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Instituto Superior de Economia e Gestão

Three Essays on Tourism and Housing

Vera Maria Gouveia Barros

Orientador(es): Prof. Doutor Miguel Pedro Brito St. Aubyn

Prof. Doutor Luís Francisco Gomes Dias de Aguiar-Conraria

Tese especialmente elaborada para obtenção do grau de Doutor em Economia

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2024

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1. Introduction

Tourism is one of the world's most important economic sectors. The global tourism economy has consistently grown over the last six decades, generating income, creating jobs and playing a key role in export revenue (OECD, 2020). Moreover, tourism and other industries have broad and deep linkages. Actually, indirect impacts account for more than a third of the value added generated by tourism in the domestic economy (OECD, 2019). According to the World Travel & Tourism Council, between 2014 and 2019, tourism was responsible for generating one out of every five new jobs worldwide.

In 2015, the United Nations 70th General Assembly defined 2017 as the International Year of Sustainable Tourism for Development. In the same year, the 2030 Agenda for Sustainable Development was adopted; given its cross-cutting nature, tourism was recognized as a contributor to all goals (World Tourism Organization, 2017).

However, as pointed out by Ivanova (2017),

> "The ever increasing tourist flows produce significant benefits for the destinations, but they also produce a number of issues deriving from this mass of people travelling around. Destination governance institutions should deal with the proper management of tourist places in order to avoid troubles for the host population and damaging tourists' experiences." (Ivanova, 2017: 116)

An effective tourism policy should foster both the competitiveness and sustainability of the destination (Ritchie & Crouch, 2003). Given that the tourism product comprises a multifaceted combination of unique resources, goods, and services generated by various sectors, establishing a cohesive and integrated framework of tourism policies necessitates two primary steps. First and foremost, it involves facilitating communication and collaboration among all relevant stakeholders. Secondly, it entails considering initiatives targeted at shaping tourists' conduct and enhancing the development of tourism supply, such as the operations of hotels, tour operators, and travel agencies. Additionally, these policies should encompass aspects related to other facets of the tourism ecosystem, including transportation, culture, and the environment, which can also exert an influence on the tourism sector. (Manente et al., 2013)

Transport is part of the tourism product (Papatheodorou & Zenelis, 2013) and, as such, it plays a pivotal role in shaping the tourism experience, being a significant factor in destination development (Prideaux, 2000). Kaul (1985) highlights the necessity for a unified and integrated approach across both sectors. The growing importance of tourism as an economic activity has impelled tourism research, occasioning an increase in the number of tourism, hospitality, and leisure journals, papers, scholars, academic institutions and doctoral dissertations (Benckendorff & Zehrer, 2013; Butler, 2015; Correia & Kozak, 2022). Since the tourist's journey to and from the destination is a fundamental component of the holiday, transportation is an important topic in tourism research (Bieger & Wittmer, 2006; Kaul, 1985; Prideaux, 2000). The connection between air transport and tourism is a widely recognized phenomenon acknowledged by the majority of scholars, policymakers, and individuals in the business sector (Ivanova, 2017).

Another relevant topic concerns tourist behaviour. Tourists exhibit significant diversity in terms of age, motivations, wealth, and preferred activities. Different tourists may generate different impacts, both positive and negative. Additionally, tourist behavior is closely intertwined with marketing efforts, affecting the success of small businesses and exerting considerable influence on socio-cultural and environmental aspects within the tourism industry. Then, understanding tourist behavior is crucial for decision-makers across various sectors, namely public officials. (Pearce, 2005)

In this vein, the following chapter analyses the behaviour of tourists holidaying on Madeira island, based on different transportation modes. Air transportation is the main mode for international travel, accounting, in some cases, such as the island of Madeira, for almost 100% of the international tourism arrivals. So we consider only air transport, but breaking it down into three different classes of flight: scheduled, low-cost and charter. We adopted a triprobit model and used data from an annual questionnaire undertaken by the Madeira Airport Authority.

Our results show that the variables affecting the probability of visitors to Madeira choosing to travel by scheduled airline differ from those variables affecting the decision to travel by low-cost airline or by charter flight. That is, each type of tourist by travel type has their personal characteristic which may be determinant in terms of their preferences, meaning that the presence in the market of three different types of air carrier is justified in order to cater adequately for the different tourist segments.

Although tourism has the potential to be a factor of inclusive and sustainable growth, some of its impacts are not positive (Stynes, 1997). According to OECD (2020:90), its "continued growth is causing pressure on infrastructure, the environment, local communities, other economic sectors, and wider society", leading to negative attitudes towards it (Barron et al., 2018; Martín-Martín et al., 2019).

On average, house prices have grown twice as fast as inflation in the last two decades; they have also grown more quickly than median incomes. Consequently, the public debate on issues of housing affordability (Anacker, 2019; Baptista & Marlier, 2019; Baqutaya et al., 2016; Pittini et al., 2019) sparked and tourism has been appointed as a factor explaining housing affordability problems (Bivens, 2019; Churchill et al., 2022; Meleddu, 2013; Mikulić et al., 2021; Paramati & Roca, 2019).

Housing is universally recognized as a human right, being identified as such by the Universal Declaration of Human Rights, by the United Nations International Covenant on Civil and Political Rights and by the International Covenant on Economic, Social and Cultural Affairs. Then, studying housing market dynamics and its relationship with tourism is a significant matter.

In chapter 3, we focused on assessing housing price synchronization between Portugal and other nations, identifying the international markets that exhibit stronger connections with Portugal, and then conducting a similar analysis within Portuguese cities. We employed the Continuous Wavelet Transform and several wavelets tools associated with it, enabling us to examine trends and relationships across various frequencies.

Our findings suggest the British housing market is the one Portugal is most synchronized with. Italy, Spain, and France come next, but Spain is the country with which Portugal has the largest regions of statistically significant coherency. Concerning the other three countries, regions of high coherency are fewer. Repeating the exercise for the Portuguese cities, we discovered that the Portuguese housing market is segmented and exhibits regional heterogeneities, which implies that housing policies should be designed locally.

In chapter 3, we have not explored the determinants of synchronicity patterns found. Literature suggests that distance, emigrant destination, and tourism flows are factors to consider. So, in chapter 4, we have investigated the interplay between tourism and housing prices in European countries. Once again, we applied wavelet analysis to housing prices and then to nights spent at tourist accommodation establishments. Our results show distinct cycles and synchronizations. With the Spearman correlation coefficient close to zero, our findings indicate that countries with synchronized housing markets do not necessarily exhibit synchronization in tourism, and vice versa. We further studied the relationship between both markets by estimating the wavelet coherency between house prices and tourism. After incorporating real GDP growth into the wavelet coherency analysis, we found that most correlations were consistently low across various frequencies and that the small regions of high coherency further diminished. Based on these findings, we infer that tourism is unlikely to be a significant driving force behind the fluctuations observed in housing prices in these nations.

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2. Transportation choice and tourist's behaviour[1]

Abstract: Transportation is an important topic in tourism research, since the tourist's journey to and from the destination is a fundamental component of the holiday. In island resorts, this issue assumes greater relevance, as modes of transportation are limited. This paper analyses the travel behaviour of tourists holidaying on the island of Madeira, based on their type of air transport (scheduled airline flight, low-cost flight or charter flight). A trivariate probit model is used, taking into account correlation between alternative transport types. Policy implications of the research findings, particularly those related to the management of tourist-based transportation modes, are discussed.

Keywords: Transportation, tourist behaviour, triprobit, Madeira.

2.1. Introduction

Given that it is axiomatic that tourists must travel to and from their chosen destination, the question of their transportation assumes importance in tourism research (Bieger and Wittmer, 2006; Chew, 1987; Kaul, 1985; Khadaroo and Seetanah, 2007, 2008; Prideaux, 2000). Depending on the nature of the destination and the holiday, tourists may be presented with different travel options. The research objective of this paper is to analyse tourists' travel behaviour in respect of the island of Madeira. While the mode of transport is universally by airliner, this mode breaks down into three different classes of flight: scheduled, low-cost and charter. The study is based on a questionnaire put to a sample of tourists waiting to depart from the island at the end of their vacations. We adopt an innovative triprobit model (Capellari and Jenkins, 2003). Whereas binary models (Nicolau and Más, 2005; Correia, Santos and Barros, 2007) are common in tourism research, the triprobit model is not.

There are several motivations for the present research. First, the availability of alternatives in tourism transportation has proven to be a particularly important aspect of tourism management, but its application to tourism has not attracted much research interest until now (Bieger and Wittmer, 2006)

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[1] This chapter was published as BARROS, Vera (2012). Transportation Choice and Tourist's Behaviour, *Tourism Economics*, 18 (3), 519–531.

Second, since tourists' travel behaviour is of crucial concern in tourism management, it is important to ascertain which covariates are related to alternative types of air transport.

Third, it is also important for policy purposes to investigate how tourists behave. Behavioural intentions have been assessed in the literature based on the quality–satisfaction–behavioural intentions paradigm (Williams and Soutar, 2009; Baker and Crompton, 2000; Kozak, 2001; Petrick, Morais and Norman, 2001; Chen and Gursoy, 2001). Moreover, motivations act as an antecedent of any decision-making process (Devesa, Laguna and Palacios, 2010). The Crompton (1979) model is the most consensual model for analysing motivations in the literature. In essence, this model shows that travellers are driven by internal (push) motives and the external forces of a destination (pull), usually linked to the destination's attributes.

The paper contributes to the relevant literature, first, by analysing the alternative tourist behaviour based on three different categories of air travel used by tourists taking holidays in Madeira, a long-established tourist destination that has attracted little research so far; and second, by adopting a triprobit model, which is a novelty in the survival models context. We are not aware of any research paper previously adopting triprobit models in this field, or analysing alternative classes of one mode of transport.

2.2. Madeira

Madeira is an old, traditional tourism destination, situated in the Atlantic Ocean 360 miles west of the African coast and some 600 miles from Lisbon. The destination is particularly popular with tourists from the UK, Germany and Scandinavia between October and the spring, the peaks being in March and April. The summer season tends to attract more visitors from southern Europe, who seek to escape to Madeira's less intense heat and more peaceful atmosphere. New Year's Eve is also a peak period, famously marked by a firework display over Funchal that is claimed to be the largest in the world.

Tourism to Madeira began in the late-19th century, in the form of wealthy British visitors who were passengers on the earliest transatlantic liners and cargo ships. Madeira remained the exclusive reserve of the well-to-do until the opening of the airport in the capital, Funchal, in 1963, which was to lead to the development and expansion of infrastructure and the construction of more hotels.

Today, while most tourists today arrive by air, Funchal is a port of call throughout the year on the itineraries of many European and transatlantic cruise-ships. Blessed by a climate that benefits from the geographical location and its protective mountains, Madeira offers all-year-round benign temperatures and low rainfall. This nourishes the lush, semi-tropical vegetation and flora for which Madeira is famous, in the form of an abundance of exotic flowers, sub-tropical and tropical fruits and Madeira wine. Modern tourism in Madeira offers excellent opportunities to tourists seeking nature-oriented activities, such as rambling or trekking, or sports participation holidays like mountaineering, deep-sea fishing, sailing and surfing (Oliveira and Pereira, 2008; Barros and Machado, 2010).

2.3. Tourism and alternative transportation modes

Tourism and transportation are naturally linked. On one hand, tourists are obliged to travel to and from their destination, **so** transportation is part of the tourism experience. Indeed, travelling has been largely influenced by the development of transport. For example, the road system in the Roman Empire allowed Pompeii and Herculaneum to became retreats for wealthy citisens of Rome, while seaside resorts grew throughout the United Kingdom during the 19th century due to the development of railways (Prideaux, 2000). On the other hand, transportation is affected by tourism, since a large part of travelling is for leisure purposes (Bieger and Wittmer, 2006).

Notwithstanding this, there are neither many articles concerning transportation in tourism journals, nor are there many articles with regard to tourism in transportation journals. The importance of transportation in tourism has been acknowledged by various researchers (Gilbert, 1939; Gunn, 1994; Hall, 1991; Inskeep, 1991; Page, 1994, 1999; Robinson, 1976), but not investigated in detail. The relationship between transportation and tourism is frequently approached in terms of accessibility, adopting a spatial or geographic perspective without demonstrating a specific causal relation (Prideaux, 2000; Khadaroo and Seetanah, 2008). For example, Lundgren (1982) examines the role of transportation in tourist flows between metropolitan and rural destinations; and Pearce (1987) analyses tourist transportation between a city and other destinations around it.

Other studies have focused on the connection between transport and destination attractiveness. Kaul (1985) stresses that it relies on the transport system and summarised this relation into nine postulates. The works of Crouch and Ritchie (1999), Naudee and Saayman (2005) and Khadaroo and Seetanah (2007, 2008) all analyse the relation between tourism development and transport supply. Chew (1987) points out that improved transport facilities have boosted tourism, for example, bringing the Asia-Pacific region within reach of North Americans and Europeans.

Following a different path, a number of researchers (Lim, 1997; Martin and Witt, 1988; Witt, 1980; Witt and Witt, 1995; Taplin, 1980) identify transport infrastructure as an important factor in international tourism demand estimation.

According to Prideaux (2000), the tourism transport system is "the operation of, and interaction between, transport modes, ways and terminals that support tourism resorts in terms of passenger and freight flows into and out of destinations, the provision of transport services within the destination, and the provision of connecting transport modes in the tourism-generating region" (Prideaux, 2000: 56). By modes, he means the various specific types of transport, which are usually classified as road, air, sea and rail.

Air transportation is the main mode for international travel, accounting, in some cases, such as the island of Madeira, for almost 100% of the international tourism arrivals. In general, air transportation can be divided into network carriers, charter airlines and low-cost companies. Diferent kinds of airline business models are related to differences in the traffic carried, particularly regarding the nature of the visitor. Charter and low-cost airlines, for instance, are often thought to be associated with mass and low-income tourism, yet have contributed to the creation of new forms of tourism, namely, city breaks and residential/second home tourism (Papatheodorou, 2002; Bieger and Wittmer, 2006) or to the expansion of tourism to new regions (Bel, 2009).

In spite of a large literature on aviation regimes and their consequences for the industry, little research has been conducted on their impacts on tourism and on the relation between different modes or classes of transport and tourists' behaviour.

2.4. Theoretical framework

The triprobit model estimated in this study is based on the theory of consumer behaviour developed by Lancaster (1966) and the concept of hedonic prices (Rosen, 1974). The economic theory of consumer behaviour assumes that a consumption decision faced by an individual aiming to maximise utility, subject to budgetary restrictions, is taken on the basis of prices and income (Varian, 1987:95). This traditional framework, however, does not allow for circumstantial conditions and social factors which are known to play an important role in shaping tourism demand, given the composite or differentiated nature of the services that comprise a tourist destination (Eugenio-Martin, 2003; Morley, 1992, 2009 and Sakai, 1988). Therefore, the demand for tourism is derived from the demand for the various goods and services offered by a tourism destination (Ben-Akiva and Lerman, 1985), according to the Lancaster approach. Moreover, the conceptual model is grounded in the theory of planned behaviour (Ajzen, 1991). Accordingly, the three types of tourist transportation to and from Madeira are regressed in independent variables.

2.5. Method

Let us consider the tourists who take vacations in Madeira. These tourists, due to their own motivations, are obliged to travel to the destination.

The model used in this research is the following:

$$U_{ij} = C_0 + \alpha_{ij} + \beta . X_{ij} + \varepsilon_{ij} \quad (1)$$

Where U_{ij} defines the utility derived from the visit (j = 0,1) made by the individual (i) who completes the questionnaire. C is a constant defining the average utility, defined as the difference between the probability of using one category of flight or another, α_{ij} is a random alternative specific constant associated with the individuals and the alternatives. β is a vector of random parameters of individual-specific and alternative-specific attributes. X_{ij} is a vector of individual-specific and site-specific attributes. ε_{ij} is an unobserved random term for the utility of choosing a category of flight**,** which is assumed $\varepsilon_{ij} \sim N(0,1)$.

The probability that individual i uses a type of flight j, conditional on $\mu_{ij},$ can be described by a binomial probit form:

$$P(j = 1|\mu_{ij}) = P(\beta, x_i) = \Phi(X\beta) \quad (2)$$

Cappellari and Jenkins (2003) suggest the application of the Geweke-Hajivassiliou-Keane (GHK) simulation method for maximum likelihood estimation. This is based on the fact that a multivariate normal distribution function is the product of sequentially-conditioned univariate normal distribution functions.

2.6. Research design: hypotheses

As noted above, choosing a type of air travel can be explained by several factors. The survey questionnaire therefore gathered data pertaining to: 1) alternative types of air travel; 2) socio-demographic characteristics; 3) nationalities; 4) expenditure; 5) destination attributes; 6) previous visits to the destination and 7) quality. Using the survey data on these characteristics, we tested the following hypotheses.

Hypothesis 1A (*Socio-demographic characteristics – Scheduled flights*): the tourist's choice of scheduled air travel with a conventional airline is a positive function of individual socio-demographic characteristics, such as age, gender and level of education (Goodall and Ashworth, 1988; Woodside and Lysonski, 1989; Weaver *et al.*, 1994; Zimmer, Brayley and Searle, 1995; Barros and Machado, 2010).

Hypothesis 1B (*Socio-demographic characteristics – low-cost flights*): the tourist's choice of low-cost air travel is a negative function of individual socio-demographic characteristics, such as age, gender and level of education.

Hypothesis 1C (*Socio-demographic characteristics – charter flights*): the tourist's choice of charter air travel is a positive function of individual socio-demographic characteristics, such as age, gender and level of education.

Hypothesis 2 (Nationalities): the tourist's choice of one type of transport is a positive function of the nationality of the tourist, reflecting his/her income. This is a traditional hypothesis in tourism survival models (Gokovali *et al.*, 2006).

Hypothesis 3A (*Expenditure – Scheduled flights*): the tourist's choice of a scheduled flight is a positive function of the individual's expenditure. This is a traditional hypothesis in tourism demand models, in which expenditure constraints define the frontier of consumption possibilities for travel (Aguiló Perez and Sampol, 2000; De la Vina and Ford, 2001; Hay and McConnel, 1979; Nicolau and Más, 2005).

Hypothesis 3B (*Expenditure – low-cost flights*): the tourist's choice of low-cost air travel is a negative function of the individual's expenditure.

Hypothesis 3C (*Expenditure – charter flights*): the tourist's choice of charter air travel is a positive function of the individual's expenditure.

Hypothesis 4 (*Destination attribute*): the tourist's choice of the type of transportation is a positive function of a destination's attractiveness in attributes such as wine production, cultural traditions, casinos and nature. Woodside and Lysonski (1989) argue that a destination's image and its choice are influenced by destination attributes such as those considered in this study (Wanhill and Lundtorp, 2001).

Hypothesis 5A (*Tourism travel buying act – Scheduled flights*): the tourist's choice of a scheduled flight is positively related to buying the flight at a travel agency.

Hypothesis 5B (*Tourism travel buying act – low-cost flights*): the tourist's choice of a low-cost flight is positively related to buying the flight ticket on the airline's website.

Hypothesis 5C (*Tourism travel buying act – charter flights*): the tourist's choice of a charter flight is positively related to buying the flight ticket at a travel agency.

