Research article

PIIGS in and out of sync: the changing face of financial business cycle synchronization in Europe

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Abstract: We examine the average expansion and contraction magnitude and their average duration for the PIIGS, Portugal, Italy, Ireland, Greece and Spain. We then examine the synchronization of financial and economic variables, namely GDP, equity and housing prices and credit to GDP, between themselves in the same country and between the same variable across countries, to examine their behaviour over the financial business cycle. We found that equity prices expanded and contracted more than the other variables but the difference between expansion and contraction is not significant. Their average duration is shorter than the other variables and housing prices exhibit the longer average duration. We observe a positive synchronization between GDP and household prices for both tested periods for all countries except Ireland and between GDP and household prices for Italy and Portugal respectively. In addition, there is a negative synchronization between equity prices and gaps between GDP to both the countries and the periods examined. There is a positive synchronization between short-term equity and housing prices for all countries, with the exception of Italy, with a negative one for all countries, with the exception of Ireland. The results of the synchronization between the same variable across countries are mixed. Our conclusions may have implications for the design of macro-prudential policies in an environment prone to interdependence between economies.

1. Introduction

The global economic crisis has caused a complete review of how we conduct macroeconomic policy. That is, the crisis now integrates analysis of both the causes of the financial crisis and the target of economic stability. The crisis changed the view of economists who do not incorporate funding into macroeconomic models, i.e. the economic factor was not included in models that tried to understand business fluctuations (Woodford, 2003). It is now vital to develop new tools and to establish a new framework for the institutions to pursue macro-prudential policy, which means new political mandates and objectives. Therefore, macro-prudential policy is currently widely debated. There is a growing appreciation of how goals are defined and how to assess systemic risk or economic cycle (Hansen, 2012). This thinking can lead to postponement of policy decisions in the future, or market members might not interpret policy decisions in full. Understanding the economic cycle, its factors and its actual phase is vital to the pursuit of preventive macroeconomic policy (Borio, 2013).

There is no separate measure for the economic cycle, as set for the business cycle. The bibliography suggests wide range of definition of the economic cycle but there is no concrete. Business cycles are differentiated from economic cycles through their range and frequency. Economic cycles are developed in the medium term and their analysis has to overcome the shorter period of the business cycle, which means that those affecting during good lives can last for decades (Aikman et al., 2010, 2014). According to Borio (2012), the economic cycle is an interaction between perceptions of value and risk, attitudes towards risks and funding constraints, translated into booms followed by busts. These interactions may exacerbate economic fluctuations, create imbalances and introduce macroeconomic instability.

Understanding some of the financial cycle characteristics of the PIIGS economies is important to on understanding the efficiency of the policies applied on them with the common EU policy framework. If these economies are expected to be synchronized then their post crisis recoveries should be similar. So, we can use our results to cross-check the policy implication access different measures of economic and financial activity. Thus, this paper contributes to both the literature of financial business cycles and also to the discussion about the policy implication of the post crisis EU economic policies.

The purpose of this study is first to examine for a short-term (12 months interval) and long-term period (36 months interval) the magnitude expansion and contraction and their duration and then to compare the cycles and their synchronicity between a GDP-based measure and Credit or Credit/GDP, Housing prices growth, Equity growth between the same country variables and between the PIIGS countries.

Our results suggest that equity prices expanded and contracted more than the other variables but the difference between expansion and contraction is not significant. Their average duration is shorter than the other variables and housing prices exhibit the longer average duration. A positive synchronization was found between GDP and household prices for all countries except Ireland and between GDP and household prices for the two tested seasons for Italy and Portugal respectively. In addition, there is a negative synchronization between equity prices and gaps between GDP to both countries. There is a positive synchronization between short-term equity and housing prices for all countries, except for Italy, with a negative one for all countries, apart from Ireland. We finally found that the synchronization between the same variable across countries are mixed.

The rest of the paper is organized as follows: the second section defines the financial cycle and highlights its core empirical features. The third section describes the underlying data and the methodology used to construct a financial cycle analysis whereas section four exhibits the results before concluding and discussing policy implications.

2. The financial cycle: definition-characteristics

Fisher (1933) and Keynes (1936) were the first who investigated the interactions between macroeconomics and financial developments after the Great Depression. Cochrane (2006), Gilchrist and Zakrajsek (2009), Adrian et al. (2010), Christiano et al. (2010), Ng (2011), Drehmann et al. (2012), Egert and Sutherland (2012), Claessens et al. (2012), Avouyi-Dovi and Matheron (2005), Borio et al. (2013), and Borio (2014) further investigated the aforementioned issues.

