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Real Estate Bubbles and Contagion: Evidence from Selected European Countries*

Jean-Louis Bago† Imad Rherrad‡ Koffi Akakpo§ Ernest Ouédraogo¶

Abstract

Using quarterly housing price-to-rent ratios from 1970 to 2020, this paper investigated the presence of real estate bubbles at a national level in six selected European countries, namely France, Germany, Italy, Netherlands, Spain, and the United Kingdom. We applied the generalized sup ADF test developed by Phillips et al. (2015) to detect explosive behavior in house prices. Subsequently, we implemented the non-parametric model with time varying coefficients developed by Greenaway-McGrevy and Phillips (2016) to estimate bubbles contagion among these real estate markets. We found evidence of housing prices exuberance in all these markets. Results suggest that Germany, France, Spain, and the Netherlands experienced a bubble during the COVID-19 pandemic period, pushing prices higher, suggesting that speculators anticipated capital gains. In terms of bubbles migration, we find that bubbles migrate between these real estate markets.

Keywords: Bubble, Contagion, real estate, Europe

JEL codes: C12, G12, R31

1 Introduction

Real estate bubbles have been of interest to both researchers and policy makers, especially since the Great Recession. While the seminal contribution of Case and Shiller (2003) was a huge step to understand prices dynamics in real estate markets, Phillips et al. (2011, 2015) model allowed to detect and datestamp bubbles, and to assess whether they are contagious (Greenaway-McGrevy and Phillips, 2016).

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Although an abundant literature since the great recession has relied on Phillips et al. (2011, 2015) to detect the appearance of real estate bubbles, little empirical evidence has focused on the interconnection of real estate markets and their contagiousness (Greenaway-McGrevy and Phillips, 2016). In fact, when it comes to price exuberance in real estate markets, most of the empirical literature is focused on detecting bubbles and stamping their emergence and duration without taking into account market interconnectedness (Phillips et al., 2011, 2015; Engsted and Pedersen, 2015). In the case of Europe, previous papers have investigated the presence of bubbles (Zhou and Sornette, 2003; Gürkaynak, 2008; Agnello and Schuknecht, 2011; Kholodilin et al., 2014; Engsted and Pedersen, 2015; Engsted et al., 2016; Chen and Xie, 2017). The issue is central to understand the appearance of bubbles and the exuberance of prices in markets increasingly dependent on each other.

Indeed, real estate bubbles are determined by a dysfunctional relationship between prices and macroeconomic fundamentals (Garber, 1990; Flood and Hodrick, 1990; Case and Shiller, 2003), bubbles can migrate from one country to another because of their proximity or their economic connection (International Monetary Fund, 2013). Ignoring the transmission of bubbles across countries can affect the effectiveness of housing policies, especially in the context of an increasing cross-country synchronization of real estate prices (Grjebine, 2014; Katagiri et al., 2018; International Monetary Fund, 2013). A recent paper by Gomez-Gonzalez et al. (2018) suggested that, except for Spain, housing bubbles have only migrated from US housing market to European countries. To extend this analysis, our paper focus on bubbles contagion between European countries. Our methodology use a new model developed by Greenaway-McGrevy and Phillips (2016) to estimate bubbles contagion. This model estimate time-varying coefficients of bubbles contagion based on a non parametric estimation. We also extend the analysis to test for the presence of a COVID-19-related housing bubble in these countries.

The aim of the present paper is two-fold. First, we test for housing bubbles within the six countries with the largest share of European Union's (EU) gross domestic product (GDP), namely Germany, United Kingdom, France, Italy, Spain, and the Netherlands[1].