2.7. Survey and study context

The research study is based on an annual questionnaire undertaken by the Madeira Airport Authority to evaluate tourists' categories of flight and behaviour. Our research uses data gathered from the questionnaire conducted in March and April 2008. Tourists were randomly approached to answer the questionnaire prior to departing from Funchal Airport, Madeira. Although the questionnaire took the individual tourist as reference, family context was taken into account. The sample was defined by the confidence interval approach (Burns and Busch, 1995).

The interviewer approached the randomly-selected tourist while he/she was waiting in the departure lounge to board the flight home. Budgetary restrictions limited the number of questionnaires to 844.

The general characteristics of the respondents were that they were male (49.6%) with an average age of 36 and an average daily expenditure of 177.70 euros. On average, they were middle-class, middle-aged individuals with a family that includes one child. Other characteristics of the sample are summarised in Table 1, which also broadly indicates the items contained in the questionnaire.

Table 1. Characterisation of the Variables

Variable	Description	Min [a]	Max [b]	Mean	Std. Dev
	Endogenous variables				
Scheduled flight	Scheduled flight (Scheduled flight =1, otherwise =0)	0	1	0.433	
Low-cost airline	Low-cost airline (low cost=1; otherwise =0)	0	1	0.204	
Charter flight	Charter flight (Charter=1, otherwise =0)	0	1	0.318	
	Socio-Demographic characteristics				
Gender	Gender of the individual (female=0, male=1)	0	1	0.496	
Age	*Age of the individual*	9	91	36	15.73
	Nationalities				
Portuguese	Portuguese tourist (Portuguese tourist=1, otherwise=0)	0	1	0.127	
British	British tourist (British tourist=1, otherwise=0)	0	1	0.317	
German	German tourist (German tourist=1, otherwise=0)	0	1	0.138	
French	French tourist (French tourist=1, otherwise=0)	0	1	0.189	
Dutch	Dutch tourist (Dutch tourist=1, otherwise=0)	0	1	0.100	
	Expenditure				

Expenditure	*How much did you spend daily during your vacation?*	0	100,000	177.70	2,341.5
	Destination attributes				
Beach	*Visit the beach (No=0, Yes=1)*	0	1	0.522	
Shows	*Attended shows (No=0, Yes=1)*	0	1	0.037	
Culture	*Enjoyed culture (No=0, Yes=1)*	0	1	0.162	
	Information				
Airline desk	Where did you obtain information on Madeira? (airline desk=1, otherwise=0)	0	1	0.023	
Website of airline	Where did you obtain information on Madeira? (website of airline=1, otherwise=0)	0	1	0.199	
Travel agency	Where did you obtain information on Madeira? (travel agency=1, otherwise=0)	0	1	0.464	
Website of travel agency	Where did you obtain information on Madeira? (website of travel agency=1, otherwise=0)	0	1	0.241	
	Quality				
Quality	Satisfaction with overall quality (satisfied=1. not satisfied=0)	0	1	0.282	

[a] Min – Minimum; [b] Max – Maximum

The survey contained three types of variables: dichotomous variables, continuous variables and qualitative variables (using a 5-point Likert scale). The set of explanatory variables considered in this study sought to capture the key determinants of the tourist decision process, based on the theoretical framework and the literature review (Barros, Correia and Crouch, 2008). The reference individuals were Portuguese tourists (20%).

In order to evaluate the degree of correlation among the explanatory variables, which can cause multicollinearity, the correlation matrix was estimated, concluding that it was low among the variables used in the analysis (these results are available on request from the authors).

2.8. Results

Table 2 presents the results. A multivariate triprobit model, using simulated maximum likelihood (Capellari and Jenkins, 2003), was estimated with Stata 11. The endogenous variables are scheduled flight, low-cost airline and charter flight.

Table 2. Parameter Estimates and t-Statistics

	Scheduled flight	Low-cost airline	Charter flight
Variables			
Intercept	-0.623 (-1.88)	-0.830 (-2.48)	-0.757 (-2.07)
Gender	-0.101 (-1.06)	0.107 (1.01	-0.180 (-2.05)
Age	0.002 (0.75)	-0.005 (-1.59)	0.002 (0.93)

Portuguese	0.645 (3.18)*	-0.759 (-3.25)*	-1.206 (-5.66)*
British	-0.492 (-3.12)*	0.088 (3.58)*	0.107 (0.86)
German	-0.376 (-2.03)	-0.221 (-1.10)	0.216 (3.37)*
French	-0.563 (-3.37)*	-0.089 (-0.55)	0.224 (3.69)*
Dutch	-0.708 (-3.20)*	–	–
Expenditure	-0.003 (-3.21)*	0.026 (3.45)*	0.008 (3.57)*
Beach	0.442 (3.93)*	-0.252 (-2.58)*	-0.166 (-3.32)*
Shows	–	-0.444 (-1.44)	0.236 (1.29)
Culture	0.184 (1.26)	–	0.019 (0.13)
Website of airline	-0.097 (-3.53)*	0.736 (3.48)*	0.540 (-2.83)*
Travel agency	-0.338 (-3.84)*	0.534 (2.54)	0.109 (2.62)*
Web site of travel agency	0.042 (0.26)	-0.118 (-0.60)	-0.029 (-0.18)
First time in Madeira	0.285 (2.41)	–	
How many times in Madeira	0.037 (2.23)	–	
Golf	0.232 (0.46)	–	
Main reason		0.102 (1.73)	
Accommodation		-0.027 (-0.87)	
Return		-0.030 (-0.23)	
Hotel and travel		0.025 (0.40)	
How many times have you visited Madeira			-0.011 (-1.80)
Satisfaction			0.078 (1.29)
Trekkng			-0.078 (-0.44)
Type of ticket			0.131 (1.66)
Atrho	-0.441 (6.41)*	-0.910 (-12.76)*	-0.314 (-4.74)*
Rho	-0.414 (-7.27)*	-0.721 (21.08)*	-0.304 (-5.06)*
Observations	844		
Log-Likelihood	-1073.78		
Wald chi2(51)	259.68		

Likelihood ratio rho1=rho2=rho3=0	Chi2(3)=540.673 (prob>chi2=0.000)

*Means statistically significant at 1%;

The model estimates the variables used in the hypotheses simultaneously. However, for the model to converge, some variables that are specific to each equation must be included (starting from 'first time in Madeira'). Therefore, they are presented only for a single type of flight and are not used in the hypotheses.

The overall fit of the model is reasonably good, with a log-likelihood of -1073.78 and a Wald test with a Chi-square statistical value of 259.68, with 51 degrees of freedom and a level of significance of 0.0000.

How do we interpret these three simultaneous regressions? They are interpreted as in the traditional probit model, where one option is to choose a scheduled flight rather than a low-cost airline or a charter flight. The constant is negative, signifying that there is a probability of the tourists' not choosing the type of air transportation in each alternative, regardless of any attribute considered in the analysis. With regard to the characteristics of these alternative classes of flight, the first type is positively related to age, signifying that scheduled airlines are chosen by older tourists, while Portuguese tourists and beach are negative for the other variables (Correia, Santos and Barros, 2007). Low-cost airline travel is positively related with British tourists, with tickets purchased online at the low-cost airline's website or at a travel agency and with expenditure. The charter flight is positively related with British, German, French, expenditure, shows and culture.

Turning next to a consideration of the hypotheses; firstly, the analysis does not support Hypothesis 1A, since the scheduled flight is positively related with age and negatively related with gender. Equally, the analysis does not support Hypothesis 1B, since the low-cost airline is positively related with gender and negatively related with age. The analysis also does not support Hypothesis 1C, since the charter flight is positively related with age, but negatively related with gender. Therefore, scheduled flights and charter flights present the same characteristic, which is distinct from low-cost airlines. This signifies that the low-cost traveller differs from the others in this sample by being younger than the other tourist types.

The findings do not support Hypothesis 2, since nationalities have different relationships with different types of air transport. For example, the scheduled flight has a positive relation with Portuguese tourists, but a negative relation with other nationalities. The low-cost flight has a positive relation with British and a negative relation with all other nationalities. Finally, the charter flight has a positive relation with all nationalities except the Portuguese. An explanation could be that only a British low-cost airline operates into and out of Madeira. Charters operate in several European countries, such in UK, Germany, France while scheduled flights in Madeira are operate by TAP, the Portuguese national carrier**.**

With regard to the direct impact of expenditure on the probability of choosing a specific type of flight, the authors do not confirm Hypothesis 3A, since expenditure has a negative sign, neither Hypothesis 3B, since low-cost tourists have a positive sign. Hypothesis 3C is accepted, given the positive sign of charter flight tourist expenditure. This signifies that low-cost and charter tourists are similar in terms of expenditure, while differing from scheduled flight tourists.

With regard to destination attributes, the results do not support Hypothesis 4, since signs of the destination attributes' variables change from one type of flight to another. For example, scheduled flight tourists value the beach and culture, while low-cost tourists do not value the beach or shows and charter tourist value shows and culture, but not the beach.

Finally, considering information issues, Hypothesis 5A is accepted, since scheduled flight tourists' tickets are bought on the website of a travel agency, rather than on the airline's website or by going to a travel agency. In relation to Hypothesis 5B, low-cost tourists purchase their tickets either on the airline's website, or in a travel agency, but not on the travel agency's website. Lastly, charter flight tourists do not with buy tickets in website of airline or web site of a travel agency, but rather in travel agency shop signifying they buy tickets from tour operators.

To summarise, some hypotheses are rejected and other are accepted for each category of flight, signifying that each category has its own type of passengers, with their specific preferences and behaviour.

Therefore, the overall conclusion is that each type of tourist by travel type has his/her personal characteristics which may determine the differences among tourists in terms of preferences.

2.9. Conclusions

This paper reports the application of a triprobit model to gain a deeper insight into tourism behaviour in relation to different classes of air travel. A multivariate triprobit model using simulated maximum likelihood (Capellari and Jenkins, 2003) is estimated, leading to the conclusion that the variables affecting the probability of visitors to Madeira choosing to travel by scheduled airline differ from those variables affecting the decision to travel by low-cost airline or by charter flight.

Therefore, the overall conclusion is that each type of tourist by travel type has his/her personal characteristic which may be determinant in terms of their preferences. For example, scheduled flight tourists have a positive relation with age, Portuguese, beach, culture and web site of a travel agency; low-cost tourists have a positive relation with gender, British, expenditure, web site of an airline and travel agency; charter flight tourists have a positive relation with age, British, German, French, expenditure, shows and culture. From these statistical relationships emerges a distinct pattern of tourists, based on their flight type.

The policy implication of the present research is that the presence in the market of three different types of air carrier is justified in order to cater adequately for the different tourist segments. The travel agencies should be aware that in order to optimise their selling strategies, they need to define specific strategies for the scheduled flight and charter flight segments identified**.** The fact that British tourists using the airline Easyjet tend to be in the youngest adult age groups should be taken in consideration for future tourist policies. Easyjet was the sole low-cost carrier flying to Madeira from London and Bristol at the time of the questionnaire.

Clearly, targeting strategies should be subject to considerable scrutiny before approval or implementation. Since this research is an exploratory study, the intention is not to obtain definitive results for direct use by the travel agencies. Rather, the study calls the attention of the tourism community to the value of this innovative procedure for segmenting individuals in a sample based on their transportation types. Moreover, since the data set is short, the conclusions are limited and, in order to generalise, a panel data set would be necessary. However, the exploratory nature of the research, limited budget and pressure of time in which to collect the data justify this cross-section format. Nonetheless, the behaviour identified in the present research is found to be consistent with earlier research findings. In addition, more segments may exist in the sample, but the limited data set restricts their estimation. Additional preferences and other constraints not accounted for in this analysis may explain the behaviour; therefore, future research should embrace a critical, more detailed data set and a process-oriented simulation analysis.

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3. Synchronism in Portuguese Housing[2]

3.1. Introduction

In recent years, especially after the financial crisis, several advanced economies saw their house prices increasing (IMF, 2018). According to OECD (2019), the gap between house prices and consumer price index inflation widened in the early 2000s, it lessened during the global financial crises, and it has broadened after that. On average, house prices have grown twice as fast as inflation in the last two decades; they have also grown more quickly than median incomes.

In this chapter, we are concerned with the dynamics of housing prices in Portugal. To be more precise, we first study housing price synchronization between Portugal and other countries, detecting which international markets are more interconnected with the Portuguese. Second, we perform a similar analysis between Portuguese cities. We will rely on wavelet analysis, which will allow us to examine the evolution and find relationships at different frequencies.

Housing has some peculiar characteristics, such as its durability. A house satisfies the basic need for shelter, security, personal space, and privacy, but, being a durable good, it is also an instrument of wealth accumulation, long-term investment, and collateral for lending. Correspondingly, there are two housing markets with blurred boundaries: one for the investment good (the housing stock) and the other for the consumer good (the housing services) (Arnott, 1987; Coakley, 1994; Fallis, 1985; Maclennan, 1979; Meen, 1996; Smith et al., 1988). Therefore, housing demand depends on permanent income, wealth, credit constraints, portfolio decisions, and financial-market dynamics. Thus, expectations about future price movements, risk diversification, and return rates on alternative investments are important (Adair et al., 1999; Coakley, 1994; Fallis, 1985; Whitehead, 1999; Yang et al., 2018).

Between 1950 and 2015, housing assets in several advanced economies exhibited an average annual real return similar to equity investments, between 5 percent and 8 percent, but with a lower standard deviation (IMF, 2018; Jordà et al., 2017, 2019). Consequently, real estate has become more significant as store-of-value and housing-based wealth achieved records (Fernandez & Aalbers, 2016).

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Another notable feature of housing is its spatial fixity. Gotham (2009) defines spatial fixity as "a condition of non-exchangeability, non-transferability, immobility, illiquidity and long turnover times between buying and selling." It is why we traditionally look at housing markets as local markets (Aalbers, 2016; Bardhan & Kroll, 2007; Case et al., 2000; de Bandt et al., 2010; Ley, 2015; Pow, 2017; Vansteenkiste & Hiebert, 2011). However, real estate knows geographic substitutability as an asset for investment and, actually, the housing market has increasingly become an international market (Büdenbender & Golubchikov, 2017; Clerc, 2019; Fields, 2015; IMF, 2018; Ley, 2015; Pow, 2017; Rogers & Koh, 2017; Ronald & Dewilde, 2017).

Global investors' existence in housing markets is associated with increased housing price synchronization, especially at the city level. Studying price synchronization between different housing markets is, therefore, a very relevant matter. It suggests that global investors and global financial conditions may influence local housing price dynamics, which has implications for the effectiveness of a range of policy tools to address imbalances in the housing market, namely affordability problems (Alter et al., 2018; Duca, 2020; Hoesli, 2020; IMF, 2018; Katagiri, 2018).

3.2. Literature review

As an autonomous and separate area of study, housing economics progressed in the 1970s and has grown significantly since then and covered a wide range of topics (Arnott, 1987; Maclennan, 1979; O'Sullivan & Gibb, 2003; L. B. Smith et al., 1988).

In the vast majority of OECD countries, house prices have increased sharply between the mid-1990s and the early 2000s (Girouard et al., 2006; Igan & Loungani, 2012; Miles, 2017). In the United States, they started falling in 2006, causing the 2008 subprime mortgage crisis, which evolved into a global economic crisis and caused a worldwide collapse of housing prices (Flor & Klarl, 2017; Hirata et al., 2012; Kuang & Wang, 2018; Muellbauer & Murphy, 2008; Ryczkowski, 2019). In recent years, housing has experienced a rise in its price in many countries. These developments have generated a research agenda on the comovement of housing prices across countries or cities (Beltratti & Morana, 2010; Gupta et al., 2015; Hoesli, 2020; IMF, 2018, 2019; Miles, 2017).

Demand and supply determine housing prices. Therefore, in the long run, housing prices should reflect market fundamentals. Several studies relate housing prices to household (permanent) income and wealth, mortgage interest rates, financial conditions, leverage, costs of land acquisition and construction, tax and other policies, and structural factors as demographics or urbanization (Duca, 2020; Geng, 2018; Girouard et al., 2006; Gupta et al., 2015; Igan & Loungani, 2012; IMF, 2018, 2019; Kishor & Marfatia, 2017; Marfatia, 2018). Housing prices synchronization may be, therefore, the result of the comovement in economic fundamentals, either real macroeconomic or financial variables, across countries and regions (de Bandt et al., 2010; Duca, 2020; IMF, 2018; Miles, 2017; Terrones & Otrok, 2004; Vansteenkiste & Hiebert, 2011).

In industrial countries, real housing prices are procyclical; reflecting household's disposable income and employment prospects, they rise in a boom and fall in a recession (Davis & Nieuwerburgh, 2015; Hwang & Quigley, 2006; IMF, 2018; Leung, 2004; Terrones & Otrok, 2004). Between 1970 and 2000, for the OECD as a whole, business-cycle and house-price turning points have roughly coincided (Girouard et al., 2006). Some authors have documented an increase in business cycle synchronization (Aguiar-Conraria et al., 2017; Aguiar-Conraria & Soares, 2011b; Belke et al., 2017; Bordo & Helbling, 2003; Fidrmuc et al., 2012; Kose et al., 2008, 2012).

User cost of capital is another demand driver of housing prices. We usually define the deal user cost of capital as the after-tax mortgage nominal interest rate plus property taxes, insurance costs, and physical depreciation minus expected house price appreciation (Duca, 2020; Duca et al., 2011; Meen, 1990, 1996; Muellbauer & Murphy, 2008; Poterba, 1984). Investors' projections concerning house price appreciation in one country may be revised given expectations on other countries house prices so that synchronicity may be a consequence of harmonized prospects on the development of housing markets across several countries (Beltratti & Morana, 2010; de Bandt et al., 2010; IMF, 2018; Vansteenkiste & Hiebert, 2011).

On the other hand, comovement in housing prices may also be the result of simultaneous changes to financial factors: global financial conditions, portfolio channels, and expectations contribute to housing prince synchronization (Alter et al., 2018; Claessens et al., 2011; Helbling & Terrones, 2003; IMF, 2018; Terrones & Otrok, 2004). Financial conditions refer to the costs, conditions, and availability of funds to the economy (IMF, 2017). They are an influential variable on housing prices (Agnello & Schuknecht, 2011; Baffoe-Bonnie, 1998; Cesa-Bianchi et al., 2015; Englund & Ioannides, 1997; Favara & Imbs, 2015). According to Del Negro et al. (2019), trends in real interest rates across advanced economies have converged over the past three decades, and country-specific trends have all but vanished since the 1970s. Other several studies have shown that different channels transmit financial conditions across countries, so that global factors significantly explain them (Baskaya et al., 2017; Bruno & Shin, 2013, 2015a, 2015b; Caceres et al., 2016; Calvo et al., 1996; IMF, 2016; Miranda-Agrippino & Rey, 2020; Rey, 2015).

Furthermore, for some housing markets, cross-border transactions appear to explain housing prices synchronization (Alter et al., 2018; Badarinza & Ramadorai, 2018; Duca, 2020; Hekwolter of Hekhuis et al., 2017; IMF, 2018; Katagiri, 2018).

Despite this conceptual framework, housing prices synchronization, which refers to the more significant correlation or comovement of house prices across geographic entities, is mainly an empirical question. It is the first step to assess the degree of synchronization (Gupta et al., 2015; Hoesli, 2020).