There is no general agreement on the definition of the economic cycle. The term will entail self-sustaining synergies between the idea of value and risk and behavior towards risk and funding constraints that turn into busts followed by busts. These interventions may increase economic fluctuations and may lead to serious economic difficulties and economic disturbances. The procyclicality of the financial system is the closest link to the aforementioned definition of the economic cycle (see for example Borio et al. (2001), Danielsson et al. (2004), Kashyap and Stein (2004), Brunnermeier et al. (2012), Adrian and Shin (2010)). It is designed to be the most relevant for macroeconomics and policy making: it focuses on business fluctuations and financial crises. The next step is the best way to empirically approach the economic cycle. Then, the variables that can better record its relationship to the business cycle, its relation to the economic crisis, the predictive content of the economic difficulties in real time and its dependence on the political regimes are examined in turn.

First, it is possible to outline a financial cycle in terms of credit and property prices (Drehmann et al. (2012)). A co-movement of these variables is more likely to explain the significance of credit in the financing of construction and the purchase of property. Equity prices and the implied aggregate assets prices demonstrate higher volatility at short term frequencies and co-vary far less than the other two variables. A financial cycle can be outlined in various ways. On one end, one could exclusively concentrate on credit–the credit cycle (e.g., Aikman et al. (2010), Schularick and Taylor (2009), Jordá et al. (2011), Dell'Arriccia et al. (2012)). At the other end, one could associate a variety of financial prices and quantity variables, so as to extract their common components (e.g., English et al. (2005), Ng (2011), Hatzius et al. (2011)).

The combination of credit and property prices seems to be the least way to capture the core features of the link between the financial cycle, the business cycle and financial crises. These are the set of variables needed to replicate sufficiently the jointly reinforcing interaction between financing constraints (credit) and perceptions of value and risks (property prices).

Secondly, the financial cycle has a much lower frequency than the traditional business cycle (Drehmann et al. (2012)). Traditionally the business cycle involves frequencies from 1 to 8 years. Contrary, the average length of the financial cycle has been around 16 years. Comin and Gertler (2006) have already shown, the importance of the medium-term component of variations exceeds that of the short-term component also for GDP. The business cycle is still recognized in the literature with short-term fluctuations, up to 8 years. Moreover, the relative importance and amplitude of the medium term component is remarkably larger for the joint behaviour of credit and property prices

than for GDP. And individual phases also diverge between both cycles. The contraction phase of the financial cycle lasts several years, while business cycle recessions generally do not exceed one year. In fact, failing to focus on the medium-term behaviour of the series can have important policy implications.

Thirdly, peaks in the financial cycle are closely associated with systemic banking crises. The financial crises with domestic origin (i.e., those that do not stem from losses on cross border exposures) occur at, or close to, the peak of the financial cycle. And the financial crises that occur away from peaks in domestic financial cycles reflect losses on exposures to foreign such cycles. Conversely, most financial cycle peaks coincide with financial crisis.

The close relationship between the economic cycle and the financial crisis is the basis of the fourth empirical observation: it is possible to measure the real-time financial crisis risk increase with fairly good accuracy. In particular, the most promising indicators of financial crises are based on simultaneous positive discrepancies (or "loopholes") of the ratio of private sector prices of credit to GDP and property, particularly property prices, from historical specifications (Borio and Drehmann (2009), Alessi and Detken (2009)). One can think of the credit gap as a gross leverage in the economy, providing an indirect indication of the absorption capacity of system losses. One can think of the property price gap as a gross measure of the probability and magnitude of the subsequent price reversal, which controls the absorption capacity. The combination of the two variables provides a much clearer signal—one with lower noise—than any variable considered to be isolated. In addition, there is more and more evidence that the cross-border credit component tends to overcome net domestic during financial short-circuits, especially those that are ahead of severe economic pressures (Borio et al. (2011), Avdjiev et al. (2012)). This is usually the case for the direct component—in the form of borrowing directly granted to non-financial borrowers from foreign banks—and for the indirect—borrowing from domestic banks abroad and lending to non-financial Borrowers. The reasons for this regularity are not yet fully cleared. One can only be the natural tendency for wholesale funding to gain ground as a credit upward path, which is then reflected in the rising ratio of loans to deposits.6 Fifth, the length and amplitude of the financial cycle are no constants of nature, of course; they depend on the policy regimes in place. Three factors seem to be especially important: the financial regime, the monetary regime and the real-economy regime (Borio and Lowe (2002), Borio (2007)). Financial liberalisation weakens financing constraints, supporting the full self reinforcing interplay between perceptions of value and risk, risk attitudes and funding conditions. A monetary policy regime narrowly focused on controlling near-term inflation removes the need to tighten policy when financial booms take hold of the backdrop of low and stable inflation. And major positive supply side developments, such as those associated with the globalisation of the real side of the economy, provide plenty of fuel for financial booms: they raise growth potential and hence the scope for credit and asset price booms while at the same time putting downward pressure on inflation, thereby constraining the room for monetary policy tightening.