We rely on the GSADF test developed by Phillips et al. (2015) to detect the real estate bubbles

[1]The selection of countries included in this study was guided by three factors: the size of the economy, the availability of a long series of house price data and the overheating of the housing market as suggested by the literature. For eexample, in 2017, 75.0% of the EU's GDP was generated by these countries. For more details, see. https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20200508-1.

episodes. The results confirm the existence of at least one housing bubble episode in each country. France, Germany, Spain, Italy, Netherland, and the United Kingdom experienced several real estate price bubbles between 1970Q1 and 2020Q2. Second, the paper investigates market interconnectedness by focusing on the transmission of real estate bubbles within these countries. The existence of historical bubble episodes in all six economies; the integrated nature of the European economies; the excess of capital in the eurozone, due to the low interest rates policy led by the European Central Bank during these last years; and the synchronization in house prices across countries and major cities, as shown by International Monetary Fund (2013), raises our second question of interest, which focuses on real estate price transmissions from one European country to another. We also find evidence that Germany, France, Spain and Netherlands are experienced a bubble during the period of COVID-19 pandemic which begins in the quarter 2019Q4. We use the non-parametric model with time-varying coefficients of Greenaway-McGrevy and Phillips (2016) to investigate housing price transmissions withing the selected European countries. We found strong evidence that most of the real estate markets were connected during several periods in terms of housing prices migration from 1970 to 2020.

This paper contribute to the literature which found evidence of bubbles migration in regional housing markets in several countries, including the United States (Xie and Chen, 2015; Phillips and Yu, 2011; Cohen and Zabel, 2018), New Zealand (Greenaway-McGrevy and Phillips, 2016), Israel (Caspi, 2017), Canada (Rherrad et al., 2019, 2020) and Chile (Gil-Alana et al., 2019). Other papers also found evidence of bubble migration between the stock and housing market (Balcilar et al., 2016; Deng et al., 2017; Hu and Oxley, 2018) and bubbles contagion in cryptocurrency markets (Fry and Cheah, 2016; Ferreira and Pereira, 2019).

The paper proceed as follows: Section 2 presents the data and descriptive statistics. Section 3 presents the model specification and empirical approach for detecting bubble episodes and investigating bubble migration. Section 4 reports our empirical results, and Section 5 provides the conclusion.

2 Data

We used quarterly housing price-to-rent series from France, Germany, Italy, the Netherlands, Spain, and the United Kingdom. Based on OECD.Stat OECD (2019) methodology, the price to rent data

for each of these countries refers to their nominal house price index divided by their housing rent price index. As stated by the OECD Residential Property Prices Indices manual, the nominal house price index covers the sales of newly-built and existing dwellings, while the housing rent price index refers to consumer Price Indices for actual rentals for housing[2]. The price to rent ratios are indices with base year 2015.

The housing real price and price-to-rent ratios evolution from 1970Q1 to 2020Q2 are presented in Figure (1). For the majority of the countries, real price and price-to-rent ratios displayed a non-monotonous, increasing trend with very sharp rises during certain periods.

The statistics summary presented in Table (1) reveals that, on average, Germany (160.1), and Italy (149.3) recorded the highest price-to-rent ratios, while United Kingdom (48.4) recorded the lowest.

Table 1: *Descriptive statistics*

Country	Min	Max	Mean	Sd	Kurtosis	Skewness
France	57.41	115.89	81.07	18.68	-1.22	0.56
Germany	88.74	160.07	118.38	21.01	-1.29	0.15
Italy	53.75	149.29	107.03	22.29	-0.05	-0.53
Netherlands	59.54	146.02	98.23	27.58	-1.43	0.18
Spain	29.16	162.92	85.96	35.67	-0.85	0.21
United Kingdom	48.39	115.27	74.83	21.20	-1.24	0.47

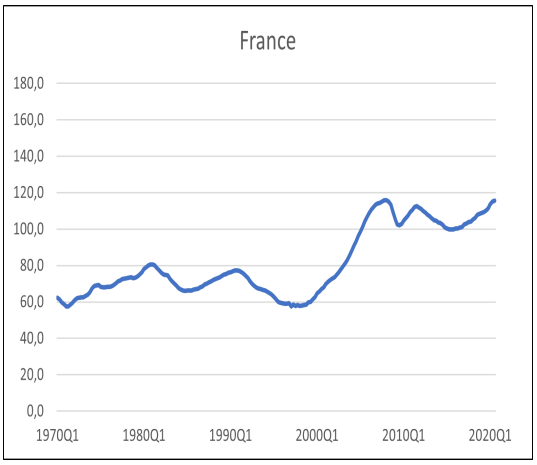
The stationary analysis (Table (2)) revealed that the price-to-rent ratios were not stationary for all three stationary tests (ADF. KPSS. and PP) for all the countries. In the following of our study, we test if this non stationary is normal or explosive.