The comovement of housing prices has been investigated at the regional level, for which there are established empirical literature, concentrated mainly in the United Kingdom. Within the framework of cointegration, several authors have studied the structure of regional house prices within the United Kingdom, finding the existence of long-run relationships between regional house prices and the ripple effect, that is, the notion of a causal link from house prices in London and the South East to other regions (Alexander & Barrow, 1994; Cook, 2003, 2005; Giussani & Hadjimatheou, 1991; Holmes, 2007; Holmes & Grimes, 2008; MacDonald & Taylor, 1993; Meen, 1999; D. Zhang, 2010); the same conclusion has been reached using other methods and econometric approaches (Cameron et al., 2006; Cascio, 2020; Cook & Thomas, 2003; Holly et al., 2011; Hudson et al., 2018; Kyriazakou & Panagiotidis, 2014; Morley & Thomas, 2011; Muellbauer & Murphy, 1994; Tsai, 2015). However, evidence on the existence of regional house prices convergence is mixed, and some papers have failed to support the ripple effect (Abbott & de Vita, 2013; Ashworth & Parker, 1997; Chowdhury & Maclennan, 2014; Drake, 1995; Hamnett, 1989; Rosenthal, 1986)

From the late 1990s onwards, some studies examining the inter-linkages between regional and local housing markets in the United States, focusing on price diffusion's general issue have been undertaken, also with mixed evidence (Apergis & Payne, 2012; Barros et al., 2012; Canarella et al., 2012; Clapp & Tirtiroglu, 1994; Clark & Coggin, 2009; Flor & Klarl, 2017; Gupta & Miller, 2012a, 2012b; Holly et al., 2010; Holmes et al., 2011; Kim & Rous, 2012; Payne, 2012; Pollakowski & Ray, 1997; Vansteenkiste, 2007; Zohrabyan et al., 2008)

Housing prices comovement has also been studied within several other countries, like Australia (Bangura & Lee, 2020; Churchill et al., 2018; Liu et al., 2008; Luo et al., 2007; Tu, 2000), Canada (Grigoryeva & Ley, 2019), China (Chiang, 2014; Huang, Li et al., 2010; Huang, Zhou, et al., 2010; Weng & Gong, 2017; F. Zhang & Morley, 2014; L. Zhang et al., 2017), Finland (Oikarinen, 2005), Ireland (Stevenson, 2004), Malaysia (Lean & Smyth, 2013), South Africa (Balcilar et al., 2013; Burger & Van Rensburg, 2008), Spain (Blanco et al., 2016; Larraz-Iribas et al., 2008; Taltavull de La Paz et al., 2017), Taiwan (Chen et al., 2011; Chien, 2010; C. C. Lee & Chien, 2011; M.-T. Lee et al., 2014), The Netherlands (Klarl, 2018; Teye et al., 2017)

Several other studies investigate housing markets spillovers across countries, namely industrial countries, and advanced economies, providing evidence that housing prices were often synchronized and that the degree of synchronization has been rising (Alter et al., 2018; Beltratti & Morana, 2010; Case et al., 1999; de Bandt et al., 2010; Gros, 2006; Helbling & Terrones, 2003; Hirata et al., 2012; Hoesli, 2020; IMF, 2018; Katagiri, 2018; Otrok & Terrones, 2005; Terrones & Otrok, 2004). Especially for the euro area, a different result has been attained by several authors (Álvarez et al., 2010; Gupta et al., 2015; Henley & Morley, 2000; Miles, 2017, 2019; Vansteenkiste & Hiebert, 2011).

3.3. Data and Methods

3.3.1. Data

To perform cross-country analysis, studying housing price synchronization between Portugal and other countries, and detecting which international markets are more interconnected with the Portuguese, we need a dataset on house prices as homogeneous as possible. *Bank for International Settlements* (BIS) publishes statistics on residential property prices for several countries in the world. They derive their selected series from the detailed data set and harmonized it following the *Handbook on Residential Property Prices Indices* (Eurostat, 2013). They offer the indicator closest to nationwide coverage for each jurisdiction and typically include all types of dwellings (new and existing). We opted for the Real Residential Property Prices Index (2010=100), computed by deflating the nominal residential property price series with the Consumer Price Index. The data set has a quarterly frequency.

For Portugal, the BIS data only refers to 2008 onwards; instead, we use the series obtained from *Confidencial Imobiliário*, starting in 1988. This data set comprises the eighteen district capitals, covering the period 1988:Q1-2020:Q1. Computing a simple average for those cities, we have determined a correlation coefficient of 0,94 with the BIS series. Therefore, in our cross-country analysis, we have employed this constructed Portuguese housing price index. Our sample includes eleven other European Union Member States. Data from 1988 was available for Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Spain, Sweden, and the United Kingdom.

We also used the data set from *Confidencial Imobiliário* to analyze comovement between Portuguese cities' housing prices.

3.3.2. Empirical strategy: wavelet analysis

Fourier spectral analysis can be (and has been) used to determine which frequencies play a predominant role in explaining the time-series overall variance. It decomposes the observed pattern over time into a spectrum of cycles of different lengths. It is similar to a prism, which decomposes light into a spectrum of colors of different frequencies. The term white noise to describe independent and identically distributed variables comes from the fact that such a process has a flat power spectral density, a white light characteristic.

The main advantage of wavelet analysis is that we estimate time-series spectral characteristics as a function of time, revealing how its different periodic components change over time. To access the synchronicity of housing price cycles, we will rely on the Continuous Wavelet Transform and several wavelets tools associated with it. We refer the reader to Aguiar-Conraria et al. (2012, 2013) for an intuitive introduction to this technique and its applications to Social Science data. For detailed technical treatment, the reader may consult Aguiar-Conraria and Soares (2014).

This chapter will rely on four main tools: the Wavelet Power Spectrum, the Wavelet Coherency, the Wavelet Phase-Difference, and the wavelet de-synchronization matrix.

A wavelet is a function with mean zero (implying that it has to wiggle up and down) and well-localized in time (e.g., have fast decay), behaving like a small wave that loses its strength as it moves away from the center, hence the term choice wavelet, little wave. We use the most popular wavelet, the Morlet wavelet. Aguiar-Conraria and Soares (2014) show that this specific wavelet has optimal features to study oscillations.

The continuous wavelet transform of a time series x(t) with respect to the wavelet is a function of two variables, $W_x(\tau, s)$: $W_x(\tau, s) = \int_{-\infty}^{\infty} x(t) \frac{1}{\sqrt{s}} \bar{\varphi}\left(\frac{t-\tau}{s}\right) dt$. The bar denotes complex conjugation, s is a scaling or dilation factor that controls the wavelet's width, and τ is a translation parameter controlling the wavelet's location.

In analogy with the terminology used in the Fourier case, the (local) wavelet power spectrum is defined as $WPS_x(\tau, s) = |W_x(\tau, s)|^2$.

It gives us a measure of the variance distribution of the time series in the time-frequency plane. With this tool, like with the Fourier power spectrum, we describe each frequency's contribution to the overall variance. Additionally, we can say when that contribution is the largest. In our pictures, the regions where the power spectrum, and hence the volatility, is larger are depicted with lighter colors.

The concepts of cross wavelet power, wavelet coherency, and phase-difference enable us to deal with relations between two time series. The cross-wavelet transform of two time-series, $x(t)$ and $y(t)$, is defined as $W_{xy}(\tau, s) = W_x(\tau, s)\bar{W}_y(\tau, s)$. The cross-wavelet power of two time-series, $|W_x(\tau, s)|$, depicts the local covariance. Compared with the cross wavelet power, the wavelet coherency, a concept akin to the correlation coefficient, has the advantage of being normalized by the two time-series power spectrum. In analogy with the concept of coherency used in Fourier analysis, given two time-series $x(t)$ and $y(t)$, one defines their wavelet coherency: $R_{xy}(\tau, s) = \frac{\left|S\left(W_{xy}(\tau,s)\right)\right|}{\sqrt{\left|S(W_{xx}(\tau,s))S\left(W_{yy}(\tau,s)\right)\right|}}$, where S denotes a smoothing operator in both time and scale.

Using a complex-valued wavelet, we can compute the phase of the wavelet transform of each series and thus obtain information about the possible delays of the two series' oscillations as a function of time and frequency by computing the phases and the phase difference, also known as the phase angle. A phase difference of zero indicates that the time series move together at the specified frequency. A phase-difference between 0 and $\pi/2$ indicates that the two series move in-phase (positive correlation), with *x* leading *y*; while if the phase-difference is between 0 and $-\pi/2$, then it is *y* that is leading. A phase-difference between $\pi/2$ and π indicates that the series move out-of-phase (negative correlation), with *x* lagging *y*; while if the phase-difference is between $-\pi$ and $-\pi/2$, then it is *y* that is lagging.

Finally, we will also measure the dissimilarities between the wavelet transform of two time-series proposed by Aguiar-Conraria and Soares (2011a). Several authors have successfully applied this tool to study cycle synchronization. The most relevant is Flor and Klarl (2017), who also study the synchronization of house prices (in the United States' metropolitan areas).

The closer to zero our measure of distance is, the more similar are the wavelet transforms of $x(t)$ and $y(t)$. To be more precise, a value close to zero means that the two regions have a very similar wavelet transform. In turn, this implies that the contribution of house price cycles at each frequency to the total variance is similar between both regions; this contribution happens simultaneously. Finally, the ups and downs of each cycle coincide.

3.4. Results

In this section, we present our results. We start by estimating the Portuguese Housing Prices index's wavelet power spectrum to get a sense of the dominant cycles that we can identify in this data.

In subsection 3.4.2, we analyze how the Portuguese index is synchronized with a sample of other EU countries (including the UK). We first estimate the "distance" between the wavelet transform of Portuguese prices and other countries' prices — one pair at a time. To assess if synchronization is statistically significant, we rely on Montecarlo simulations, considering two independent time series as the null hypothesis.

Then, we perform a more detailed analysis by estimating the wavelet coherency and the phase-difference between Portuguese prices and the prices of a sample of selected countries. For statistical significance, we rely on Montecarlo simulations. The interpretation of our econometric results proceeds as follows. First, we identify the statistically significant time-frequency regions, meaning that, in those episodes, we may confidently say that there has been a considerable comovement of the variables for cycles of the indicated period. Then, we analyze the phase differences to detect whether the comovement has been positive or negative and which countries were leading and lagging for the statistically significant locations.

In section 3.4.3, the analysis is similar, but instead of analyzing synchronization between countries, we do it for Portuguese cities.

3.4.1. The Wavelet Power Spectrum

In Figure 1, we can see, on the top, the Portuguese House Price Index (we consider the year-on-year growth rate). At the bottom, we have the wavelet power spectrum.

Lighter regions correspond to areas of high wavelet power (high volatility). We have the date on the horizontal axis; we have the cycle period on the vertical axis. They range from 1-year cycles (on top) to 16-year cycles (in the bottom). The white stripes correspond to the wavelet power spectrum's local maxima, providing an estimation of the period of the dominant cycles. The thick black contour designates the (5%) statistically significant regions.

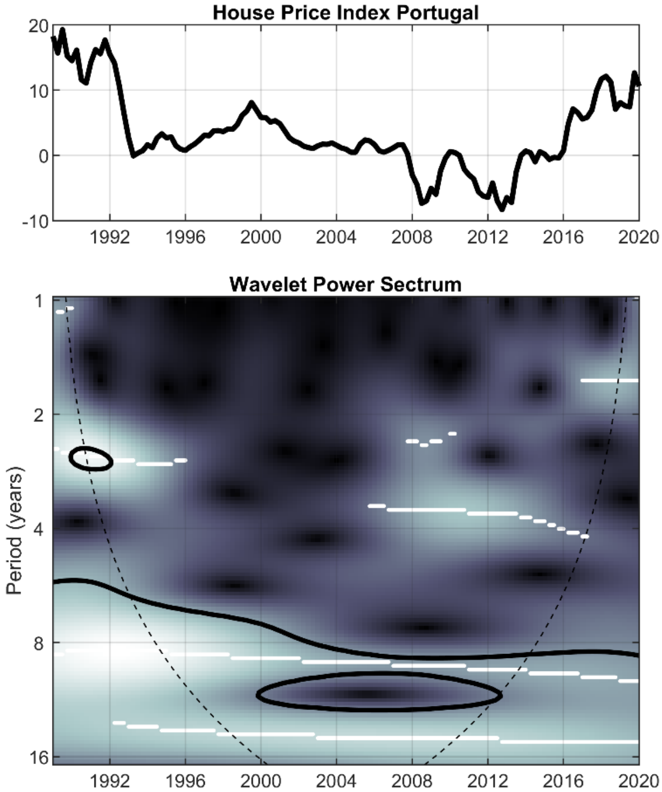

Figure 1. On the top: time series plot. At the bottom: Wavelet power spectrum — the thick gray contour designates the 5% significance level. The shade code for power ranges from black (low power) to white (high power). The cone of influence, which indicates the area affected by edge effects, is the region outside the dashed line.

We can identify two primary cycles in the data that almost run the whole sample, which superimpose each other: one with a period of about nine years and the other with about 14 years. Note that these primary cycles are statistically significant. A shorter run cycle, almost 4-years period, shows up around the 2008-2012 period, corresponding to the international financial crises and the subsequent sovereign debt crisis — although it is not significant at 5%, it is at 10% (not shown).

3.4.2. Synchronization between Portugal and other countries

In Table 3, we show the dissimilarity between the Portuguese housing cycles and several other countries. A value very close to zero means that the two countries have a very similar wavelet transform; this implies that they share the same high power regions and that their phases are aligned. Intuitively, this means that the contribution of cycles at each frequency to the total variance is similar between both countries. This contribution happens simultaneously, and the ups and downs of each cycle co-occur. It is in this sense that we say that the two countries have synchronized cycles.

Table 3. De-synchronization between Portugal other countries

	Portugal
United Kingdom	*0.17*
Italy	*0.20*
Spain	*0.21*
France	*0.23*
Belgium	*0.24*
Sweden	*0.28*
Germany	*0.28*
Denmark	*0.35*
Ireland	*0.35*
Netherlands	*0.39*
Finland	*0.43*
Legend	*1%*
	5%

Portugal is almost synchronized with the housing market in the UK. Italy, Spain, and France come next. In Figure 2, we have the estimated coherencies between Portugal and the first four countries. Wavelet coherency is akin to the absolute value of the correlation coefficient but in the time-frequency plane. Lighter regions correspond to areas of high coherency. On the right, we have the phase difference for two frequency bands. The first frequency band, 1~8-years, corresponds to the typical business cycle frequencies. The second band, 8~16-years, corresponds to longer and more structural cycles.

The country which has the largest regions of statistically significant coherency with Portugal is Spain. Until the early 2000s, there is a region of high coherency between the 4 and 8-years frequencies. The corresponding phase difference is between $-\pi$ and 0, meaning that the correlation is positive, with Spanish prices leading the Portuguese prices. After that, we can see regions of high coherencies both at higher and lower frequencies. In both of them, the phase difference indicates that Spain is the leader and Portugal the follower. The behaviour of house prices in Portugal and Spain is investigated by Lourenço and Rodrigues (2014); using three different approaches, these authors draw some conclusions regarding the dynamics and contrast of house prices in both countries.

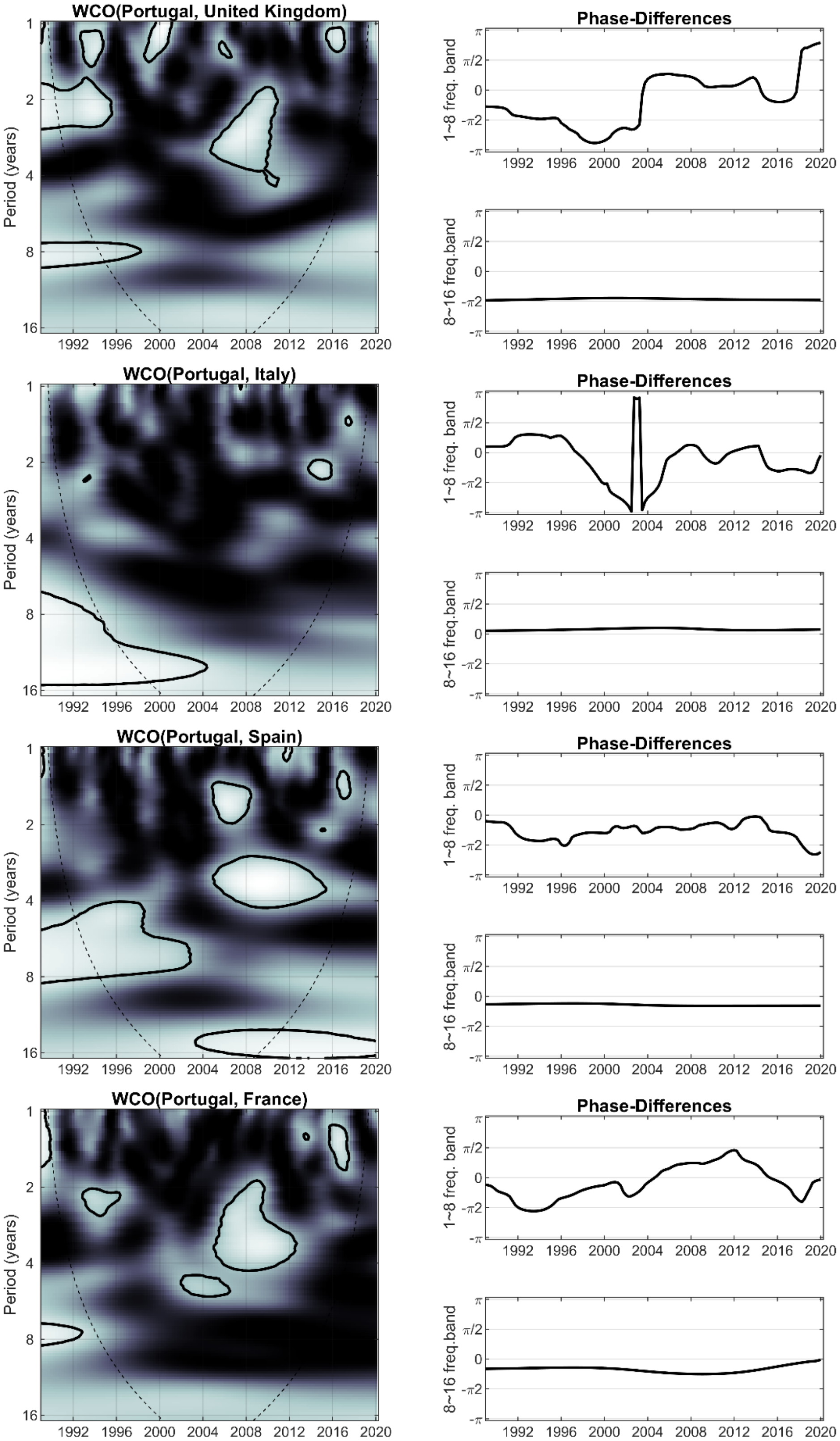

Figure 2. On the Left: Cross-Wavelet Coherency between Portugal and other countries. On the right: Phase-Difference. Wavelet Coherency: The black contour designates the 5% significance level. The shade code for coherency ranges from black (low coherency – close to zero) to white (high coherency – close to one). The cone of influence, which indicates the area affected by edge effects, is the dashed line's outer region.

With the other countries, the regions of high coherency are much scarcer. Between Portugal and the UK and between Portugal and France, the most impressive high coherency areas happen around 2008 at business cycle frequencies. Interestingly, the phase difference for these frequencies tells us that Portugal is leading.