In closing this section we mention that another strand of the literature analyses the crisis of PIIGS economies using a number of wedges as they described by the business cycle accounting (BCA) framework that first mentioned by Chari, Kehoe and McGratttan (2007). Namely, these wedges were TFT, labor, investment and government wedge. The scope of a business cycle accounting approach is to reveal the main wedges that drive business cycle. The common finding of the studies is that TFT and labor wedge are the most significant factors of the business cycle, wheather they examine a strong open economy like the U.S. (Kersting, 2008), Japan (Saijo, 2008) or

a small open economy (see for example Otsu, 2010; Lama, 2012). This is a specific topic of the crisis in the PIIGS countries known as a "sovereign debt crisis". Orsi & Turino (2014) for Italy, Caraiani (2016) for European Peripheral Economies (Greece, Ireland, Portugal, Spain), López & García (2016) for Spain, among others, examined business cycles utilizing the BCA approach for the PIIGS countries. Here we deal with a broader aspect of the crisis that is the macroprudential policy through the understanding some of the financial cycle characteristics of the PIIGS economies.

3.   Data and methodology

We analyse the behaviour of four variables for PIIGS, over the period 1995Q1 to 2016Q3 with quarterly data. We take GDP as the representative for business cycle. GDP is derived from the Eurostat database and is included in real terms and seasonally adjusted.

We consider the following financial variables for the financial cycle:
1)   Equity prices that are derived from Thomson – Reuters.
2)   Residential property prices, for asset prices. The Housing prices are derived for OECD database and are included in real terms and seasonally adjusted.
3)   Credit to GDP, to capture the credit development. The data is derived from BIS database.

In our analysis we follow the analysis as described in the Thomakos and Papailias (2012) study. We consider the results in Harding and Pagan (2006), where a coherent methodology is presented for testing cycle synchronicity. The testing methodology proposed therein presupposes that one has available indicator variables that identify expansion and contraction periods for each series. There are various ways of getting these indicator variables but here we follow a straightforward approach as presented in Harding (2008). We briefly summarize the methodology below while full details can be found in the above papers. Consider a time series of interest y_t and suppose that you would like to find its local turning points (local maxima and minima) in a window of k observations. Then, these local peaks and troughs are given by:

$$\Lambda_t \overset{\text{def}}{=} I[(y_{t-k}, \ldots, y_{t-1}) < y_t > (y_{t+1}, \ldots, y_{t+k})] \tag{1}$$
$$V_t \overset{\text{def}}{=} I[(y_{t-k}, \ldots, y_{t-1}) < y_t > (y_{t+1}, \ldots, y_{t+k})] \tag{2}$$

where $I(\cdot)$ is the indicator function. While these two variables can be used to mark expansions and contractions they have the problem that cycle phases may not alternate and, to alleviate this problem, a form of censoring can be used. To do so one uses the following recursion to construct a single binary variable that marks expansions and contractions and has the cycle phases alternating:

$$S_t \overset{\text{def}}{=} S_{t-1}(1 - \Lambda_{t-1)} + (1 - S_{t-1})V_{t-1} \tag{3}$$

Based on the above series the alternating turning points are then given by:

$$\Lambda_t^a \overset{\text{def}}{=} S_t(1 - S_{t+1}) \tag{4}$$
$$V_t^a \overset{\text{def}}{=} (1 - S_t)S_{t+1} \tag{5}$$

The focus of the analysis is in the S_t series. Consider two such series S_{tx} and S_{ty} for two underlying variables X_t and Y_t, the latter are in our context the ESI variables for country X and country Y. Let also $\rho_S \overset{\text{def}}{=} Corr[S_{tx}, S_{ty}]$ denote the correlation coefficient between S_{tx} and S_{ty} series. Adapting Harding and Pagan (2006), the series are said to be in strong positive synchronization when the following conditions hold:

$$SPS: E[S_{tx}, S_{ty}] = 0 \text{ and } \rho_S = 0 \tag{6}$$

where if in addition $\rho_S = 1$ then we have the series to be in strong perfect positive synchronization. On the other hand, the series are in strong negative synchronization if they have zero correlation, i.e. when we have:

$$SNS: \rho_S = 0 \tag{7}$$

without the need to consider the properties of the mean difference $E[S_{tx}, S_{ty}]$. Testing the above conditions is easily done via a GMM approach that accounts for the presence of potential heteroscedasticity and autocorrelation. We use two values for k, one corresponding to an annual cycle ($k = 12$ months on either side of the turning point) and one corresponding to three years cycle (k = 36 months). Other values of k produce qualitatively similar results but are harder to justify on monthly data.