Table 2: *Unit root and stationary test*

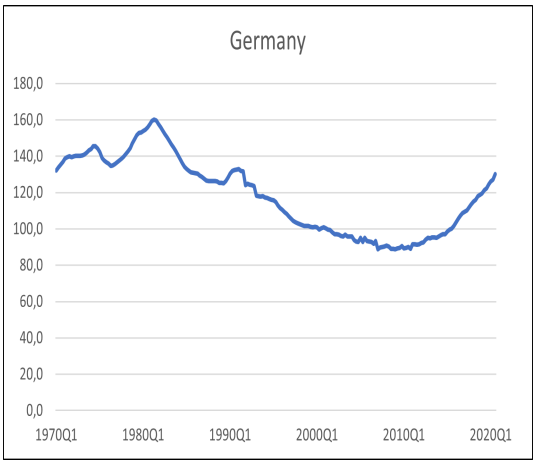
	ADF		PP		KPSS		Zi-An	
	stat	p-val	stat	p-val	stat	p-val	stat	p-val
France	-1,14	0,69	-3,39	0,91	2,57	0,01	-4,28	0,1
Germany	-1,28	0,63	2,01	0,99	3,16	0,01	-2,22	0,1
Italy	-5,25	0,52	-8,95	0,60	0,74	0,01	-5,40	0,01
Netherlands	-0,90	0,78	-3,51	0,91	1,71	0,01	-2,99	0,1
Spain	-1,61	0,47	-4,90	0,83	3,25	0,01	-4,15	0,1
United Kingdom	-1,31	0,62	-6,93	0,71	2,68	0,01	-4,90	0,03

[2]According to the OECD guidelines, "if this indicator is missing for a country, another indicator is chosen. The chosen indicator are usually those corresponding to the CPI aggregate for Housing including Actual rentals for housing, imputed rentals for housing and Maintenance and repair of the dwelling". Please, for more details see : $https://stats.oecd.org/Index.aspx?DataSetCode = HOUSE_PRICES$

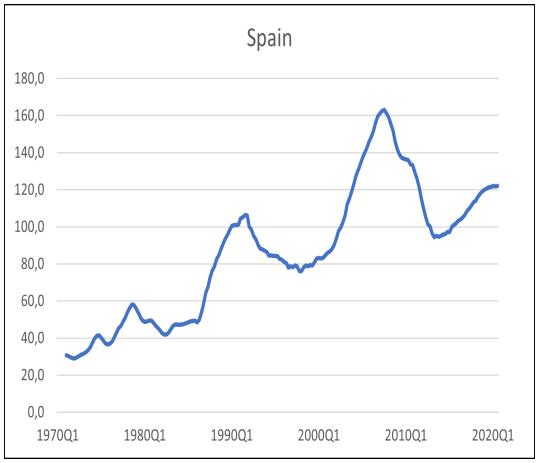
Figure 1: *Evolution of price to rent ratios from 1970Q1 to 2020Q2*