Between Portugal and Italy, the only region of high coherency happens at very low frequencies and lasts until 2004. During this time, the Portuguese cycle led the Italian one. However, there are no more regions of statistically significant coherencies.

We leave for future research trying to understand the determinants of such synchronicity between countries. Obvious candidates are distance, business cycle synchronization, general prices synchronization, emigration destination, and tourism flows.

Regarding the first three possible determinants, we did perform some exploratory analysis. Given that we are working with 12 countries, we have 66 pairs. The Spearman's correlation coefficient between the housing prices cycle dissimilarities and the physical distances between countries (distance between capitals) is 0.15. We also estimated the business cycle dissimilarities between countries (using data on real GDP) and found no correlation with housing prices cycle dissimilarities. Interestingly, the correlation between housing prices and general prices cycle dissimilarities is 50%. This result comes as a surprise because, in our data, house prices are in real terms.

3.4.3. Synchronization between Portuguese cities

We now focus on Portuguese cities. We start by estimating the de-synchronization index between the cities. Given the number of cities, 18, we have 153 pairs. It would not be reasonable to display a table with all these values. Alternatively, we use the dissimilarity matrix as a distance matrix and map the cities in a two-axis system. The idea is to reduce the dissimilarity matrix to a two-column matrix, the configuration matrix, containing each city's position in two axes.[3] This algorithm results in the map we can see in Figure 3.

The first thing to note is that this map is not similar to Portugal's geographical map. We can confirm this impression by computing the correlation between cycle distances and the physical distances between Portuguese cities. The Spearman's correlation

[3] We use (Kruskal 1964a, 1964b)'s stress algorithm and minimize the square differences between the distances in the map and the wavelet dissimilarities.

coefficient is -0.0266. Therefore, location does not seem a factor in explaining synchronicity between Portuguese cities.

The second result is that a few cities are quite de-synchronized with the rest of the country. Braga is the most obvious outlier, but the same is true for Santarém, Portalegre, and Leiria and Setúbal — these last two form a cluster of their own.

The other cities are reasonably well synchronized between themselves. It is easy to identify some subclusters. Lisbon, Porto, and Faro, the three Portuguese capitals with international airports (we do not include the islands in our sample), are synchronized.

Like the one formed by Aveiro, Bragança, Coimbra, and Guarda, other subclusters are easy to identify with the hierarchical tree clustering that we produced in Figure 4.

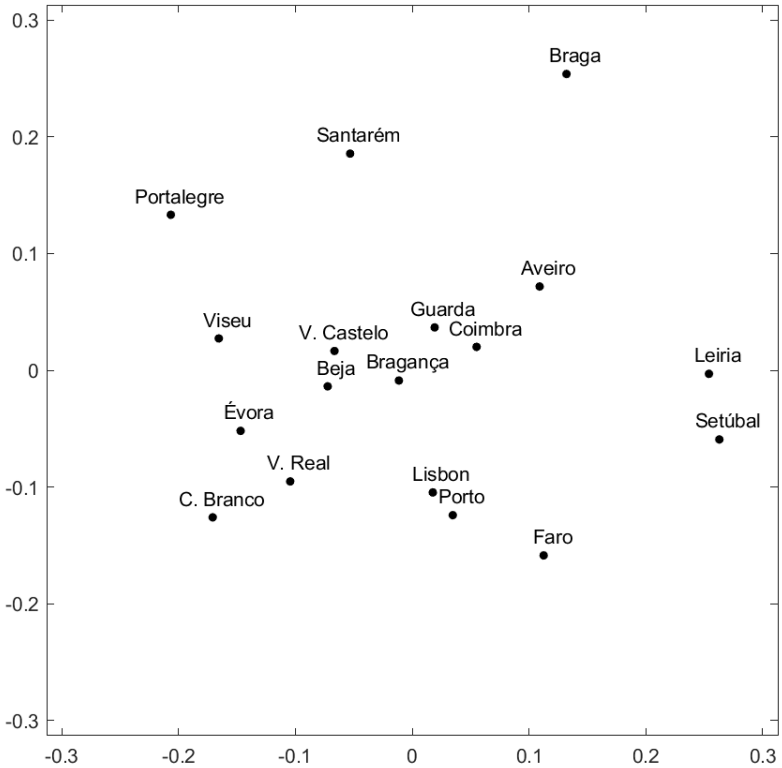

Figure 3. Multidimensional Scaling Map

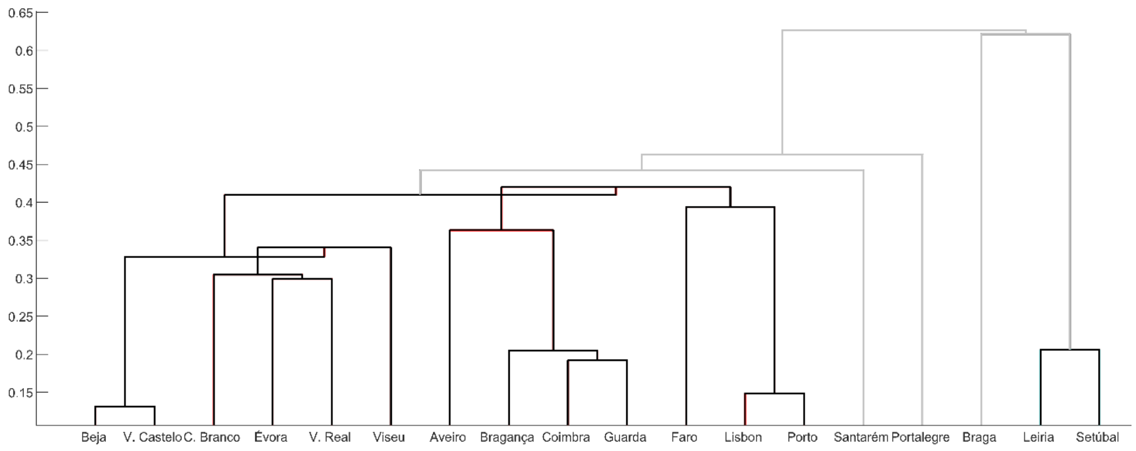

Figure 4. Hierarchical Tree Clusters

In Figure 5, we have the wavelet coherency and phase difference for a few pairs of cities. Lisbon-Porto and Lisbon-Faro (because these cities form a subcluster with the capital of Portugal, Lisbon); Viana do Castelo and Beja because this is the most synchronized pair; and Leiria and Viseu (the least synchronized pair).

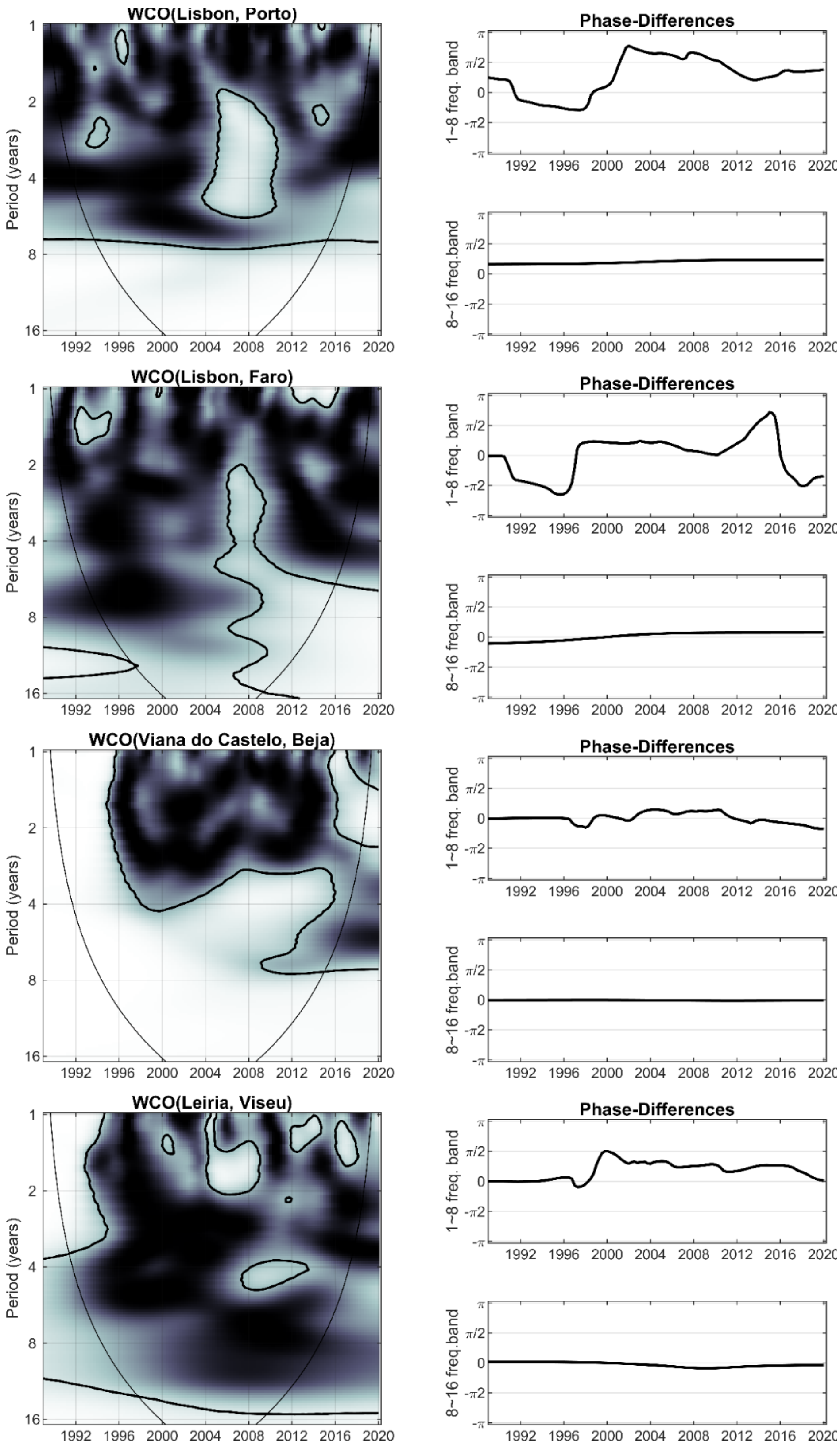

Figure 5. On the Left: Cross-Wavelet Coherency between Portuguese cities. On the right: Phase-Difference. Wavelet Coherency: The black contour designates the 5% significance level. The shade code for coherency ranges from black (low coherency – close to zero) to white (high coherency – close to one). The cone of influence, which indicates the area affected by edge effects, is the dashed line's outer region.

The coherency between the two most important Portuguese cities, Lisbon and Porto, reveals that the two capitals are synchronized at lower frequencies (longer run cycles). The phase difference informs us that the Lisbon cycle leads the one from Porto. However, at higher frequencies, the cycles may diverge from each other. We see a region of high coherency around the year 2008, in the 2~6-years frequency band. What is particularly interesting is that the phase difference reveals that the correlation is negative. Therefore, it is possible to have longer run aligned cycles while shorter run cycles are misaligned. The second picture shows that Lisbon and Faro became very synchronized after 2005, with Lisbon leading.

Comparing the third and the fourth pairs, we can see the difference between the most and the least synchronized pairs. Viana do Castelo and Beja's wavelet coherency is consistently high at several frequencies. The phase differences are very close to zero, suggesting that the cycles are almost simultaneous in both towns.

In Leiria and Viseu's case, the least synchronized pair, high coherency regions are much scarcer. However, it is still remarkable that coherency is very high and statistically significant at very low frequencies, meaning that even these two cites exhibit a common long-run cycle.

3.5. Conclusions

In this chapter, we were concerned with the dynamics of Portugal's housing prices, which have increased in recent years. The rise has been a feature of the economic recovery in several countries after the financial crisis. On average, in OECD countries, house prices have grown quicker than median incomes. Simultaneously, the housing market has increasingly become an international market, and there are claims that foreign residential investments have been driving up housing prices. Consequently, there has been an intense public debate on housing affordability and global real estate investment.

Global investors' existence in housing markets is also associated with increased housing price synchronization, especially at the city level. In this chapter, we relied on the Continuous Wavelet Transform and several wavelets tools associated with it to study housing price synchronization between Portugal and other eleven European Union Member States (Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Spain, Sweden, and the United Kingdom), covering the period 1988-2019.

We detected two primary cycles in the Portuguese Housing Prices index's, one with about nine years and the other with a period of about 14 years; these two cycles almost run the whole sample and overlap. We also identify a shorter run cycle, almost four years, corresponding to the international financial crises and the subsequent sovereign debt crisis (2008-2012).

We then estimated the "distance" between the wavelet transform of Portuguese prices and other countries' prices. The British housing market is the one Portugal is most synchronized with. Italy, Spain, and France come next. So, we have estimated the wavelet coherency and the phase-difference between Portuguese prices and those four countries' prices. This more detailed analysis has revealed that Spain is the country with which Portugal has the largest regions of statistically significant coherency. Until the early 2000s, there is a region of high coherency between the 4 and 8-years frequencies; after that, we can see high coherencies at higher and lower frequencies. The phase difference indicates that Spain is the leader and Portugal the follower. Concerning the other three countries, regions of high coherency are fewer. They exist around 2008, at business cycle frequencies, with the UK, and with France.

Interestingly, the phase difference for these frequencies shows that Portugal is leading. The Portuguese cycle also led the Italian one. However, between Portugal and Italy, the only region of high coherency occurs at very low frequencies and lasts until 2004, existing no more regions of statistically significant coherencies.

We have not explored the determinants of such synchronicity. According to the literature, distance, emigrant destination, and tourism flows (note that U.K., Spain, and France were the Portuguese top 3 outbound tourism markets in 2019) are factors to consider. However, we leave this examination for future research. The way that globalization and financialization influence national housing price dynamics is a very relevant matter. It may have implications for the effectiveness of a range of policy tools to address imbalances in the housing market, namely affordability problems.

This analysis has also been conducted focusing on Portuguese cities. To be more precise, we start by estimating the de-synchronization index between the 18 district capitals. Our results can be summarised as follows. Braga, Santarém, Portalegre, Leiria, and Setúbal are quite de-synchronized with the rest of the country (the last two form a cluster of their own). Despite the other cities being relatively well synchronized between themselves, one can distinguish some subclusters, namely the one formed by Lisbon, Porto, and Faro (the three district capitals with international airports) or the subcluster constituted by Aveiro, Bragança, Coimbra, and Guarda. Once again, we have not tried to explain such synchronicity except for the physical distances. These are not correlated with cycle dissimilarities, suggesting that location does not explain synchronicity between Portuguese cities; other determinants must be found.

Following, we have estimated the wavelet coherency and phase difference for a few pairs of cities. The two most important Portuguese cities, Lisbon and Porto, are synchronized at longer run cycles, with the Lisbon cycle leading the one from Porto. However, at higher frequencies, the cycles may diverge from each other, and the correlation is negative. Therefore, it is possible to have longer run aligned cycles while shorter run cycles are misaligned. Lisbon and Faro became very synchronized after 2005, with Lisbon leading. Viana do Castelo and Beja is the most synchronized pair; its wavelet coherency is consistently high at several frequencies. The phase differences are very close to zero, suggesting that the cycles are almost simultaneous in both towns. Regarding Leiria and Viseu, the least synchronized pair, high coherency regions are rarer. However, they still exist at very low frequencies, meaning that even these two cities exhibit a common long-run cycle.

These results suggest that the Portuguese housing market is segmented and exhibits regional heterogeneities. Knowing that Portuguese cities' housing cycles may be de-synchronized, housing policies should be designed locally.

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4. Are House Prices Cycles Synchronized with Tourism?[4]

Abstract: This paper investigates the interplay between tourism and housing prices in 11 European countries, with a special focus on Germany, Italy, France, and the UK, using quarterly data from 1990Q1 to 2019Q4. We employed the wavelet power spectrum to examine housing price patterns and synchronizations, and did the same for nights spent at tourist accommodation establishments. Our results show that the two markets exhibit distinct cycles and synchronizations. We further studied the relationship between both markets by estimating the wavelet coherency between house prices and tourism. After incorporating real GDP growth into the wavelet coherency analysis, we found that most correlations were consistently low across various frequencies and that the small regions of high coherency further diminished. Based on these findings, we infer that tourism is unlikely to be a significant driving force behind the fluctuations observed in housing prices in these nations.
Keywords: Tourism, Housing Prices, Wavelet Analysis, European countries.

4.1. Introduction

Theory recognizes the direct and indirect effects of tourism on the housing market (Biagi et al., 2012; Churchill et al., 2022; Y. Liu et al., 2020; Song et al., 2023; J. Zhang, 2023). First, tourism generates economic growth and, as a labor-intensive industry, creates jobs; this increase in income raises the demand for housing and housing prices. Second, housing prices are influenced by local amenities, which may be enhanced by tourism. Third, tourism increases the demand for land and existing housing stock, leading to higher housing prices. However, empirical literature on the subject is limited, and papers performing a cross-country analysis of this nexus are scarce.

Europe is the most visited region worldwide. In 2019, France, Spain, and Germany occupied the first three places in the World Economic Forum Travel & Tourism Competitiveness Index. According to WTTC data, in 2019, tourism contributed to 9% of Europe's GDP and was responsible for 10% of jobs. On the other hand, concerns about the impact of tourism on housing affordability are rising (Bivens, 2019; Churchill et al., 2022; Meleddu, 2013; Mikulić et al., 2021; Paramati & Roca, 2019). This paper aims at

[4] This chapter was submitted to *Tourism Management* as an article.

exploring the relationship between tourism and housing prices in eleven European countries. We adopt a wavelets approach, which operates in the time-frequency domain, revealing the temporal evolution of the various periodic components of a time series. To the best of our knowledge, we are the first to apply this methodology to investigate the relationship between tourism and housing prices.

Our study examines the relationship between tourism and housing prices in eleven European countries, focusing on the four largest. We use a wavelet approach to study time-frequency domain patterns. This is a novel application of the wavelet method in this context and a particularly useful one. As argued by Miles (2017:29), it 'would be desirable for a measure of co-movement to be time-varying.' Furthermore, another 'desirable feature of any such metric would be the ability to distinguish differences in the phase of cycles from differences in magnitude.' Our tools, based on the Continuous Wavelet Transform, precisely fulfill these criteria.

We initially use the wavelet power spectrum to identify and characterize the prevailing cycles in housing prices, doing so for each country individually. Following this, we employ a wavelet transform dissimilarity matrix to study synchronization among the different countries. This, in itself, is a contribution to the literature on international house price comovements (Duca, 2020; Gupta et al., 2015; Hirata et al., 2012; Hoesli, 2020; IMF, 2018, 2019; Miles, 2017, 2019). We will show that there is a strong comovement between Italy, France, Belgium, Spain, the UK, and Portugal, and, to a lesser degree, with Sweden. The remaining countries exhibit fewer statistically significant relationships.

We perform a similar analysis for tourism markets (namely the number of nights spent in tourist accommodations). The literature on this issue is not as rich, which is surprising, as it would provide valuable clues on whether some tourist destinations are complements or substitutes, which could inform both official and private marketing campaigns, for example (Cao et al., 2017). We identify a number of countries with significant comovement: Germany, Italy, the Netherlands, Portugal, Spain, and Sweden. Finland and Belgium may also be considered, but to a lesser extent. Notably, France and the United Kingdom are not part of the core. Our findings indicate that the synchronization patterns identifiable in one market do not correlate with those in the other.