To compare the results from the above methodology we also employ the estimation of half-lives for the differences of the same series for a pair of countries. If we define by $Z_t = X_t - Y_t$ then we can estimate the half-life using an autoregressive model with a constant term, i.e. using:

$$Z_t = \phi_0 + \phi_1 Z_{t-1} + \epsilon_t \tag{8}$$

Since the half-life is the measure of the time that it takes for the series of the differences to close half its distance from its mean, which we can say corresponds to the equilibrium difference, then it can be computed with the following formula:

$$h = \frac{\log(2)}{\log(|\phi_1|)} \tag{9}$$

Since the series of the differences will be by construction mean reverting, it follows that the larger the half-life estimate is the greater the distance of two variables to be synchronized.

4. Discussion of results

We are now examining the results presented in Tables 1–4. First, we look at the average magnitude expansion and contraction and their duration for the entire tested period, i.e. for 1995Q1 to 2016Q3 for a short-term period (12 month interval for measuring peaks and troughs) and for long-term period (36 month interval). Then we look at the synchronization between the same country variables followed by the synchronization between the same variable and between countries for the period under review.

4.1. Expansion – contraction: average magnitude, duration

Table 1 presents the effects of the average magnitude expansion and contraction for the short-time period. We first notice that the GDP contraction is more severe than that of its expansion, but its duration is shorter than the expansion for all countries. On the contrary, equity prices are expanding faster than their contractions, but the duration of the expansion is less than the contraction. Household prices are mixed. House prices are expanding more rapidly in Ireland and Greece, and fall further in Spain and Portugal. The duration is longer in their contraction that their bending is especially true for Greece. A reverse trend is seen in Spain, Italy and Portugal. The size of credit to GDP has been more extended to Greece only, while it is slowing down in Ireland, Spain and Portugal, and finally, we have equality in Italy. On the other hand, the duration of credit to GDP is higher for all countries except Portugal.

When we see the intra-country variables, we find that credit to GDP is expanding much more than the other variables in Ireland, followed by housing prices, which rose by 4.5%, which increases GDP by 2.6%. Equity prices rose by 1, 8%. The duration of house price hikes is twice as long as the duration of the credit to GDP, which in turn is almost equal to the expansion of GDP. Finally, equity price duration is between the duration of GDP and house prices. It appears that the credit finances the housing market, which in turn increases the country's GDP and equity prices rise less than all other variables. In contraction, we see that GDP is falling sharply, followed by GDP, while falling house prices are half of the decline in GDP. When we compare the variables themselves, we see a serious decline in the GDP variable relative to its expansion, while the other variables decrease less than that of GDP.

Table 1. Amplitude and duration of the expansion and the contraction.

	Amp-Exp	Amp-Con	Dur-Exp	Dur-Con
IE_RGDP	0,026	-0,061	6,000	3,143
EL_RGDP	0,013	-0,018	5,500	4,857
ES_RGDP	0.009	-0,009	6,000	6,000
IT_RGDP	0.014	-0,015	4,875	4,333
PT_RGDP	0,015	-0,013	3,400	4,889
IE_EP	0,180	-0,141	4,125	5,625
EL_EP	0,311	-0,293	3,364	3,727
ES_EP	0,256	-0,190	3,444	5,222
IT_EP	0,205	-0,206	3,200	3,500
PT_EP	0,262	-0,242	3,700	4,556
IE_RHP	0,045	-0,033	6,400	6,833
EL_RHP	0,027	-0,024	5,000	8,000
ES_RHP	0,032	-0,034	5,429	4,375
IT_RHP	0,013	-0,012	9,250	7,200
PT_RHP	0,017	-0,024	6,286	4,143
IE_CGDP	0,077	-0,082	3,455	4,000
EL_CGDP	0,031	-0,020	2,900	5,444
ES_CGDP	0,014	-0,017	5,714	6,333
IT_CGDP	0,016	-0,016	4,875	5,571
PT_CGDP	0,024	-0,037	3,909	3,182

Notes to Table 1:

1. IE: Ireland, EL: Greece, ES: Spain, IT: Italy, PT: Portugal
2. RGDP: Real GDP, EP: Equity Prices, RHP: Real House Prices, CGDP: Credit-to-GDP
3. Amp-Exp: Average expansion magnitude
   Amp-Con: Average contraction magnitude
   Dur-Exp: Average expansion duration in quarters
   Dur-Con: Average contraction duration in quarters

The duration of the expansion for GDP is longer, 6 years compared to 3 years for contraction, while the opposite applies to all other variables that are 4 years to 6 years for equity prices, almost the same 6.4 years to 6,8 years for home Prices and from 3 to 4 years for credit to GDP.