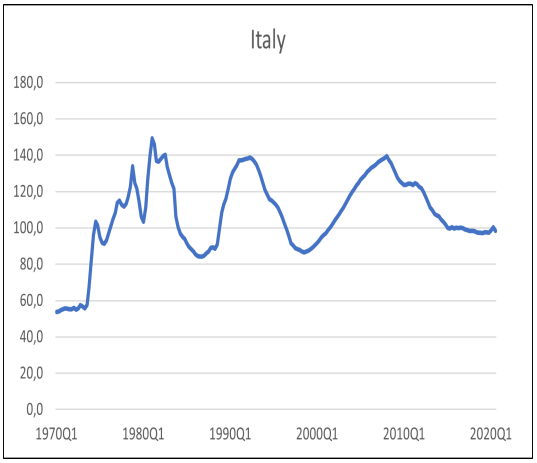
(a) *France*



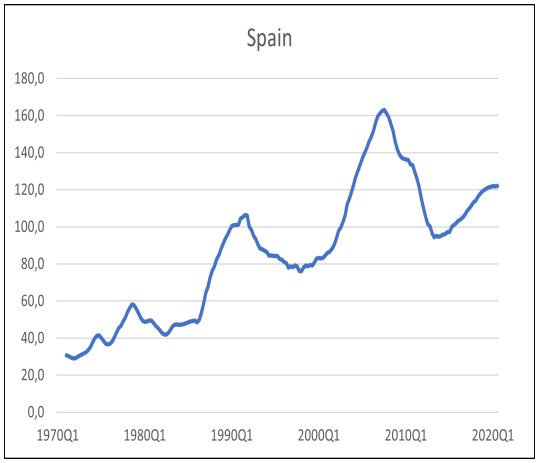
(b) *Germany*



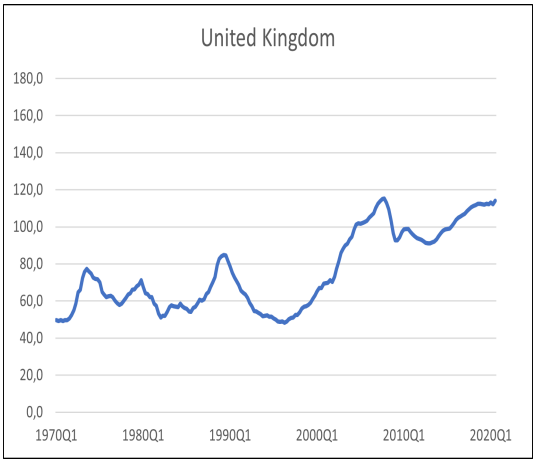
(c) *Spain*



(d) *Italy*



(e) *Netherlands*



(f) *United Kingdom*

3 Empirical Methodology

3.1 Testing for Explosive Behavior

Empirical methods such as the seminal work of Kindleberger and Aliber (2005) and the recursive tests procedure for explosive behavior by Phillips et al. (2011, 2015) have been developed to identify the presence of bubbles in time series. In this paper, we used the generalized sup ADF (GSADF) test developed by Phillips et al. (2015) to examine the explosive behavior of housing prices in European real estate markets. Consider the following equation:

$$\Delta y_{c,t} = \alpha + \beta y_{c,t-1} + \sum_{i=1}^{K} \gamma_i \Delta y_{c,t-i} + \epsilon_{c,t} \tag{1}$$

where y_t is the property price at period t in country c, α is the intercept, K is the optimal lag order, and $\epsilon_{c,t}$ is the error term. This procedure consists of testing the hypothesis that implies the series has a normal unit root ($\beta = 0$), versus the alternative hypothesis of an explosive behavior ($\beta > 0$). The GSADF test repeatedly estimates Equation (1) on sub-samples of data in a recursive fashion and is based on global backwards supremum ADF (BSADF) statistics of the form

$$GSADF(r_0) = \sup_{r_2 \in [r_0,1] r_1 \in [0, r_2 - r_0]} ADF_{r_1}^{r_2} \tag{2}$$

The BSADF statistic, which is used to determine the origination and collapse of each bubble, was defined by Phillips et al. (2015) as the sup value of the ADF statistic sequence:

$$BSADF_{r_2}(r_0) = \sup_{r_1 \in [0, r_2 - r_0]} ADF_{r_1}^{r_2} \tag{3}$$

where $r_w = r_2 - r_1$ represents the window size of the regression; r_0 is the minimum window size; r_1 is the starting point, which varies from 0 to $r_2 - r_0$; and r_2 is the ending point, which varies from r_0 to 1. Minimum window size r_0 is determined according to the formula $0.01 + \frac{1.8}{\sqrt{T}}$ proposed by Phillips et al. (2015).