Finally, we explore the dynamic interrelations existing between the two markets. For each country, we estimate the wavelet coherency between house prices and tourism flows and partial wavelet coherency between the same variables, but controlling for GDP growth. Our findings assert that fluctuations in housing prices cannot be directly and unequivocally attributed to variations in tourism inflow.

Our study examines the relationship between tourism and housing prices in eleven European countries, focusing on the four largest. We use a wavelet approach to study time-frequency domain patterns. This is a novel application of the wavelet method in this context.

We initially use the wavelet power spectrum to identify and characterize the prevailing cycles in both the housing and tourism markets, doing so for each country individually. Following this, we employ a wavelet transform dissimilarity matrix to study synchronization among the different countries within each market. Our findings indicate that the synchronization patterns identifiable in one market do not correlate with those in the other. Finally, we explore the dynamic interrelations existing between the two markets. For such, for each country, we estimate the wavelet coherency between house prices and tourism flows and partial wavelet coherency between the same variables, but controlling for GDP growth. Our findings assert that fluctuations in housing prices cannot be directly and unequivocally attributed to variations in tourism inflow.

Our research enriches the field of tourism studies by delving into the impacts of tourism, with a focus on its negative externalities. It also holds significance in Housing Economics, enhancing understanding of the factors influencing housing prices. Consequently, this study offers valuable insights for both researchers and policymakers.

The paper is structured as follows: Section two contains the literature review; Section three outlines the wavelet tools we employ; data is described in Section four. Our results and their discussion are in Section five, and Section six provides the conclusion.

4.2. Tourism and housing prices: a literature review

In the scholarly literature on economics, three primary mechanisms have been identified by which tourism influences housing prices, with two of these operating indirectly.

First, a large body of literature has investigated the relationship between tourism and economic growth, supporting the so-called tourism-led growth hypothesis (see Ahmad, 2020, Brida et al., 2016, and Comerio & Strozzi, 2019, for reviews). Another large body of literature has related housing prices to household income and wealth

(Girouard et al., 2006; Kishor & Marfatia, 2017). Thus, tourism indirectly elevates housing prices by boosting economic growth.

Second, housing is not a uniform good but rather heterogeneous, defined by attributes linked to its structure and surrounding (dis)amenities. Consequently, its price embodies the implicit value of each attribute (Can, 1992; Cheshire & Sheppard, 1995; Goodman, 1978, 1988). Tourism can thus influence housing prices by altering neighborhood features. Yet, Biagi et al. (2012), Časni & Filić (2022), and Song et al. (2023) contend that there is a paucity of research quantifying the impact of tourism amenities on housing prices.

Empirically, most studies using the hedonic pricing model focus on the influence of tourism facilities on touristic accommodation prices (Biagi et al., 2012; Churchill et al., 2022; Šimek et al., 2022). Research assessing the impact of tourism amenities on housing prices in tourist destinations usually targets singular facets, like airports (Chalermpong, 2010; Cohen & Coughlin, 2008; Limlomwongse Suksmith & Nitivattananon, 2015; Matos et al., 2013; Ngo et al., 2023; Pope, 2008), cultural heritage sites (Ahlfeldt & Maennig, 2010; Cebula, 2010; Lazrak et al., 2014; Manganelli et al., 2023; Moro et al., 2013), or golf courses (Asabere & Huffman, 1996; Do & Grudnitski, 1995; Pompe & Rinehart, 2002). Schäfer & Hirsch (2017) evaluated the effect of tourism hotspots (e.g., tourist attractions, restaurants, hotels) on housing rents. Their findings suggest a positive correlation between rents and a location's touristic appeal, though pinpointing the exact influence of urban tourism amenities remains challenging.

Finally, regarding direct effects, tourism has been a significant sector for property investment, as seen in the construction of tourist lodgings. Consequently, tourism increases the demand for land and housing, competing directly with local residents and leading to rising house prices and rents. These effects are influenced by factors including length of stay, leisure activities, and the dominant type of accommodation (Biagi et al., 2012; Časni & Filić, 2022; Churchill et al., 2022; K. Liu et al., 2020; J. Zhang, 2023). Several authors have examined the impact of the growing demand for holiday homes, concluding that it exerts pressure on local housing markets, especially in the presence of supply constraints typical in tourist destinations with natural or heritage attractions (FitzGerald, 2005; FitzGerald et al., 2003; Gallent & Tewdwr-Jones, 2001; Gill, 2000; Marjavaara & Müller, 2007; Shucksmith, 1983).

In recent years, short-term rentals have become a significant supplier of tourist accommodation. Accordingly, a body of literature studying their impact on housing prices has grown. Barron et al. (2018) explain that home-sharing platforms allow landlords to shift from long-term rentals to the short-term market. Given that the total supply of housing is fixed or inelastic in the short run, this shift increases the rental rate in the long-term market. Using a dataset for all of the United States from 2012-2016 and an instrumental variables estimation strategy, they found that Airbnb listings increase the supply of short-term rental units and decrease the supply of long-term rental units, driving up house prices and rents. This result aligns with others for various U.S. cities (BJH Advisors LLC, 2016; Coles et al., 2017; Horn & Merante, 2017; Lee, 2016; Sheppard & Udell, 2016; Wachsmuth et al., 2018; Zou, 2020), but contrasts with Garcia et al. (2021), who demonstrate, using data from Los Angeles County, that the impact of short-term rentals on housing prices depends on their effect on local amenities.

Following Barron et al. (2018) model, Benítez-Aurioles & Tussyadiah (2021) analysed borough-level data for London from 2016 to 2019. They concluded that the presence of Airbnb had an upward effect on both house prices and rents, particularly on the former. Coyle & Yeung (2016) discovered a positive correlation between Airbnb activities and rental prices in London. However, their findings differed for Berlin, suggesting that short-term rentals have varying effects on housing markets in different cities. In their study of Berlin, Schäfer & Braun (2016) confirmed that short-term rentals were concentrated in neighborhoods with high rental levels and robust rental growth. However, they acknowledged their inability to establish causality. Ayouba et al. (2020) found that the density of Airbnb rentals in Paris, Lyon, and Montpellier increased rental prices, but had no significant effect in five other cities. A greater effect was found when considering professional Airbnb rentals, but only for Paris and Marseille. Additionally, when focusing on new tenancy agreements, the effect was larger but limited to Paris, Marseille, and Montpellier. In Paris and Montpellier, Airbnb's impact was influenced by the proportion of owner-occupiers and inversely related to hotel density, while the impact of second homes was ambiguous. Other studies, including Garcia-López et al. (2020), Mozo Carollo et al. (2023), Rodríguez-Pérez de Arenaza et al. (2022), Sangers (2016), and Segú (2018), have primarily concentraded on European cities or regions. Franco et al. (2019) examined the impact of short-term rentals on the Portuguese housing market after the 2014 regulatory reform. They concluded that the effects were mainly localized to the historical centers and touristic areas of Lisbon and Porto. Several other studies, such as Cunha & Lobão (2022), Duso et al. (2020), Koster et al. (2021), Peralta et al.

(2023), and Valentin (2021), have utilized policy changes as natural experiments to estimate the impact of short-term rentals on housing markets.

Another strand of literature has investigated the relationship between housing prices and tourism at a more macro level. Using the hedonic princing model, Biagi & Faggian (2004) estimate the impact of the tourism sector, proxied by a composite tourism index, on house prices at municipality level in Sardinia. Their findings supported a positive correlation between the tourism orientation of a place and local housing prices. Similarly, Kavarnou & Nanda (2018) employed a tourism penetration rate to examine the relationship in Crete and arrived at a similar conclusion. In a study of Italian municipalities in 2002, Cannari & Faiella (2008) identified a positive impact of the share of firms operating in the tourism industry on house prices. Biagi et al. (2015) used a system Generalized Method of Moments (GMM-SYS) approach to analyse data from 103 Italian cities spanning 1996 to 2007. After accounting for various factors such as local housing market characteristics, amenities, geography, and urban size, they confirmed the positive and significant effect of a composite tourism index on house price levels in Italy. However, Biagi et al. (2016) adopted a latent class approach and reached different conclusions. They found that the positive effect was more pronounced in cities in the center-northern part of the country, well-known art cities, and some small cities specializing in mountain tourism. In about half of the sample, increases in tourism activity had no impact on housing prices, and in small cities focused on marine tourism, a negative effect was observed.

An inverted demand approach to model house prices is also considered by Šimek et al. (2022). Using dynamic regression analysis, they examined the relationship between nights spent at tourist accommodation establishments and the house price index from the first quarter of 2005 to the second quarter of 2021. After controlling for typical housing price determinants, their findings did not find a statistically significant link between nights spent at tourist accommodation establishments and variations in housing prices. This contrasts with the conclusions drawn by Brotman (2022) and Vizek et al. (2022) regarding the impact of tourism on the Croatian housing market.

Applying an Exponential Generalized Autoregressive Conditional Heteroskedasticity model (EGARCH) to data for New Zealand, Balli et al. (2019) examined the extent to which macroeconomic fundamentals and tourism affect housing prices. They found that the larger metropolitan regions were more sensitive to macroeconomic factors than smaller ones. Additionally, they observed that house price volatility in southern regions was influenced by macroeconomic fluctuations more than northern areas. Furthermore, they discovered that tourism had a significant impact on house price volatility, particularly in touristic areas. In another study focused on New Zealand, Tsui et al. (2019) used on three-stage least squares (3SLS) structural model. Their findings did not provide statistical evidence of a relationship between tourism activity and housing prices, except in the case of a major and popular tourist center.

Several studies have utilized autoregressive distributed lag (ARDL) models to explore the relationship between tourism income and housing property prices. Muzindutsi & Surujlal (2018) investigated both short-run and long-run relationships between income from tourism accommodation and housing property prices in South Africa. They found that, in the long run, the growth of the tourism industry tended to affect property prices, although this effect was not observed in the short run. The same was concluded by Rehman (2020) for Portugal. However, Alola et al. (2020) studied Cyprus and estimated that an increase in the number of international tourist arrivals led to higher house prices in both the long and short run. For Turkey, Kariş & Altintaş (2021) identified distinct long-term impacts of foreign tourists from different parts of the world on various Turkish regions. Yıldırım & Karul (2022) found support for a one-way causality from the international tourism receipts to house prices.

Churchill et al. (2022) analysed a historical data set of 150 years for Germany using time-varying non-parametric techniques. Their results exhibit a time-varying effect of tourism flows on house prices, although with mixed effects. Before World War II, the effects were both positive and negative. They became consistently positive after 1950 but declined until the mid-1990s. After 2000, the impact of tourism on house prices became significantly positive and has become more pronounced in recent years.

H. Zhang & Yang (2021, 2023) developed a small open economy dynamic stochastic general equilibrium model that includes a tourism sector and a housing market, encompassing owner-occupied and rental sections, for Iceland. Their simulations show that inbound tourism demand has a positive impact on both house prices and rental prices. Furthermore, they find that an inbound tourism demand shock is a key driver of house prices fluctuations, while housing preference shocks are crucial in determining the volatility of rental prices. Additionally, their research highlights that inbound tourism reduces income inequality but increases wealth inequality.

Several authors have investigated the relationship between tourism development and housing prices in China, yielding mixed results (Cong et al., 2023; Wu, 2019; Wu et al., 2022; J. Zhang, 2023). Song et al. (2023), using instrumental variable methods and multiple robust techniques, including quantile regression, discovered that the positive effect of tourism on urban housing prices is primarily driven by domestic tourism. This effect varies based on urban scale, hierarchy, location, and type, with greater significance in small- and medium-sized cities, noncentral cities, central and western cities, and nontourist cities, while it is limited in cities with high housing prices. They also concluded that tourism's impact on housing prices is linked to the expansion of investment scale, increasing income levels, and improvements in public services. In a similar vein, K. Liu et al. (2020) noted that although tourism development contributes to higher housing prices, its impact on income is more substantial, resulting in a reduction in the house price-to-income ratio.

The question of housing affordability in connection with tourism activity is investigated by Mikulić et al. (2021). Their results reveal that tourism has negative effects on housing affordability in Croatia, especially due to employment fluctuations, difficulties in maintaining economic status, and revenue instabilities associated with seasonality. Similarly, in the case of Lisbon, Lorga et al. (2022) found that factors such as tourism, the presence of foreign residents, the spread of short-term rentals, and public policies have a significant influence on the worsening of housing affordability. However, Valente et al. (2022) conducted a study across 85 European regions and found that an increase in the number of visitors may benefit mean incomes and alleviate the pressure on housing costs. Still, it can lead to higher income inequality and residential displacement, with variations between homeowners and tenants.

A small number of papers have considered cross-country analysis. Paramati & Roca (2019) examined this connection in twenty OECD economies. They controlled for various determinants, including banking credit, per capita income, income inequality and institutional quality. Their results, derived from Augmented Mean Group (AMG) estimator, indicated a significant positive impact of tourism on house prices. The interaction between tourism and income inequality also played a role, with the growth in banking credit and per capita income further increasing house prices. For the EU27, Perić et al. (2022) confirmed the influence of standard housing prices determinants, such as economic growth, unemployment and credit to the private sector. However, they also found that tourism significantly increased housing prices, regardless of the indicators used. Interestingly, hotel accommodation appeared to buffer of the the impact of tourism on the growth in housing prices. Cró & Martins (2023) explored the impact of tourist activities on house prices in eight tourism-dependent countries in terms of exports. They applied a Vector-Error Correction Model (VECM) and found that tourist activities Granger–caused house prices in all eight countries, both in the short- and long-run. However, the reverse causality was significant only in Australia, Iceland, and Portugal, and in Greece solely in the long-run. In the G7 countries, Yang et al. (2023) used a panel smooth transition regression (PSTR) to reveal a nonlinear relationship between tourism and house prices.

The impact of tourism became positive and significant when economic growth exceeded a certain threshold. Additionally, they observed a U-shaped relationship between economic growth and house prices, and a positive and significant association between population and inflation show.

4.3. Wavelet analysis

Fourier spectral analysis has been employed to identify the frequencies that significantly contribute to the overall variance in a time-series. This technique deconstructs observed temporal patterns into a spectrum of cycles with varying lengths. In contrast, the primary advantage of wavelet analysis is its ability to estimate the spectral characteristics of a time-series in relation to time. This unveils the temporal evolution of its various periodic components. For this reason, the suitability of wavelet analysis over spectral analysis is accentuated when dealing with noisy and non-stationary series.

Emerging in the mid-1980s from works like Grossmann & Morlet (1984), wavelets initially addressed geophysical issues before permeating various fields. In economics, discrete wavelet transform applications were pioneered, with Crowley (2007) offering foundational insights and Gallegati et al. (2011) for a very neat practical application.

Over the last decade, the Continuous Wavelet Transform (CWT), which we apply, has gained traction in economic studies, with a plethora of papers making it challenging to encapsulate the volume of contributions. Flor & Klarl (2017), Ko & Funashima (2019), Verona (2020), Aguiar-Conraria et al. (2023) are just a few examples of CWT's capacity to handle complex economic data efficiently. Even in the specific case of tourism economics and management, there have been some aplications, such as F. Balli et al., (2018, 2019), Kumar et al. (2019), Mishra et al. (2020), Khalfaoui et al. (2022) or Tiwari et al. (2019).

For the examination of the synchronicity in housing price cycles, we will utilize the Continuous Wavelet Transform along with several affiliated wavelet instruments. For an accessible introduction to this methodology and its applicability to social science datasets, we direct the reader to Aguiar-Conraria et al., (2012, 2013). For a comprehensive technical exposition, one might consult Aguiar-Conraria & Soares (2011, 2014).

Our analysis will rely on four tools: the Wavelet Power Spectrum, the Wavelet (Partial) Coherency, the Wavelet (Partial) Phase-Difference, and the wavelet de-synchronization matrix.

4.3.1. The wavelet

A wavelet, $\varphi(t\ )$, is a mathematical function characterized by a zero mean, ensuring that it oscillates positively and negatively. Furthermore, it is well-localized in time, manifesting characteristics such as rapid decay. This suggests that it behaves akin to a small wave that attenuates in magnitude as it deviates from its central point, justifying the nomenclature wavelet. Among the diverse wavelets available, the Morlet wavelet, $\varphi_{\omega_0}(t) = Ke^{i\omega_0 t}e^{-\frac{t^2}{2}}$, stands out as the most prevalent. Aguiar-Conraria & Soares (2014) have demonstrated that this particular wavelet possesses attributes that are optimal for examining oscillatory phenomena.

The Morlet wavelet is popular due to several properties. First, it can act as an analytic wavelet and therefore be convenient for analyzing modulated signals — i.e., signals with time-varying frequency and amplitude. Second, this family of wavelets has an optimal joint time-frequency concentration and, consequently, there is a minimum trade-off between time and frequency precision. Lastly, because both the time and the frequency radius are equal, the Morlet wavelet achieves an excellent accuracy compromise between these two dimensions.

To ensure that the admissibility condition is satisfied, the normalizing constant K in equation takes the value $\pi^{-\frac{1}{4}}$ so that $\varphi_{\omega_0}(\mathrm{t})$ has unit variance. Furthermore, like most economic papers, we assume $\omega_0 = 6$. Therefore, the specific Morlet wavelet that we use is:

$$\varphi(t) = \pi^{-\frac{1}{4}}e^{6it}e^{-\frac{t^2}{2}}$$

The continuous wavelet transform of a time series x(t) with respect to the wavelet is a function of two variables, $W_x(\tau, s)$:

$$W_x(\tau, s) = \int_{-\infty}^{\infty} x(t) \frac{1}{\sqrt{s}} \bar{\varphi}\left(\frac{t-\tau}{s}\right) dt.$$

The bar denotes complex conjugation, s is a scaling or dilation factor that controls the wavelet's width, and τ is a translation parameter controlling the wavelet's location.

4.3.2. Univariate tools

In analogy with the terminology used in the Fourier case, the (local) **Wavelet Power Spectrum** is defined as

$$WPS_x(\tau, s) = |W_x(\tau, s)|^2.$$

This provides a quantification of the variance distribution of the time series within the time-frequency domain. Utilizing this instrument, akin to the Fourier power spectrum, we can delineate the contribution of each frequency to the cumulative variance. Furthermore, it facilitates pinpointing temporal instances when this contribution is maximized. Within our visual representations, regions where the power spectrum—and consequently, the volatility—is high are illustrated using lighter shades.

Given that the wavelet φ is complex-valued, the wavelet transform W_x is also complex-valued and so can be expressed in the polar form as:

$$W_x = |W_x| e^{i\phi_x}, \phi_x \in (-\pi, \pi)$$

Where $|W_x|$ is the amplitude and ϕ_x denotes the argument, often referred to as the (wavelet) phase angle. The latter term is specifically crucial because it yields information on the position of the variable in the cycle as a function of its frequency. This information, of course, is crucial when one is studying cycles, hence the importance of relying on a complex wavelet such as the Morlet wavelet.

4.3.3. Bivariate wavelet tools

The concepts of cross wavelet power, wavelet coherency, and phase-difference enable us to deal with relations between two time series. The cross-wavelet transform of two time-series, $x(t)$ and $y(t)$, is defined as

$$W_{xy}(\tau, s) = W_x(\tau, s) \bar{W}_y(\tau, s).$$

This metric can be conceptualized as the local covariance between two time series across various instances and frequencies.