The results are quite simple because the expansion of credit directed to the market is not followed by the same share price increase. On the contrary, the fall in GDP has a larger impact on GDP, the 8.2 per cent drop in credit leads to a 6.1 per cent drop in GDP, while the fall in house prices is just 3.3 per cent and the share price Is 1.41%. It appears that the increase in credit finances the domestic property market, which in turn increases the country's GDP.

On one hand, Greece is almost inversely trending. We observe that household prices are further expanding from equity prices and an almost similar credit expansion and a small bust of GDP. In addition, we observe the same trend in contraction. Equity prices declined, followed by a decline in household, credit and GDP prices respectively. On the other hand, the duration of the equity price widening is less, 3.3 years, than that of the credit, 5.7 years, GDP, 5.5 years, and house prices, 5 years respectively. When comparing the variable between the countries, we notice that the GDP fall is higher than the other variables that expansion and contraction do not differ significantly. The duration of contraction is higher for housing prices than for expansion, from 8 to 5 years, which also applies to credits, from 5.4 to 2.9 years. In the case of Greece, it appears that equity prices have risen more than the other variables. In addition, equity price rises are financing households that have resulted in a small increase in GDP.

We are then following Spain where the results show that equity prices rose more than those of other variables, followed by a tilt in household, credit and GDP prices respectively. On the other hand, the time for share price widening is less, 3.3 years, than that of the other variables, i.e. 5.7 years for credits, 5.4 years for household prices and 6 years for GDP. When comparing the variables with each other, we do not see significant differences between the expansion and contraction phases, except equity prices. The same is true when we see the duration of the expansion and contraction phases, with the exception of equity prices. The results show that Spanish equity prices finance the purchase of a home and have little impact on credit expansion and GDP growth.

Italy has a different trend. Equity prices were further broadened than the other variables followed by credit, GDP and household prices, respectively. The equity price widening was 3.2 years with the other variables, i.e. 4.9 years for credits and GDP and 9.3 for household prices. We do not see a significant fall for all variables in Italy for both size and duration, except for the duration of the contraction in house prices. In addition, when comparing the variables in Italy, we observe that the magnitude of the expansion is almost the same for all variables, which is true for both the duration and the exception for the duration of the contraction of house prices. It appears that in Italy both equity prices and credit expansion equally finance the housing market.

Portugal has a similar trend to Italy. Share prices were further broadened than the other variables followed by credit, GDP and household prices, respectively. Extending equity prices lasted 3.7 years with the other variables, i.e. 3.9 years for credits, 6.2 years for household prices and 3.4 years for GDP. We do not see a significant contraction for all variables in Portugal for both size and duration, with the exception of the decline in house prices. In addition, when we compare the variables between them in Portugal, we notice that the magnitude of the expansion is almost the same for GDP and equity prices, but the decline in housing and credit is more severe than their expansion, which is true for the duration of the recession household prices. The duration of extension and contraction do not differ significantly.

The results for Portugal indicate that the rise in equity prices leads to the purchase of a dwelling, although the credit has widened as equity prices and implies that only the rise in house prices is responsible for GDP growth, which was increased almost as household prices widened.

In summary, it appears that the expansion of housing prices has led to GDP growth, with the exception of Italy. In addition, the extent of expansion and contraction is, for most countries, identical or not significantly different. Another interesting conclusion is that in general the duration of equity price expansion is less than the expansion of other variables, and the expansion of GDP and household prices lasts longer.

Table 2 shows the results of the range and contraction for a longer period (36 months from both sides of the turning points) for all countries. We observe similar trends as previously described.

Table 2. Amplitude and duration of the expansion and the contraction.