Phillips et al. (2015)'s procedure consists of estimating the equation (1) and then repeatedly calculating the ADF statistics on a sequence of backward expanding sub-samples. As in Rherrad et al. (2020), we compute the critical values using the wild bootstrap method proposed by Harvey

et al. (2016), with 10000 replications. Harvey et al. (2016) demonstrates that the wild boostraap procedure is consistent to date stamps bubbles in presence of time varying volatility of prices and helps to avoid spurious identification of a bubble. The maximum value of the ADF statistics (BSADF) is compared to the critical value to determine the presence of a bubble in each sub-period.

3.2 Bubble Contagion

We used the non-parametric regression with time varying coefficient developed by Greenaway-McGrevy and Phillips (2016) to analyze the bubbles contagions between pairs of real estate markets. This model uses rolling windows coupled with local kernel regressions to detect the contagion dynamic between the market. Let us consider two markets: A and B. The non-parametric regression specified by Greenaway-McGrevy and Phillips (2016) is as follows [3]:

$$\widetilde{\beta}_{B,t} = \delta_{t,T}\widetilde{\beta}_{A,t-d} + \epsilon_t \tag{4}$$

where $\widetilde{\beta}_{k,t} = \hat{\beta}_{k,t} - \frac{1}{T-w+1}\sum_{t=w}^{T}\hat{\beta}_{k,t}$.

The time varying coefficient δ is estimated by local kernel regression, such that

$$\hat{\delta}(r;h,d) = \frac{\sum_{j=w+d}^{T} K_{hj}(r)\widetilde{\beta}_{B,j}\widetilde{\beta}_{A,j-d}}{\sum_{j=w+d}^{T} K_{hj}(r)\widetilde{\beta}^2_{A,j-d}} \tag{5}$$

where $K_{hj}(r) = \frac{1}{h}K(\frac{j/T-r}{h})$, $K(.) = (2\pi)^{-1/2}e^{-\frac{1}{2}(.)^2}$ is a Gaussian kernel, h is the bandwidth, r is the fraction date, and d is a non-negative delay parameter that captures the lag in market contagion from the market A to the market B.

If $\hat{\delta}(r;h,d) > 0$, the two real estate markets are connected, and there could be bubble contagion between theses markets. Otherwise, the markets are not connected and there is no bubble migration between these markets.

[3] Deng et al. (2017) notation.

4 Empirical Results

4.1 Detecting Bubble Episodes

The bubble detection results are presented in Table (3) and Figure (2). Overall, the GSADF statistics in Table (3) are significant at 1% threshold for all the countries. This result support the bubble hypothesis that these six selected European real estate markets have been exuberant during the 1970–2020 period. This result is consistent Engsted et al. (2016) and Gomez-Gonzalez et al. (2018) who also found evidence of explosive behaviour in price to rent ratios in the theses countries. To

Table 3: *GSADF test for bubble detection*

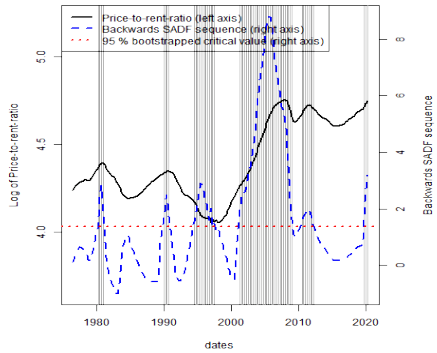
Country	Period	Optimal lags	GSADF	Interpretation
France	1970Q1-2020Q2	3	2,562***	Presence of bubble
Germany	1970Q1-2020Q2	3	2,812***	Presence of bubble
Italy	1970Q1-2020Q2	2	2,178***	Presence of bubble
Netherlands	1970Q1-2020Q2	4	2,947***	Presence of bubble
Spain	1971Q1-2020Q2	1	3,468***	Presence of bubble
United Kingdom	1970Q1-2020Q2	1	2,161***	Presence of bubble