To further explore the correlation between two variables within the time-frequency domain, we employ the wavelet coherency (WCO). Compared with the cross wavelet power, the wavelet coherency, a concept akin to the correlation coefficient, has the advantage of being normalized by the two time-series power spectrum. In analogy with the concept used in Fourier analysis, given two time-series $x(t)$ and $y(t)$, one defines their wavelet coherency:

$$R_{xy}(\tau, s) = |\varrho_{xy}| = \frac{\left|S\left(W_{xy}(\tau, s)\right)\right|}{\sqrt{\left|S\left(W_{xx}(\tau, s)\right)S\left(W_{yy}(\tau, s)\right)\right|}}.$$

Here, ϱ_{xy} signifies the complex wavelet coherence and S denotes a smoothing operator in both time and scale.

Finally, the complex wavelet coherence can also be written in polar form as $\varrho_{xy} = |\varrho_{xy}|e^{i\phi_{xy}}$, where the angle ϕ_{xy} is called the phase difference and can be approximated to $\phi_{xy} = \phi_x - \phi_y$. This measure provides information on the possible delays of the series' oscillations as a function of frequency and time. In particular if $\phi_{xy} = 0$, then both series move together at a given time and frequency. If instead ϕ_{xy} ϵ $\left(0, \frac{\pi}{2}\right)$ then both series are in phase with x leading y, and if ϕ_{xy} ϵ $\left(-\frac{\pi}{2}, 0\right)$, the series are in phase, with x lagging. On the other hand, if ϕ_{xy} ϵ $\left(-\pi, -\frac{\pi}{2}\right)$, series x leads y in an out of phase relation, and if ϕ_{xy} ϵ $\left(\pi, \frac{\pi}{2}\right)$ the series x and y are out of phase, with y leading.

4.3.4. Wavelet spectra distance matrix

Finally, we will also measure the dissimilarities between the wavelet transform of two time-series proposed by (Aguiar-Conraria & Soares, 2011), which several authors have successfully applied—Flor & Klarl (2017).

Comparing time series through their wavelet spectra is akin to juxtaposing two images. A direct comparison isn't always apt, as areas with lower power might dominate, skewing the comparison. This situation is reminiscent of contrasting two pencil sketches by predominantly considering the paper's shade, while overlooking the actual drawings. Drawing inspiration from Rouyer et al. (2008), Aguiar-Conraria & Soares (2011) employ the singular value decomposition (SVD) to emphasize shared high-power time-frequency areas. This approach has parallels to Principal Component Analysis. However, where the latter targets linear combinations to maximize variance with certain orthogonality constraints, our method pinpoints components that accentuate covariances. Consequently, the extracted leading components capture the key shared patterns within the wavelet spectra. Armed with this data, our task then becomes defining a suitable metric to gauge the distance between these various components.

To calculate the distance between the wavelet spectra of countries x and y, we use the equation:

$$\text{dist}\left(W_x, W_y\right) = \frac{\sum_{k=1}^{K} \sigma_k^2 \left[d\left(\mathbf{l}_x^k, \mathbf{l}_y^k\right) + d\left(\mathbf{u}_x^k, \mathbf{u}_y^k\right)\right]}{\sum_{k=1}^{K} \sigma_k^2}.$$

In this formula, $\mathbf{l}_x^k$ and $\mathbf{l}_y^k$ represent the leading patterns, while $\mathbf{u}_x^k$ and $\mathbf{u}_y^k$ denote the singular vectors. Additionally, σ_k stands for the singular values. To ascertain the distance between two vectors, we gauge the angle between each paired segment, determined by the sequential points of the two vectors, and subsequently determine their average.

The resulting distance is deduced for every pair of countries. With these computed distances, a comprehensive matrix can be formed. A value closer to zero in our distance metric implies a higher similarity in the wavelet transforms of x(t) and y(t). To be more precise, a value close to zero means that the two regions have a very similar wavelet transform. In turn, this implies that the contribution of the cycles of each variable at each frequency to the total variance is similar between both regions; this contribution happens simultaneously; and, finally, the ups and downs of each cycle coincide.

4.3.5. Multivariate wavelet tools

The wavelet coherency and the wavelet phase difference have generalizations to the case where we are dealing with more than two series, namely the wavelet partial coherency (WPC) and partial phase-difference; see Mihanović et al. (2009), for the case of three series, and Aguiar-Conraria & Soares (2014) for the more general case. Since the formulas are quite cumbersome, we do not include them here, and refer the interested reader to mentioned papers.

4.4. Data

Our sample consists of a set of 11 European countries—Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden and United Kingdom—for the period 1990-2019. This sample was chosen, in part, based on the availability of quarterly data related to tourism and housing prices; the period of the pandemic was deliberately excluded as tourism was profoundly affected, which could bias the analysis.

As an indicator of tourism activity level, the number of nights spent in tourist accommodations by non-residents was selected (Šimek et al., 2022). Eurostat provides monthly data starting from January 1990, which were transformed into quarterly data. However, for France and the United Kingdom, monthly time series only start in 1993 and 1994, respectively, but annual series from 1990 onwards were available. By regressing the quarterly data against the annual data, it was possible to extrapolate the missing quarterly data for these two countries. Being tourism activity subject to significant seasonality, we applied the United States Census Bureau's X-13 method to obtain seasonally adjusted series (Vatsa, 2021).

For the housing prices, we have opted to utilize the Real Residential Property Prices Index (2010=100) published by the Bank for International Settlements (BIS) and reported on a quarterly basis. This index encompasses all types of residential properties, including both new and existing ones, and is calculated by adjusting nominal residential property price data using the Consumer Price Index. However, for Portugal, the BIS data only covers the period starting from 2008 onwards. So, we have accessed a dataset from Confidencial Imobiliário, covering eighteen district capitals and spans from the first quarter of 1988 to the first quarter of 2020. By computing a simple average for these cities, we have determined a strong correlation coefficient of 0.94 with the BIS series. Then, we have chosen to use this constructed Portuguese housing price index.

Following housing economics literature, we controll the tourism–housing prices nexus for GDP. Data on this variable is the one published by the OECD, following the expenditure approach, and we selected it starting in 1989 in order to compute growth rates.

4.5. Results

4.5.1. Preliminary data analysis — Wavelet Power Spectrum

In this segment, we start to outline our findings. Initially, we estimate the wavelet power spectrum for the Housing Prices index of the most prominent countries in our dataset: France, Germany, Italy, and the United Kingdom.

The power spectrum provides insights into the prevailing cycles identifiable within this data set. Subsequently, we shift our focus to examine similar patterns related to tourism. In the subsequent subsections, our analysis will expand to incorporate bivariate and multivariate considerations.

In Figures 6 and 7, the bottom segment displays the wavelet power spectrum. Areas represented in lighter shades indicate regions of heightened wavelet power, signifying increased volatility. The horizontal axis plots the date, while the vertical axis denotes the cycle period, spanning from short 1-year cycles at the top to longer 18-year cycles at the bottom. White stripes manifest the local maxima of the wavelet power spectrum, offering an estimation of the dominant cycle. Furthermore, a pronounced black contour delineates regions that are statistically significant at a 5% level, against the null of a flat spectrum.

4.5.1.1. The Housing Prices index

In Figure 6, the top portion illustrates the House Price Index, showcasing the year-on-year growth rate, for the four aforementioned countries. For France, Germany, and Italy, the data reveals two predominant cycles that span nearly the entire sample duration. These cycles overlap: one exhibits a longer period, oscillating slightly around 15 years, while the other possesses a shorter duration — approximately eight years for Germany and four years for both France and Italy. In the context of the UK, we can also identify two main cycles, with periods of 4 and 8 years; however, they don't extend for as lengthy durations.

It's noteworthy that in France's context, the cycle with a shorter period prominently stands out between 2000 and 2016. Additionally, Germany's pattern distinctively deviates from the other countries, with the wavelet power spectrum predominantly manifesting its significance in the latter half of the sample.

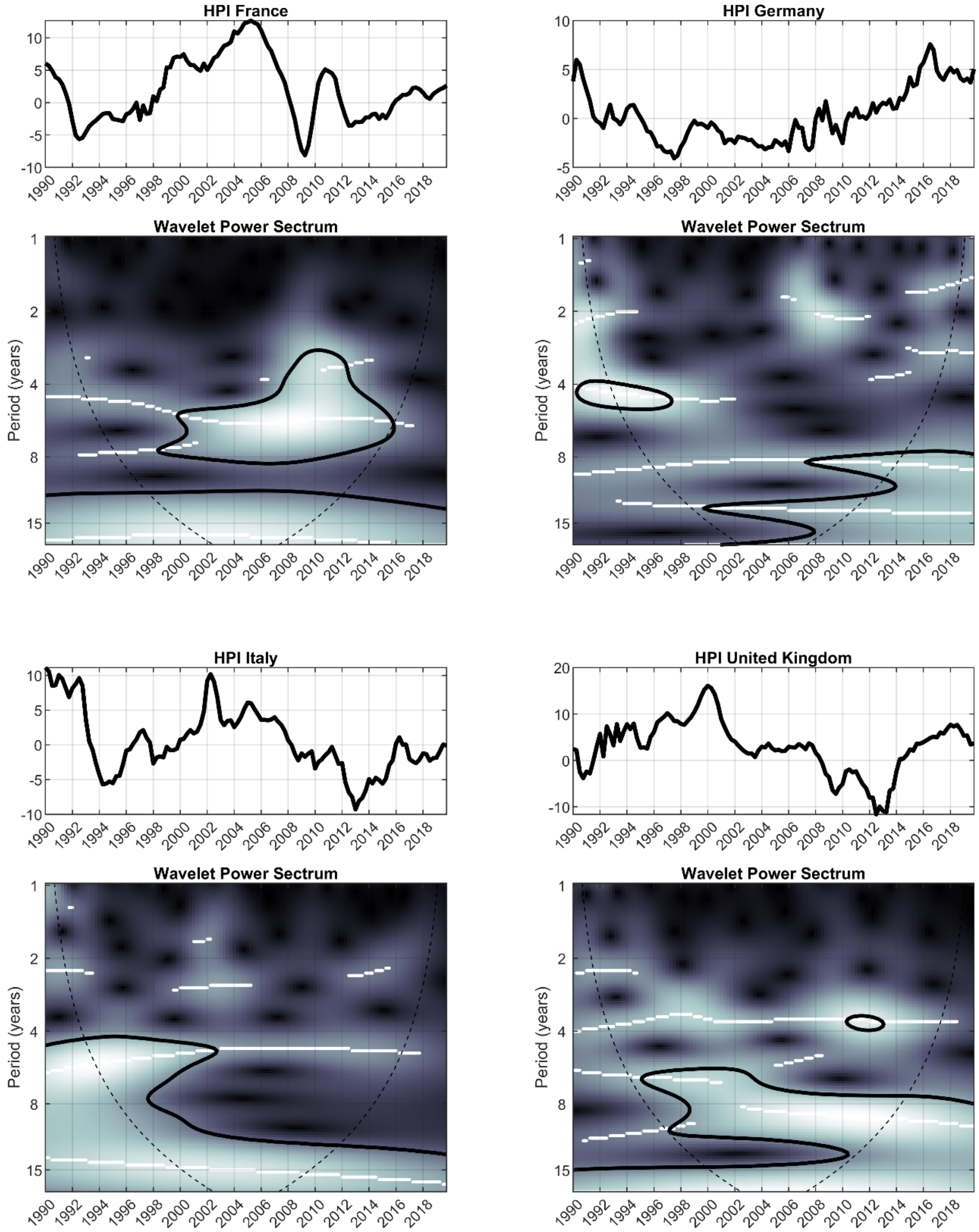


Figure 6. House Price Index (year on year growth rate). On the top: time series plot. At the bottom: Wavelet power spectrum — the thick gray contour designates the 5% significance level. The shade code for power ranges from black (low power) to white (high power). White stripes correspond to local maxima of the wavelet power spectrum. The cone of influence, which indicates the area affected by edge effects, is the region outside the dashed line.

4.5.1.2. Tourism — Nights in touristic accommodations

In Figure 7, we present plots and wavelet power spectra related to tourism flows, specifically focusing on the number of nights spent at tourist accommodations. Note that we are working with the logs, which means cycles should be interpreted as percentage deviations.

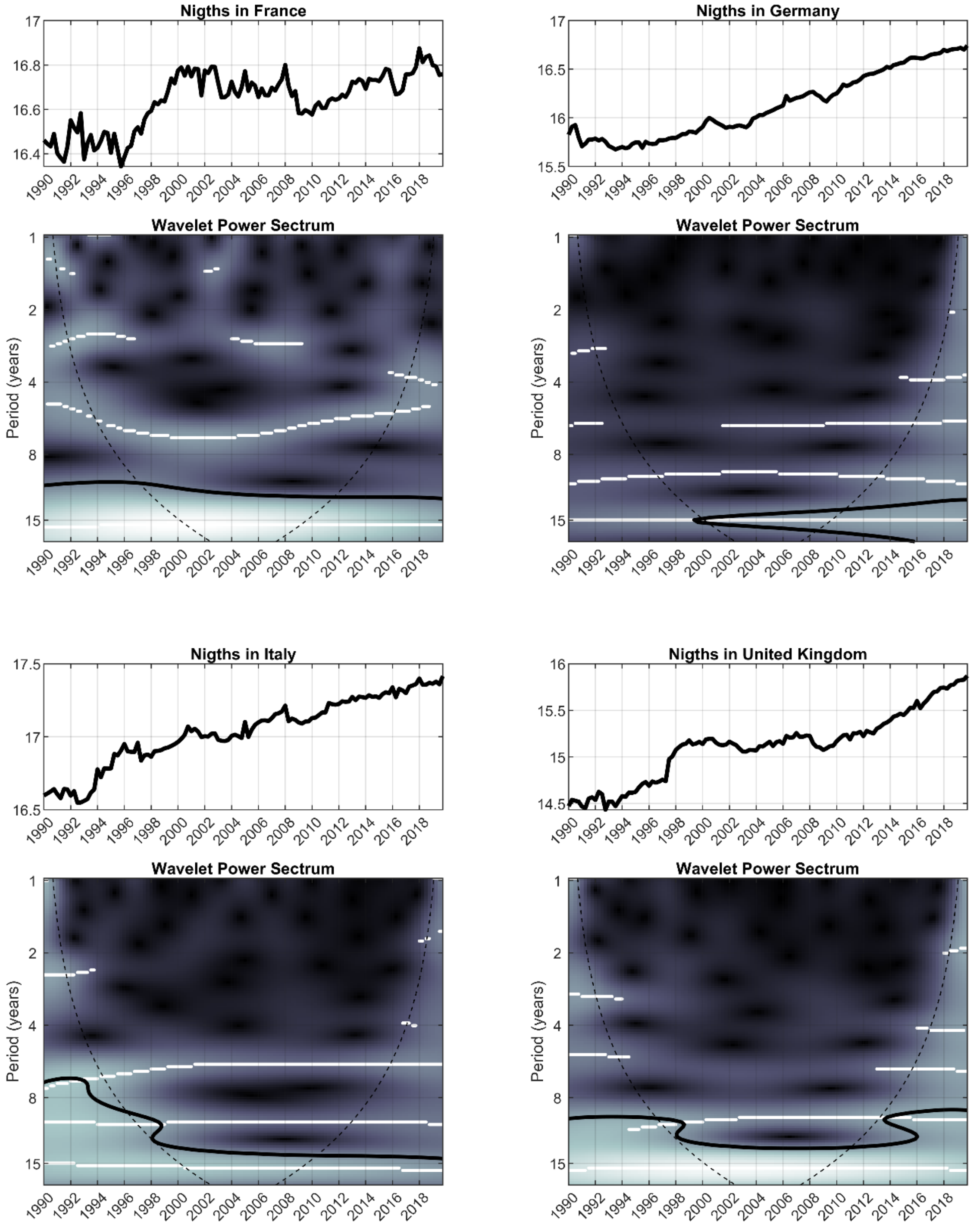


Figure 7. Tourism (nights spent at tourist accommodation establishments by non-residents). On the top: time series plot. At the bottom: Wavelet power spectrum — the thick gray contour designates the 5% significance level. The shade code for power ranges from black (low power) to white (high power). White stripes correspond to local maxima of the wavelet power spectrum. The cone of influence, which indicates the area affected by edge effects, is the region outside the dashed line.

The first observation is that the four countries have a predominant 15-year cycle. However, in the case of Germany, this cycle becomes statistically significant only after 1999. Shorter duration cycles are highlighted by white stripes, both above and below eight-year periods, representing local maxima of the wavelet power spectrum. Yet, they do not meet the criterion for statistical significance. Nonetheless, given their persistence across the sample, they cannot be disregarded.

4.5.2. Are countries cycles synchronized?

We now transition to a structured comparison of the House Price cycles across countries, and similarly for tourism cycles. Our initial step involves calculating the dissimilarity indices for each country pairing. Subsequently, we will estimate the coherence and wavelet phase-difference for the largest economies.

4.5.2.1. Synchronization between house price cycles

Table 4 presents the dissimilarity among housing cycles across the 11 countries in our sample. A value approaching zero signifies a high similarity in the wavelet transform between two countries. This indicates that the nations share identical high-power regions and that their respective phases are synchronized. In layman's terms, it suggests that the influence of cycles at every frequency on the total variance is consistent between the two countries. Moreover, these contributions occur concurrently, with the peaks and troughs of each cycle occurring simultaneously. It is from this perspective that we infer that the two countries exhibit synchronized cycles.

Table 4. De-synchronization between house prices

	Be	Dk	Fi	Fr	Ge	It	Ne	Pt	Sp	Sw	UK
Belgium		0.55	0.44	**0.17**	**0.31**	**0.22**	0.42	**0.26**	**0.20**	0.36	**0.16**
Denmark	0.55		0.45	0.59	0.45	0.60	**0.29**	0.33	0.54	**0.23**	0.47
Finland	0.44	0.45		0.47	0.49	0.49	0.52	0.47	0.56	0.42	0.53
France	**0.17**	0.59	0.47		0.37	**0.14**	0.49	**0.25**	**0.18**	**0.31**	**0.12**
Germany	**0.31**	0.45	0.49	0.37		0.39	0.35	**0.26**	0.38	**0.30**	**0.32**
Italy	**0.22**	0.60	0.49	**0.14**	0.39		0.53	**0.24**	**0.22**	0.34	**0.17**
Netherlands	0.42	**0.29**	0.52	0.49	0.35	0.53		0.37	0.56	**0.31**	0.44
Portugal	**0.26**	0.33	0.47	**0.25**	**0.26**	**0.24**	0.37		**0.23**	**0.30**	**0.18**
Spain	**0.20**	0.54	0.56	**0.18**	0.38	**0.22**	0.56	**0.23**		0.36	**0.16**
Sweden	0.36	**0.23**	0.42	**0.31**	**0.30**	0.34	**0.31**	**0.30**	0.36		**0.31**
United Kingdom	**0.16**	0.47	0.53	**0.12**	**0.32**	**0.17**	0.44	**0.18**	**0.16**	**0.31**	
Average	0.31	0.45	0.48	0.31	0.36	0.33	0.43	0.29	0.34	0.32	0.29

Legend: **p-value <0.01** **p-value <0.05** **p-value <0.10**

The pair exhibiting the highest synchronization is France and the United Kingdom, whereas the most divergent pairing is represented by Italy and Denmark. Upon examining Table 4, several compelling insights can be drawn. The countries demonstrating the greatest average synchronization are the United Kingdom and Portugal (Barros et al., 2022), with Finland manifesting the least synchronization. Intriguingly, the latter does not display significant synchronization (at least at standard statistical significance levels) with any other country, seemingly isolating it from the rest of Europe. In contrast, the United Kingdom stands out, having the most entries significant at the 1% level. That the United Kingdom is the country with the highest synchronization is a result we also find in (Miles, 2017). However, in this author's findings, Finland appears in second place.