	Amp-Exp	Amp-Con	Dur-Exp	Dur-Con
IE_RGDP	0,156	-0,053	7,000	13,667
EL_RGDP	0,040	-0,057	7,800	7,750
ES_RGDP	0,022	-0,032	13,667	9,667
IT_RGDP	0,031	-0,054	10,750	6,750
PT_RGDP	0,051	-0,031	5,200	11,000
IE_EP	0,729	-0,319	5,250	16,333
EL_EP	1,039	-0,788	5,400	10,750
ES_EP	0,183	-0,641	12,750	6,333
IT_EP	0,623	-0,403	5,750	12,000
PT_EP	0,410	-0,826	8,400	5,600
IE_RHP	0,125	-0,119	7,500	8,750
EL_RHP	0,057	-0,070	12,000	16,500
ES_RHP	0,071	-0,076	9,667	12,000
IT_RHP	0,035	-0,034	16,000	16,500
PT_RHP	0,060	-0,061	10,667	11,000
IE_CGDP	0,120	-0,199	16,333	7,000
EL_CGDP	0,062	-0,110	10,750	5,400
ES_CGDP	0,005	-0,073	29,000	6,000
IT_CGDP	0,031	-0,049	14,667	13,000
PT_CGDP	0,050	-0,099	10,500	5,600

Notes to Table 2: See Table 1.

4.2. Synchronization between pairs of the same country

Table 3 shows the results of synchronization between the pair of the same countries for the short and the long period. First, there is a positive synchronization between GDP and household prices for both tested periods for all countries except Ireland. Secondly, there is also a positive synchronization between GDP and household prices in the two tested periods for Italy and Portugal. In addition, there is a negative synchronization between equity prices and gaps between GDP to both countries and the two periods under review. The result above is more or less likely, as there is a negative correlation between equity prices and credit expansion. In addition, there is a positive synchronization between short-term equity and housing prices for all countries, with the exception of Italy, with a negative one for all countries, with the exception of Ireland.

Table 3. Synchronization between pairs of the same country.

		GDP	EP	RHP	CGDP
Ireland	GDP	*			
	EP	(-, +)	*		
	RHP	(x, +)	(+,+)	*	
	CGDP	(-, -)	(-,-)	(-, x)	*
Greece	GDP	*			
	EP	(-, x)	*		
	RHP	(+,+)	(+, -)	*	
	CGDP	(-, -)	(-, -)	(+,+)	*
Spain	GDP	*			
	EP	(x, -)	*		
	RHP	(+,+)	(+, -)	*	
	CGDP	(+, x)	(-, -)	(+, x)	*
Italy	GDP	*			
	EP	(+,+)	*		
	RHP	(+,+)	(-, -)	*	
	CGDP	(-, +)	(-, -)	(+,+)	*
Portugal	GDP	*			
	EP	(+,+)	*		
	RHP	(+,+)	(+, -)	*	
	CGDP	(-, -)	(-, -)	(-, -)	*

Notes to Table 3:

1. + : positive synchronization, - : negative synchronization, x : unsynchronized

2. First sign refers to 12 months intervals for measuring peaks and troughs; second sign refers to 36 months intervals for measuring peaks and troughs.

Starting with Ireland, we see a negative synchronization between GDP and equity prices, the short-term tested period and GDP, while GDP and house prices are not synchronized. When we turn to the long-term period, we see that GDP is negative in line with CGDP, while there is a positive synchronization between GDP and equity and housing prices. There is a positive synchronization between equity and house prices for both periods, while there is a negative synchronization between

equity prices and credit to GDP for both periods. Finally, we see a negative synchronization between house prices and credit to GDP over the short-term period while unsynchronized for the long-time period.

Greece presents a different pattern in the synchronization between the pairs of variables. GDP is negatively synchronized with equity prices for the short-term period and is unsynchronized for a long-term period. On the other hand, there is a positive synchronization between GDP and house prices for both periods, while there is a negative synchronization between GDP and GDP for all periods. We observe a positive synchronization between equity and housing prices in the short-term while negatively synchronizing in the long-term. On the other hand, there is a negative synchronization between equity prices and credit to GDP for all periods. There is a positive synchronization between house prices and credit to GDP for both tested periods.

The findings of Spain show some interesting results. Spanish GDP is unsynchronized in the short-term, with long-term negative synchronization. In addition, GDP is in line with house prices for both periods. GDP is also a positive GDP adjusted, but only in the short-term, while not synchronizing for a long time. We see a positive synchronization between equity and housing prices for short-term, while there is a negative price for a long time. Finally, house prices are positively synchronized with the credit to GDP for Spain in the short term, and are unsynchronized over the longest period.

There is a positive synchronization between Italian GDP and share and housing prices for both short and long test periods. There is a negative synchronization between GDP in Italy and GDP for the short test period while we see an inverse synchronization for these variables in the long run. Equity price results show a negative synchronization with house prices and credit to GDP for both tested periods. Finally, housing prices in Italy show a positive synchronization with the credit cost to GDP for all periods.