detect date-stamp bubble episodes for each country, the BSADF statistics are presented in Figure (2). France's real estate market (Figure 2a) experienced six bubble episodes for the periods 1980Q2 - 1981Q1, 1990Q1 - 1990Q4, 1994Q3 - 1997Q3, 2001Q2 - 2009Q1, 2010Q3- 2012Q2 and since 2019Q4. The longest and most intense bubble is from 2001Q2-2009Q1 with a peak at 2005Q4. In Germany, the results in Figure 2b also indicate the presence of seven bubbles during the period 1980Q3 - 1981Q3, 1985Q1 - 1986Q1, 1986Q4 - 1987Q2, 1996Q4 - 2000Q2, 2001Q4-2003Q1, 2004Q2 - 2004Q4 and and since 2015Q4. For Spain (Figure 2c), real estate bubbles took place during the period 1977Q4 - 1978Q4, 1986Q4 - 1992Q1, 2002Q1 - 2008Q3, 2011Q4 - 2014 Q1 and since 2018Q4. Italy (Figure 2d), has experienced bubble episodes in the period 1990Q2 - 1991Q3, 1996Q2 - 1998Q3, 2003Q1 - 2008Q2 and 2012Q4-2016Q1. We also found four bubble episodes in the Netherlands (Figure 2e) from 1976Q3 - 1978Q2, 1996Q2 - 2009Q1, 2012Q1 - 2015Q3 and since 2019Q2. Finally, the United Kingdom (Figure 2f), which is the only country outside the euro area in our study, experienced three majors bubbles in 1988Q2 - 1989Q3, 1999Q3 - 2008Q2 and 2016Q3 - 2019Q1.

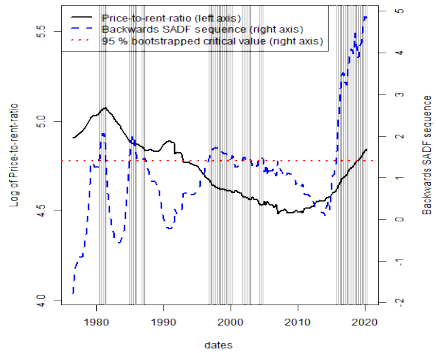
Overall, our results indicate that all the studied countries have experienced at least one bubble episodes in the studied period. The results indicates that four markets namely Germany, France, Spain and Netherlands are experienced a bubble during the period of COVID19. The last bubble in

France emerge with the begin of the COVID19 (2019Q4) while the last bubbles in Germany, France, Spain were accelerated. This result suggest that the COVID-19 crisis may has created a shift of housing demand in European countries and exacerbate speculative housing bubbles. (Cournède et al., 2020).

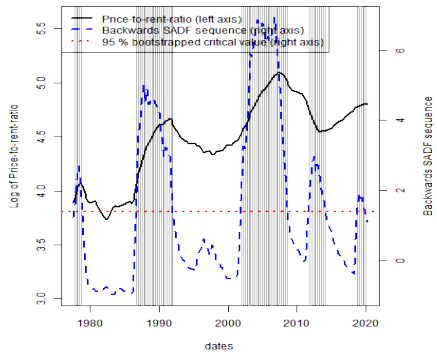
Figure 2: *Real estate bubble detection using GSADF*