To enhance the visualization of the matrix depicted in Table 4, we employ the dissimilarity matrix as a distance matrix and position the countries within a two-dimensional system. The objective is to condense the dissimilarity matrix into a two-column configuration matrix, which delineates the positioning of each country along two axes. We apply the stress algorithm as proposed by (Kruskal, 1964a, 1964b) to minimize the squared discrepancies between the mapped distances and the wavelet dissimilarities. This process culminates in Figure 8.

In Figure 8, we observe a discernible cluster comprising Italy, France, Belgium, Spain, the UK, and Portugal, with Sweden affiliated to this grouping to a lesser degree. The remaining countries align with those exhibiting the highest average dissimilarities, as indicated in Table 4. These nations also present the fewest statistically significant relationships. Gupta et al. (2015) also identified cointegration between the Euro area's series and those of Belgium, Germany, and France. Additionally, they detected cointegration relationships between Belgium and Spain and between France and Spain. Differently from our results, they detected cointegration relationships between Belgium and the Netherlands, as well as between Germany and Spain.

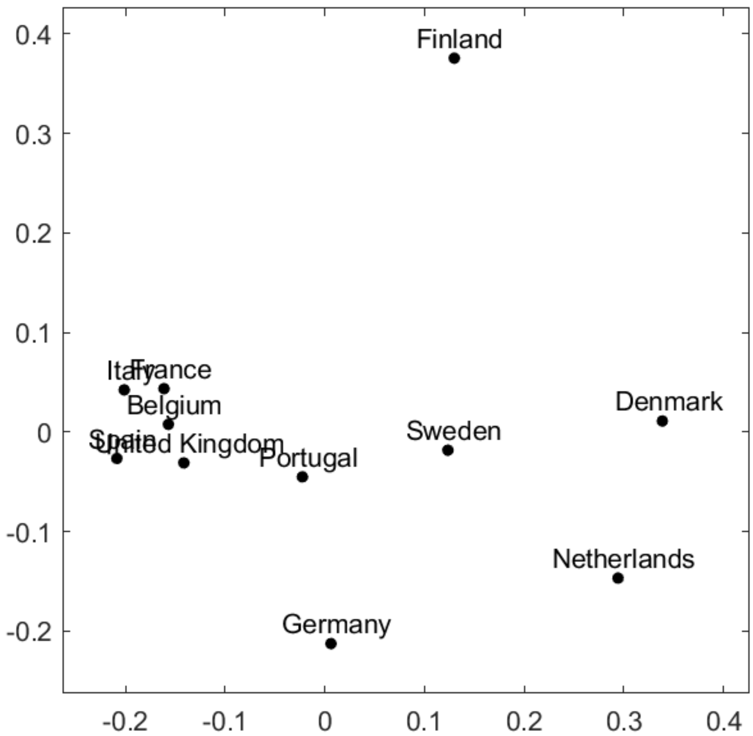
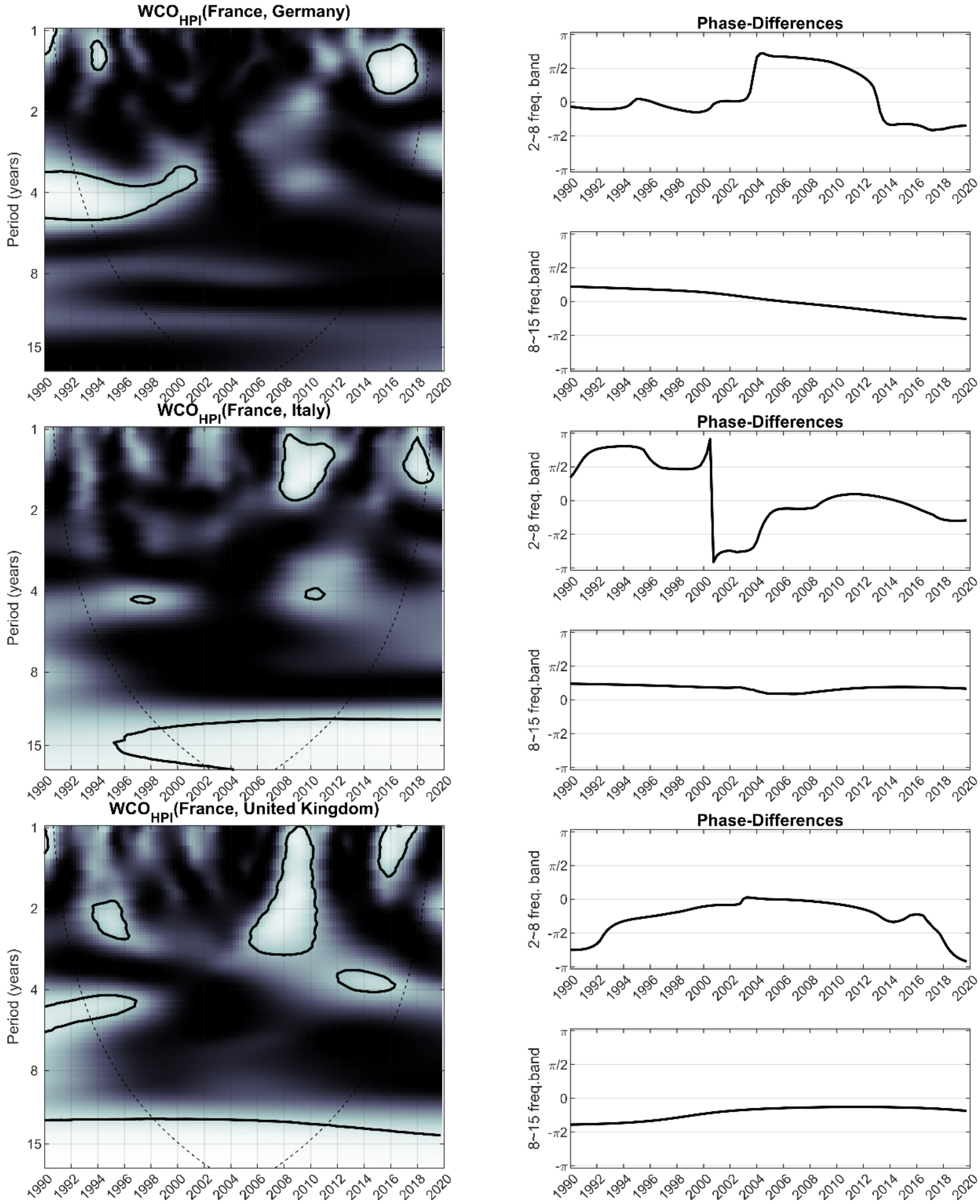


Figure 8. Multidimensional Scaling Map (house prices)

In Figure 9, the wavelet coherencies and phase-differences for each of the four largest countries are presented. The most striking observation is the pronounced region of high and statistically significant coherency at extremely low frequencies for all countries, with Germany being the exception. Generally, at these lower frequencies, phase differences suggest a positive correlation. However, at business cycle frequencies, spanning periods of 2 to 8 years, the phase-differences display greater volatility. This suggests that while there exists a synchronized co-movement at low frequencies, this synchronicity becomes much less consistent at higher frequencies.


WCO_HPI(France, Germany)
Phase-Differences
WCO_HPI(France, Italy)
Phase-Differences
WCO_HPI(France, United Kingdom)
Phase-Differences
Period (years)
2~8 freq. band
8~15 freq.band

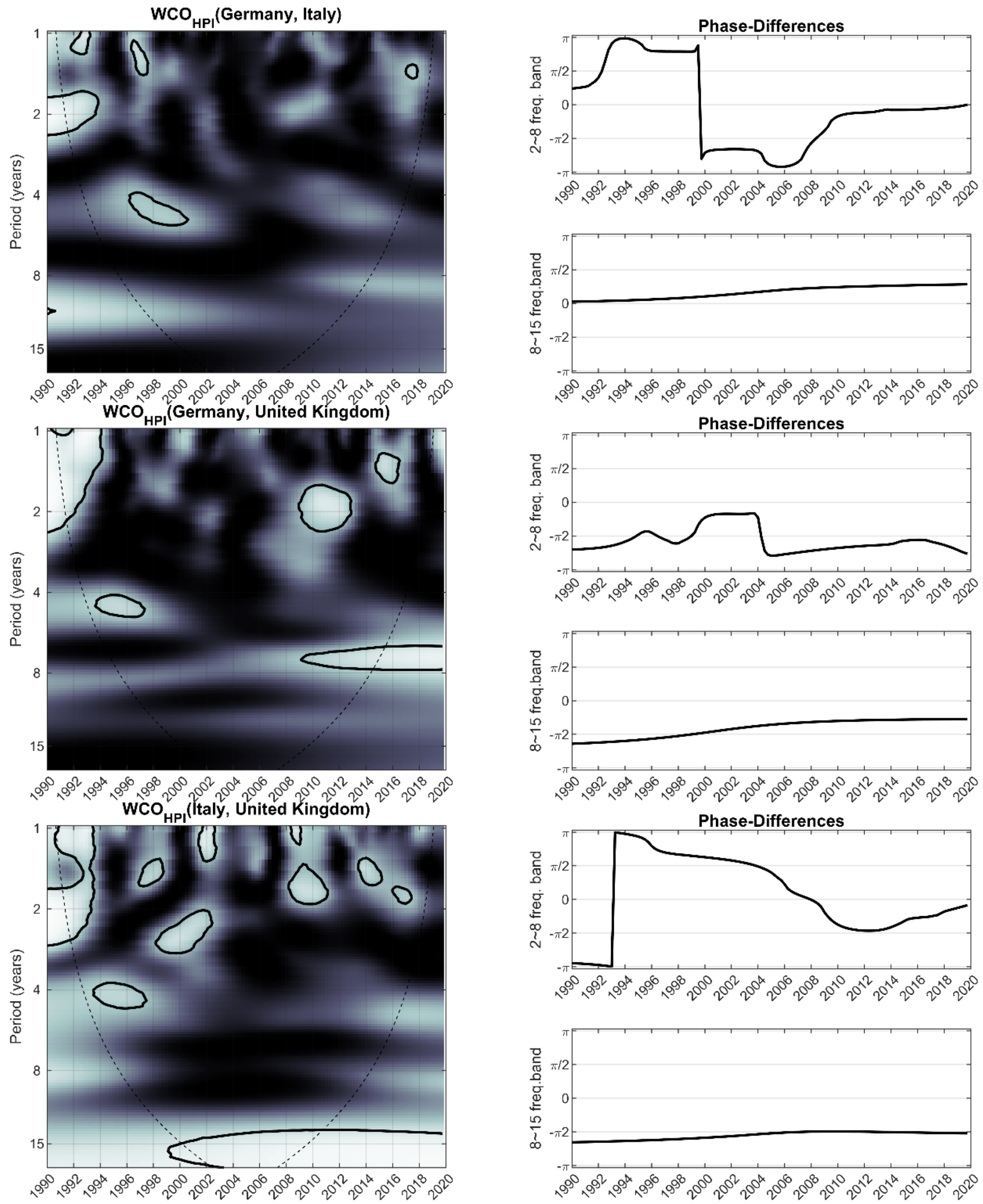


Figure 9. On the Left: Cross-Wavelet Coherency for House prices between major economis. On the right: Phase-Difference. Wavelet Coherency: The black contour designates the 5% significance level. The shade code for coherency ranges from black (low coherency -- close to zero) to white (high coherency -- close to one). The cone of influence, which indicates the area affected by edge effects, is the dashed line's outer region.

4.5.2.2. Synchronization between tourism cycles

Table 5 showcases the dissimilarity among tourism cycles for the 11 countries featured in our sample. The two countries least synchronized with the rest are the United Kingdom and Denmark; the most synchronized pair is Spain and the Netherlands; Sweden emerges as the country with the highest number of statistically significant connections at the 1% level, followed by Spain and Italy (Andraz & Rodrigues, 2016; Gouveia & Rodrigues, 2005). These findings suggest that the dynamics driving the synchronization of cycles between tourist flows and housing prices, as observed in the previous subsection, differ from one another.

Table 5. De-synchronization in Nights Spent at Tourist Establishments

	Be	Dk	Fi	Fr	Ge	It	Ne	Pt	Sp	Sw	UK
Belgium		0.43	**0.28**	**0.30**	**0.31**	**0.16**	**0.20**	**0.32**	**0.17**	**0.22**	0.46
Denmark	0.43		0.37	0.38	0.53	0.40	0.41	0.43	0.44	0.39	**0.19**
Finland	**0.28**	0.37		0.48	**0.25**	**0.16**	**0.27**	**0.27**	**0.25**	**0.15**	**0.33**
France	**0.30**	0.38	0.48		0.38	0.35	**0.22**	**0.30**	**0.24**	0.35	0.42
Germany	0.31	0.53	**0.25**	0.38		**0.23**	**0.22**	**0.21**	**0.20**	**0.17**	0.50
Italy	**0.16**	0.40	**0.16**	0.35	**0.23**		**0.18**	**0.25**	**0.15**	**0.12**	0.37
Netherlands	**0.20**	0.41	**0.27**	**0.22**	**0.22**	**0.18**		**0.16**	**0.10**	**0.14**	0.38
Portugal	**0.32**	0.43	**0.27**	**0.30**	**0.21**	**0.25**	**0.16**		**0.22**	**0.15**	0.40
Spain	**0.17**	0.44	**0.25**	**0.24**	**0.20**	**0.15**	**0.10**	**0.22**		**0.16**	0.38
Sweden	**0.22**	0.39	**0.15**	0.35	**0.17**	**0.12**	**0.14**	**0.15**	**0.16**		0.35
United Kingdom	0.46	**0.19**	**0.33**	0.42	0.50	0.37	0.38	0.40	0.38	0.35	
Average	0.28	0.40	0.28	0.34	0.30	0.24	0.23	0.27	0.23	0.22	0.38

Legend: **p-value <0.01** **p-value <0.05** **p-value <0.10**

Building upon our earlier methodology, we transform the data from Table 5 into a two-dimensional visual representation in Figure 10. What's immediately striking is that the clustering patterns deviate substantially from those observed with housing prices. Notably, France and the UK, previously central figures in the housing data clustering, now situate further away from the majority of other countries. Conversely, Finland and Germany, which were previously more peripheral, now seem to move closer to the core of the cluster.

To identify a cluster of countries with closely aligned cycles, Germany, Italy, the Netherlands, Portugal, Spain, and Sweden emerge as primary candidates. Finland and Belgium may also be considered to a lesser extent.

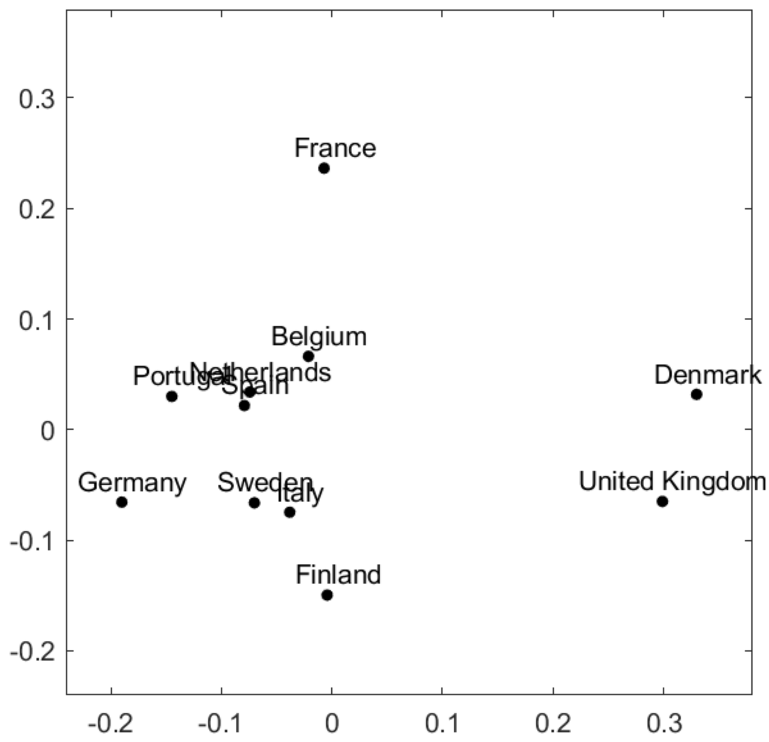
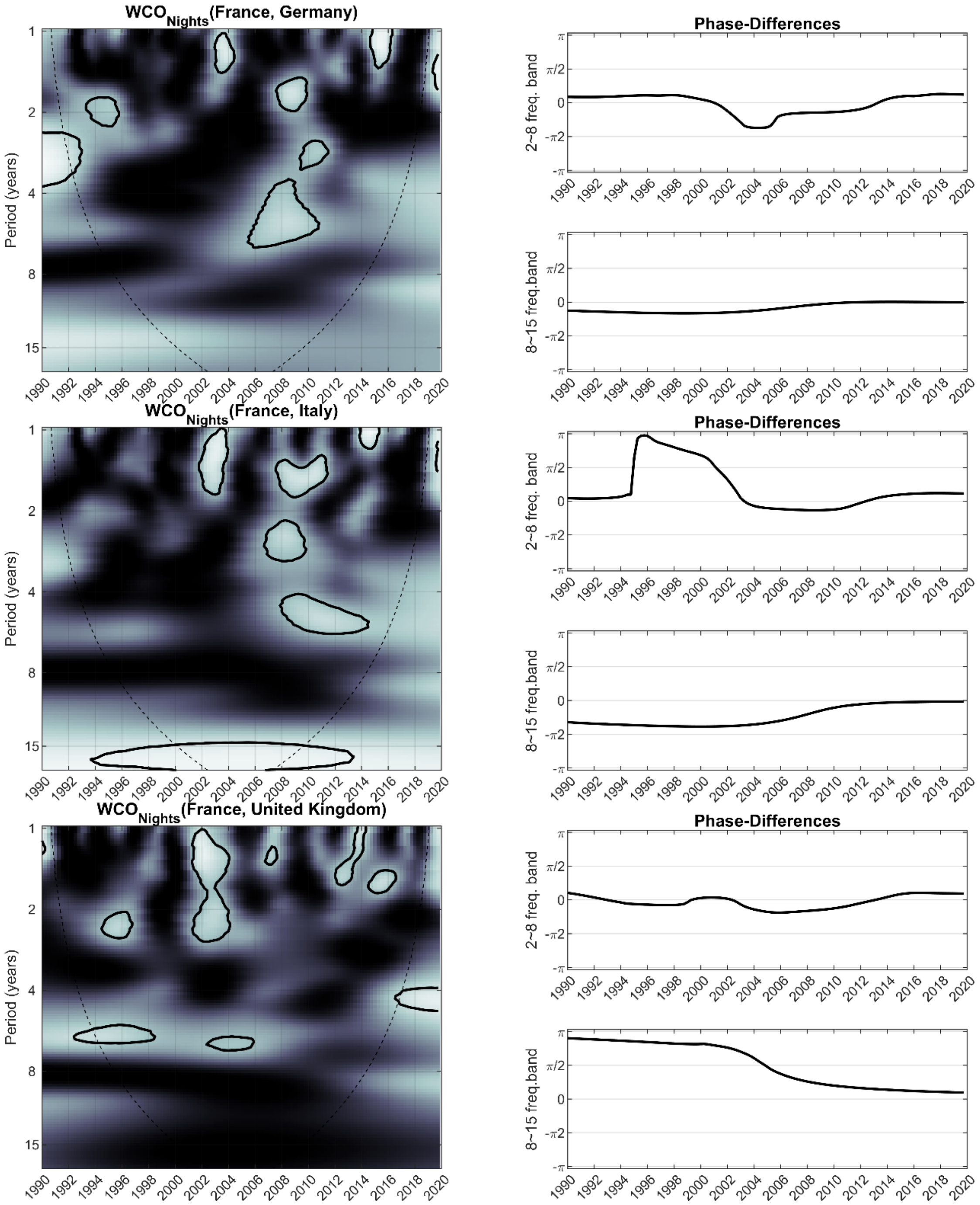


Figure 10. Multidimensional Scaling Map (tourism)

Transitioning to Figure 11, we present the wavelet coherencies and phase-differences among the four larger countries. Several patterns merit attention. Firstly, France and Italy exhibit a quite synchronized cycle at very long run frequencies. Furthermore, Germany's alignment with the UK and, more markedly, with Italy, has experienced a considerable surge in recent years, particularly evident at business cycle frequencies.