Portuguese GDP has a similar pattern to that of Italy. There is a positive synchronization between the country's GDP and the share and housing prices for both tested seasons. On the other hand, there is a negative synchronization between GDP and credit to GDP again for both tested periods. Equity prices are positively synchronized, but only for the short-term, while there is a negative synchronization between equity prices and credit to GDP for all periods. Finally, we see an identical synchronization between house prices and credit to GDP for all periods under review.

4.3. Synchronization between the same variable across countries

Table 4 shows the results for synchronization between the same variables as well as between countries. GDP for Ireland is not synchronized with GDP for Spain and Italy. Exit a positive synchronization between Irish and Greek GDP for the short-term while being asynchronous for the long-term. There is a reverse link between Irish GDP and Portuguese GDP. On the other hand, Greek GDP is in line with the GDP of Spain, Italy and Portugal for both tested periods. Spanish GDP is in the short-term synchronized with Italian and Portuguese GDP and is asynchronous for the long-term period. Finally, we see a similar pattern for Italian GDP relative to Portuguese GDP.

Equity prices in Ireland are positively synchronized with the equity prices of Greece and Italy for both tested segments, while they are positively synchronized with Spanish and Portuguese equity prices for the short-term period of time and long-term asynchronous. Equity prices in Greece are not synchronized with those in Spain for both periods but are positively synchronized for both periods between Ireland and Italy. We observe that equity prices for Greece are not synchronized with prices

in Spain for both tested seasons, while there is a positive synchronization between the prices of the shares of Italy and Portugal.

Table 4. Synchronization between the same variable across countries.

		Ireland	Greece	Spain	Italy	Portugal
GDP	Ireland	*				
	Greece	(+, x, 2.317)	*			
	Spain	(x, x, 1.929)	(+, +, 2.916)	*		
	Italy	(x, x, 2.203)	(+, +, 6.407)	(+, x, 5.926)	*	
	Portugal	(x, +, 2.127)	(+, +, 4.260)	(+, x, 4.269)	(+, x, 2.987)	*
EQUITY PRICES	Ireland	*				
	Greece	(+, +, 3.325)	*			
	Spain	(+, x, 2.665)	(x, x, 2.884)	*		
	Italy	(+, +, 1.981)	(+, +, 2.814)	(x, x, 1.543)	*	
	Portugal	(+, x, 2.451)	(+, +, 2.999)	(+, x, 1.212)	(+, +, 2.277)	*
REAL HOUSE PRICES	Ireland	*				
	Greece	(x, +, 10.652)	*			
	Spain	(+, +, 11.764)	(+, +, 7.127)	*		
	Italy	(+, +, 16.404)	(+, +, 5.274)	(+, +, 16.536)	*	
	Portugal	(+, +, 12.878)	(+, +, 12.564)	(+, +, 21.782)	(+, -, 16.438)	*
CREDIT TO GDP GAPS	Ireland	*				
	Greece	(+, +, 2.376)	*			
	Spain	(+, x, 2.366)	(+, x, 2,739)	*		
	Italy	(+, +, 2.240)	(x, +, 3.034)	(+, +, 8.360)	*	
	Portugal	(+, -, 2.797)	(x, +, 4.173)	(+, -, 5.591)	(+, +, 5.371)	*

House prices are positively synchronized in all countries for both tested periods outside Ireland and Greece and Italy and Portugal. Irish housing prices are not synchronized with those of Greece in the short-term, while they are synchronously positive for the long-term. On the other hand, Italy's house prices are positively synchronized with those of Portugal, while there is a reverse timing for the long-term.

The credit to GDP is positively synchronized for Ireland and Greece, Ireland and Italy, Spain and Italy, and Italy and Portugal. Credit cost to Ireland's GDP is positively synchronized with the corresponding Portuguese GDP in the short-term while negatively synchronized for the long-term period. The same pattern follows the Spanish credit-to-GDP variable in relation to the Portuguese variable. The Irish GNP credit line is positively synchronized in relation to the corresponding

Spanish credit product to GDP in the short-term and is unsynchronized for the long-term period. The same pattern follows the Greek credit-to-GDP variable in relation to the Spanish variable. Finally, the Greek credit deficit to GDP is not synchronized with that of Italy and Portugal for the short-term, while it is positively synchronized for the long-term tested period.

The half-life values will be discussed in section 4.4 of this chapter.3.

4.4. Explaining the results

The results can be explained considering the common characteristics of the PIIGS countries for the pre- and the crisis period as they described in the literature (see for example Fagan & Gaspar, 2007; Mendoza, 2006) on the one hand and on the other hand the different type of crisis that the PIIGS countries faced.