(a) *France*



(b) *Germany*



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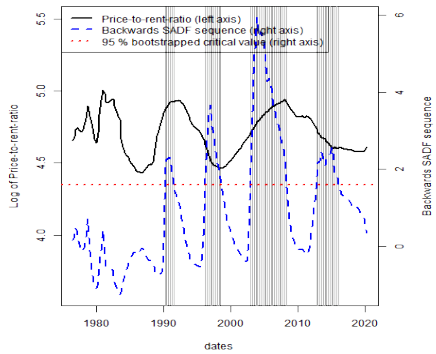
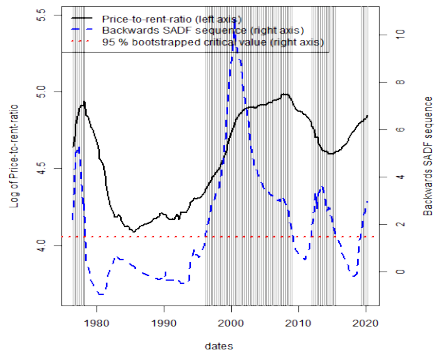
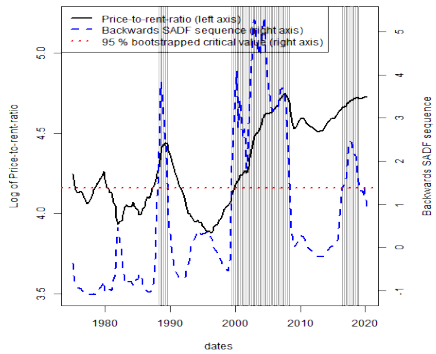


(d) *Italy*



(e) *Netherlands*

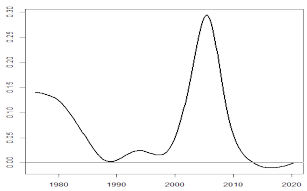


(f) *United Kingdom*

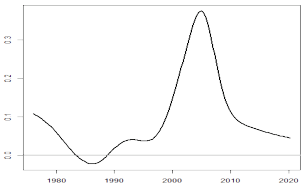
4.2 Analyzing Bubble Contagion

In this section, we emphasize real estate bubbles contagion between the selected countries. Figure (3) presents the non-parametric time-varying coefficients for bubble contagion between the 15 market pairs estimated from Greenaway-McGrevy and Phillips (2016)'s model. We estimate rolling auto-regressions of the equation (1) for each of the series with a fixed window size of w = 10%. To measure the contagion parameters, the data were restricted to the shortest series available, which is Spain. The results indicate that the time-varying coefficients shifted between the positive and negative area, with a larger part in the positive area for most of the pairs. If we focus on the pairs involving Germany and France, which are the biggest real estate market and is currently entering a COVID-19 related bubble territory, the results suggest the following: 1) The pairs Germany-France (Figure 3a) and Germany-United Kingdom (Figure 3b) have been connected during the entire period (except from the 1984Q2 to 1988Q4 for United Kingdom) in terms of real estate price transmissions ; indicating that these real estate markets have been connected and bubbles could have migrated between these markets. For the remaining pairs,2) Germany has been connected to Italy from 1991Q1 to 2010Q4 (Figure 3c) and Netherland (Figure 3e) from 1986Q2 to 2008Q4, in terms of housing price transmissions; 3) In addition to Germany, The real estate market of France is also connected to United Kingdom, Italy, Spain (Figure 3f, Figure 3j and Figure 3k respectively). Overall, our results indicates that the market of Europe were connected during several period from 1970 to 2020, which could favor the migration of housing bubbles between theses markets.

Figure 3: *Bubble and contagion*



(a) *Germany-France*



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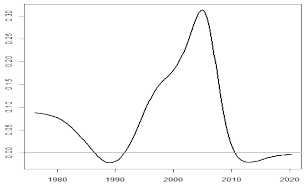
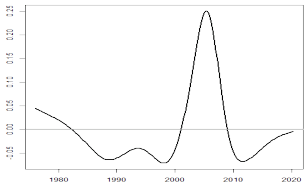


(c) *Germany-Italy*



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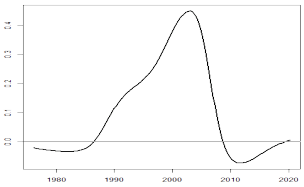

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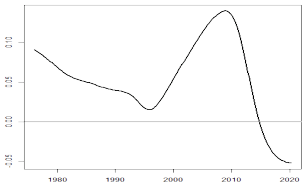