In summary, our findings indicate a distinct disparity in synchronization between house price cycles and tourism cycles. Consequently, it is improbable that one directly influences or causes the other. Next, we will further analyse this hypothesis.


WCO$_{Nights}$(France, Germany)
Phase-Differences
WCO$_{Nights}$(France, Italy)
Phase-Differences
WCO$_{Nights}$(France, United Kingdom)
Phase-Differences
Period (years)
2~8 freq. band
8~15 freq.band

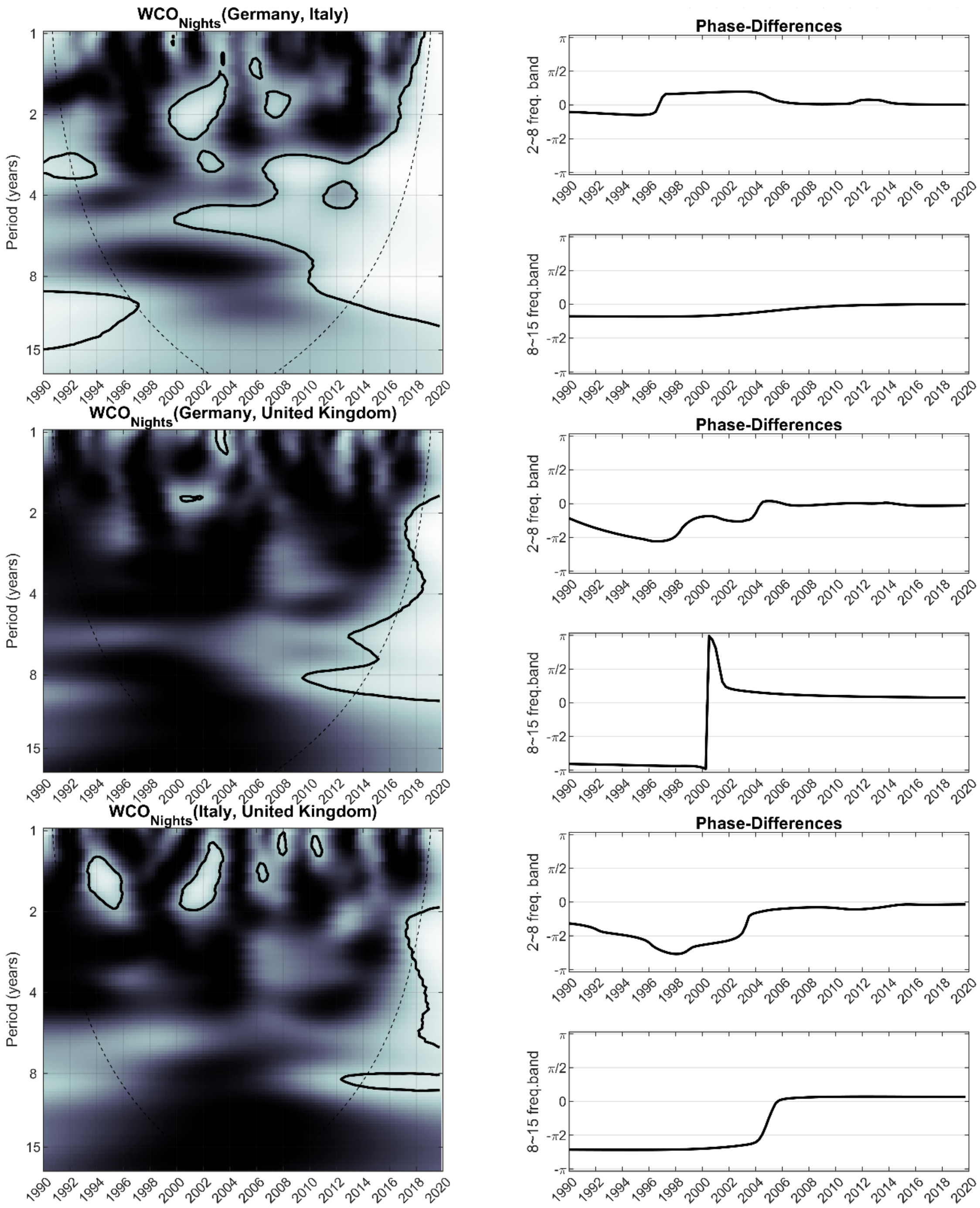


Figure 11. On the Left: Cross-Wavelet Coherency for nights spent between major economis. On the right: Phase-Difference. Wavelet Coherency: The black contour designates the 5% significance level. The shade code for coherency ranges from black (low coherency -- close to zero) to white (high coherency -- close to one). The cone of influence, which indicates the area affected by edge effects, is the dashed line's outer region.

4.5.3. Is there a meaningful relation between house and tourism cycles?

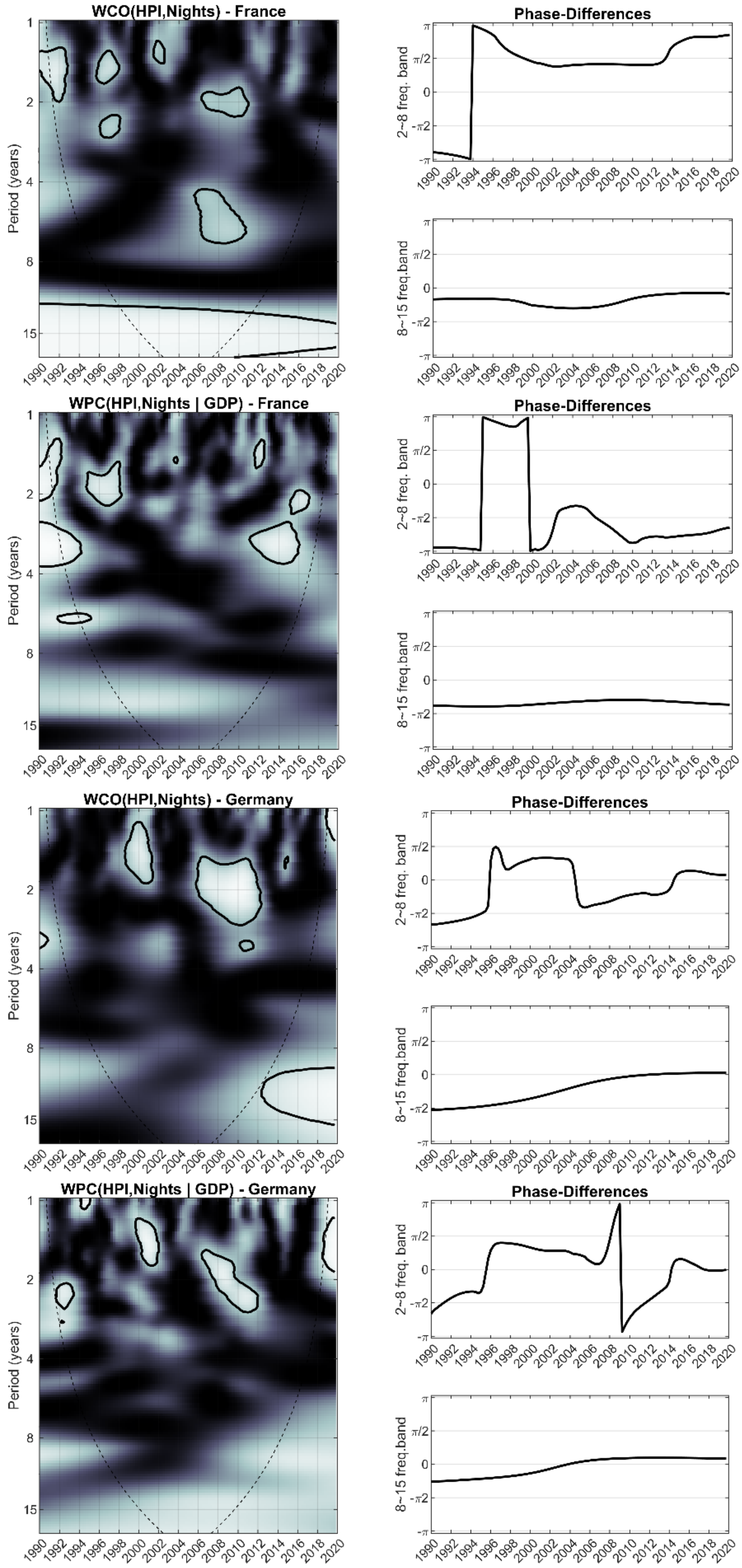
So far, we delved into the synchronization patterns across various countries in relation to both housing and tourism markets. We noticed distinct synchronization patterns in each market, but this observation has not been formally evaluated. One method of doing so is simply through the application of Spearman's correlation coefficient, comparing the distances in Table 4 to those in Table 5. This correlation doesn't directly equate the actual values of distances but rather gauges their relative rankings. It aims to determine if countries that are highly synchronized in one market display similar synchronization levels in the other. The derived Spearman correlation coefficient stands at -0.036, accompanied by a p-value of 0.79, indicating an absence of a discernible pattern.

Subsequently, for each of the four major economies, we calculate the wavelet coherency (WCO) and the phase differences between house prices and nights spent in tourism establishments. Concurrently, we estimated the wavelet partial coherency (WPC) and the partial phase differences, factoring in the influence of GDP growth. A striking observation was that any (faint) relationship evident in the wavelet coherency diminishes significantly upon accounting for the real GDP's year-on-year growth rate. This result is in line with findings from several studies showing that tourism impact on housing market is mediated by economic growth (K. Liu et al., 2020; Song et al., 2023; Valente et al., 2022).

Piecing together all these findings, we can infer that it's highly unlikely for tourism to be a driving force behind fluctuations in housing prices, a conclusion similar to the one reached by Šimek et al. (2022).

The findings are depicted in Figure 12. Among the displayed results, France and the UK stand out for contrasting reasons. In the French case, house prices and tourism demonstrate a pronounced coherency at extremely low frequencies, with tourism taking the lead. This suggests a potential interconnection between the two sectors. However, when GDP growth is accounted for, this region of strong coherency dissipates. Thus, it can be deduced that tourism doesn't exert a direct influence on housing prices.

Conversely, for the UK, the coherency remains consistently low across different frequencies and over time, pointing once again to a lack of correlation. Consistent with previous patterns, when partial coherency is introduced into the analysis, even the minor pockets of statistically significant coherency diminish further.


WCO(HPI,Nights) - France
Phase-Differences
WPC(HPI,Nights | GDP) - France
Phase-Differences
WCO(HPI,Nights) - Germany
Phase-Differences
WPC(HPI,Nights | GDP) - Germany
Phase-Differences
Period (years)
2~8 freq. band
8~15 freq.band

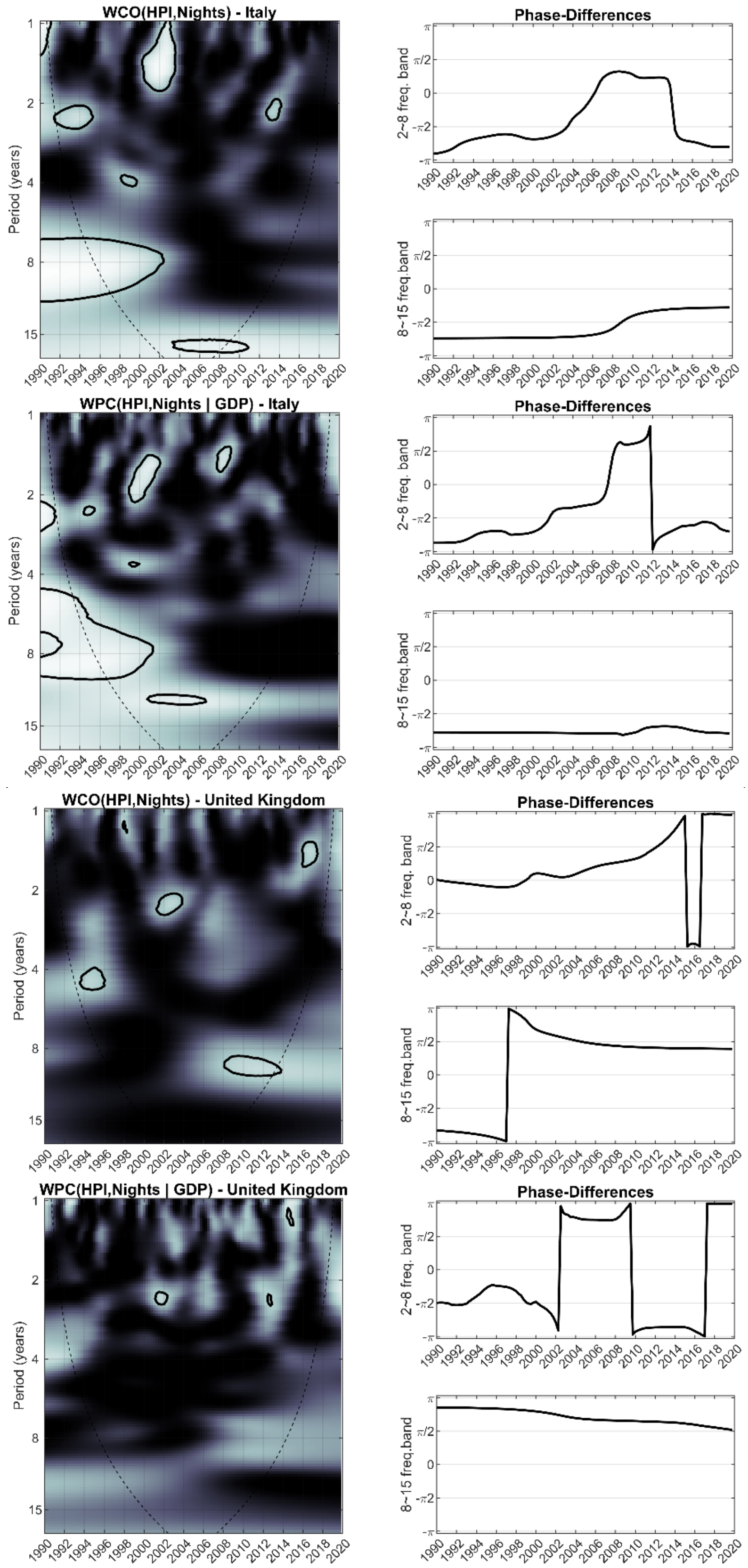


Figure 12. On the Left: Wavelet (Partial) Coherency between house prices and nights spent in tourism establishments (after controlling for GDP growth). On the right: (Partial) Phase-Difference. Wavelet (Partial) Coherency: The black contour designates the 5% significance level. The shade code for coherency ranges from black (low coherency -- close to zero) to white (high coherency -- close to one). The cone of influence, which indicates the area affected by edge effects, is the dashed line's outer region.

4.6. Conclusions

With the wavelet power spectrum analysis of the housing market, insights were gained into the patterns and synchronizations of housing prices in major European countries. When observing the Housing Prices Index for countries like France, Germany, Italy, and the UK, distinct cycles emerged. France, Germany, and Italy showcased two dominant cycles. The first being a longer one, averaging a period of about 15 years, and the second being of shorter duration. In contrast, the UK revealed two different cycles lasting for durations of 4 and 8 years, respectively.

Parallel to the housing market analysis, the study also delved into the patterns associated with the tourism sector, particularly the number of nights spent in touristic accommodations. All four major countries—France, Germany, Italy, and the UK—exhibited a dominant 15-year cycle in their tourism flows. However, the persistence of shorter duration cycles was also noted. These cycles, though consistently visible across the sample, did not always achieve statistical significance.

The crux of this study, however, was not to merely identify these cycles but to understand if, and how, they synchronize across countries. A structured comparative approach revealed that synchronization was not uniform across all countries and sectors. For instance, in the realm of house prices, we identified a pronounced comovement among Italy, France, Belgium, Spain, the UK, and Portugal, with Sweden also showing some, albeit lesser, degree of synchronization. The remaining countries demonstrated much fewer statistically significant relationships. This result aligns with prior studies that have focused on advanced economies and have consistently observed an increasing degree of synchronization in housing prices (Alter et al., 2018; Hirata et al., 2012; IMF, 2018; Katagiri, 2018). France and the UK stood out as the most synchronized duo, whereas Italy and Denmark exhibited significant divergence. Finland stood out for its minimal synchronization, offering a unique position in the European housing market landscape.

In juxtaposition, when the focus was shifted to tourism, a different synchronization pattern emerged. Spain and the Netherlands showcased the highest synchronization, while the UK and Denmark both found themselves on the less synchronized end of the spectrum. We pinpoint several countries exhibiting significant comovement: Germany, Italy, the Netherlands, Portugal, Spain, and Sweden. Finland and Belgium also display comovement, though to a reduced extent. Notably, France and the United Kingdom are not central to this interconnected dynamic.

However, beyond synchronization, a question loomed: is there a tangible relationship between the house price cycles and tourism cycles? Initial observations pointed to distinct disparities in synchronization patterns between the two. To quantify this, the Spearman correlation coefficient was applied, comparing the synchronization patterns of housing and tourism. The resulting coefficient was close to zero, suggesting that countries with synchronized housing markets did not necessarily exhibit synchronization in tourism and vice-versa.

Furthermore, we factored real GDP growth into the wavelet coherency analysis. In France, a possible interconnection between the housing and tourism sectors was observed. But, this connection, which was pronounced at very low frequencies, disappeared when GDP growth came into play. This highlights the role that broader economic factors, like GDP growth, play in shaping and influencing house prices. Other countries, like the UK, had minor pockets of statistically significant coherency between housing and tourism, which were further dwindled when GDP's influence was considered. This result is common to most countries in our sample.

In summation, while distinct cycles and synchronizations are present in both the housing and tourism sectors across major European countries, the relationship between them is not straightforward. The inclusion of GDP growth in the analysis further mitigates this relationship. Based on the findings, it is safe to infer that tourism is unlikely to be a very relevant driving force behind the fluctuations observed in housing prices in these nations. Economic factors, policies, and broader market dynamics might be playing more significant roles in shaping these trends.

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