markets and Analysis*. 2(3), 293-308.

Lee, C., and Park, J. (2022). The Time-Varying Effect of Interest Rates on Housing Prices. *Land*, 11(12), 2296.

Li, W., and Yao, R. (2007). The life-cycle effects of house price changes. *Journal of Money, Credit and Banking*, 39(6), 1375-1409.

Liu, Z., Miao, J., and Zha, T. (2016). Land prices and unemployment. *Journal of Monetary Economics*, *80*, 86-105.

Lütkepohl, H., and Krätzig, M. (Eds.). (2004). Applied time series econometrics. UK: Cambridge University Press.

Mian, A., and Sufi, A. (2011). House prices, home equity–based borrowing, and the US household leverage crisis. *American Economic Review,* 101(5), 2132-2156.

Miles, I. (2008). Patterns of innovation in service industries. *IBM Systems Journal*, 47(1), 115-128.

Mishkin, F. S. (2007). Housing and the Monetary Transmission Mechanism. *Finance and Economics Discussion Series,* 40, 1-53.

Mohan, S., Hutson, A., MacDonald, I., and Lin, C. C. (2019). Impact of macroeconomic indicators on housing prices. *International Journal of Housing Markets and Analysis*. 12(6), 1055-1071.

Mueller, E. (1966). The impact of unemployment on consumer confidence. *Public Opinion Quarterly*, 30(1), 19-32.

Muellbauer, J., and Murphy, A. (1997). Booms and busts in the UK housing market. T*he Economic Journal,* 107(445), 1701-1727.

Ni, J. S., Huang, S. S., and Wen, Y. (2011). Interest rates, unemployment rate and house market in US. In International Conference on Social Science and Humanity. IACSIT Press, Singapore.

Peek, J., and Wilcox, J. A. (1991). The Measurement and Determinants of Single-Family House Prices. *Real Estate Economics*, 19(3), 353-382.

Pinter, G. (2019). House prices and job losses. *The Economic Journal*, 129(618), 991-1013.

Poterba, J., and Sinai, T. (2008). Tax expenditures for owner-occupied housing: Deductions for property taxes and mortgage interest and the exclusion of imputed rental income. *American Economic Review*, 98(2), 84-89.

Reichert, A. K. (1990). The impact of interest rates, income, and employment upon regional housing prices. *The Journal of Real Estate Finance and Economics*, 3, 373-391.

Schnure, C. (2005). Boom-Bust Cycles in Housing: The Changing Role of Financial Structure (IMF Working Paper No. 05/200). Washington, DC: International Monetary Fund.

Shen, X., Holmes, M. J., and Lim, S. (2015). Wealth effects and consumption: a panel VAR approach. *International Review of Applied Economics,* 29(2), 221-237.

Shin, Y., Yu, B., and Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. Festschrift in honor of Peter Schmidt: In: Sickles, R., Horrace, W. (eds) Festschrift in Honor of Peter Schmidt. Springer, New York, NY.

Simo-Kengne, B. D. (2019). Population aging, unemployment and house prices in South Africa. Journal of Housing and the Built Environment, 34(1), 153-174.

Stratton, L. S. (2017). Housing prices, unemployment rates, disadvantage, and progress toward a degree, IZA Discussion Paper No. 10941. Available at: https://docs.iza.org/dp10941.pdf

Su, H., and Quigley, J. M. (2013). Testing for asymmetric information effects in the housing market. *Real Estate Economics*, 41(2), 245-269. doi: 10.1111/1540-6229.12009

Wang, J., Koblyakova, A., Tiwari, P., and Croucher, J. S. (2020). Is the Australian housing market in a bubble?. *International Journal of Housing Markets and Analysis*. 13(1), 77-95.

Zhao, K., Hao, Y. B., and Wu, W. S. (2022). Asymmetric Effect of Monetary Policy on Housing Price from Short-Term and Long-Term Perspectives. *Journal of Advanced Computational Intelligence and Intelligent Informatics*, 26(4), 581-589.