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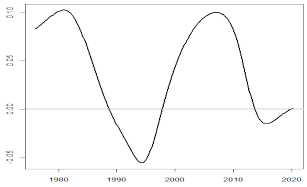
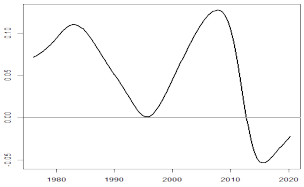
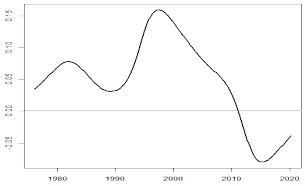


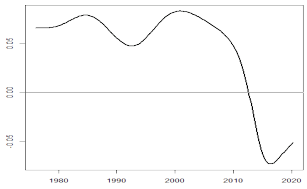
(g) *United Kingdom-Italy*



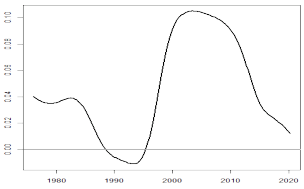
(h) *United Kingdom-Spain*



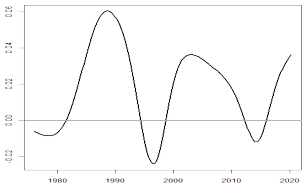
(i) *United Kingdom - Netherlands*



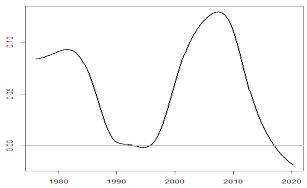
(j) *France-Italy*



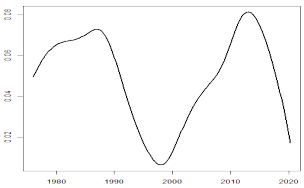
(k) *France-Spain*



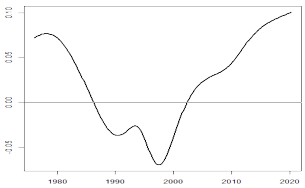
(l) *France-Netherlands*



(m) *Italy–Spain*



(n) *Italy-Netherlands*



(o) *Spain–Netherlands*

5 Conclusion

This paper provides new evidence on the existence of housing bubbles within six European countries, and allows to verify the extent to which these bubbles are transmitted from one economy to another among these countries. Using quarterly price-to-rent ratios from the OECD.Stat OECD (2019), we applied the GSADF test of Phillips et al. (2015) to detect and datestamp housing bubbles and the non-parametric model with time-varying coefficients of Greenaway-McGrevy and Phillips (2016) to assess contagion effects of these bubbles. This paper contribute to the literature in two ways.

First, historical housing price bubbles are detected in all the six countries. These results are consistent with previous studies including Engsted et al. (2016) and Gomez-Gonzalez et al. (2018). This is the first paper to find evidence of a COVID-19 related bubble in European markets with four markets namely Germany, France, Spain and Netherlands experiencing a COVID-19 housing bubble. This is consistent with UBS Group (2020)'s data indicating that many European countries are seeing house prices rise despite the pandemic-induced global recession. According to UBS Group (2020), prices rose in several European countries, with Germany prices up 11%. One possible reason is that very low interest rates combined with government support limit the loss of income for households affected by the pandemic, which has supported the high demand for housing(UBS Group, 2020).

Second, the paper's finding also suggest that bubbles migrate between these real estate markets, assessing contagion dynamics between these markets. One can argue that coordinated housing policies aiming at providing society with affordable and good housing will be needed to avoid the negative effects of house price bubble migrations. Specifically measures focusing on controlling interest rates have shown their efficacy in reducing housing prices Bilyk and teNyenhuis (2018). The fact that our results point out COVID19-related rising bubbles in Germany, France, Spain and Netherlands , with the fear of a migration of these bubbles to other European markets, requires more vigilance from policy makers.

Although providing new insights into the emergence, transmission and migration of housing bubbles between European countries, this paper does not address the impact of bubbles on housing affordability. An interesting avenue for future research will be to investigate housing market affordability, especially for vulnerable people in these countries during the bubbles episodes.

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