First, for the pre-crisis period most of the PIIGS economies are characterized by:
1. Lower interest rates following the adoption of the Euro.
2. Private consumption increased while the rate of savings decreased
3. Private credit increased leading to an increased indebtedness
4. These economies ran large and persistent current account deficits
5. The real exchange rate appreciated in these countries

As soon as the crisis began, these economies were characterized by what can be described as a typical sudden interruption (stop):
1. The interest rate increased sharply
2. The current accounts reversed from deficit towards surpluses
3. The real exchange rate depreciated
4. Private credit is reduced
5. Output and private consumption declined

The PIIGS economies faced a different type of crisis. Greece, Italy and Portugal were confronted with fiscal profligacy which led to austerity and economic adjustment programs while Spain and Ireland had to cope with the private debts arising from a property bubble were transferred to sovereign debt because of banking system bailouts and government responses to slowing economies post-bubble.

The Irish sovereign debt crisis arose not from government over-spending, but from the state guaranteeing the six main Irish-based banks who had financed a property bubble.

Our results indicate that the average expansion magnitude of the Ireland's GDP is the largest of all the PIIGS economies while the average contraction magnitude was the deepest. Furthermore, the duration of the expansion is the longest and contraction of the GDP was the shortest. The reason is that the Irish economy recovered much faster than the other PIIGS economies. On the other hand, Ireland's GDP is generally not synchronized with those of the other countries which can be explained by the half live value which is relatively small for all pair of countries indicating that the Irish GDP can converge in a short time to the country's median resulted to asynchronization. The asynchronization can be also explained by the structural country differences.

The values of the Irish equity prices suggest that the average expansion and contraction magnitude is the smallest of all the PIIGS economies, but the duration of the expansion and contraction is the longest. Furthermore, the equity prices are generally synchronized with those with the other countries. Moreover, the half-life values are again small indicating that the return to a

median value is quicker apart from Greece. The findings imply that the equity prices are mostly affected by the fall of the equity prices in the Irish stock market due to the real estate market problems and the recovery is slower than that of the other countries but at the same time the move together because the stock market was influenced by the international capital movements and investments.

The real house prices in Ireland show a fast and a deep average expansion and contraction respectively. The duration of the expansion and contraction are among the highest compared to the other countries that implies that because of the severe decline of the property prices because of the property bubble that caused the crisis in Ireland. Furthermore, the real house prices move together along with the other countries, but it takes longer to return to their difference of means because they can be less responsive to policy achieves which focus on restoring growth and employment.

We observe that the results of the credit to GDP gaps values are the highest for both the average expansion and contraction magnitude and the respective duration is among the shortest. This holds because of the crisis there was a shortage of credit in Ireland because the real estate market was financed from the banks. The short duration of the contraction is because of the fast-Irish recovery due to the policies implemented.

Greece's debt crisis was due the government spending to keep the economy functioning, after the financial crisis of 2007–2008.

The Greek GDP experienced a contraction almost of the same average magnitude compared to the other countries that holds for the duration as well. The recovery of the GDP was slower than its decline but lasted more. Moreover, the Greek GDP moves together along with the other PIIGS countries, but it has to take longer to return to their difference of means because Greece although implemented all the structural reforms is still in the crisis phase with slow recovery.

The Greek equity market experienced a severe downturn but an impressive expansion that was due to the bank recapitalization. It has to be mentioned the Greek stock market is dominated by the banks. The equity prices move again together with the other countries because of the fruitful international stock market effect but is still true that it will take longer to converge to the differences of their means. The house prices exhibit an almost average magnitude of expansion and contraction, but the downturn lasted most than the other countries and the expansion was again slower. This is true because the real estate market was hit more severe of the crisis than the other economic sections and the recovery is subject to the economic policies that aim a recovery.

Spain had a comparatively low debt level among advanced economies prior to the crisis. Its public debt relative to GDP in 2010 was only 60%, more than 20 points less than Germany, France or the US, and more than 60 points less than Italy, Ireland or Greece. Debt was largely avoided by the ballooning tax revenue from the housing bubble, which helped accommodate a decade of increased government spending without debt accumulation. When the bubble burst, Spain spent large amounts of money on bank bailouts.

The Italian economy has experienced a prolonged slowdown in per capita growth. A long-term analysis suggests that this poor performance of the Italian economy cannot be attributed to an unfortunate business cycle incident. The macroeconomic data demonstrates that the Italian economy has not evolved as quickly as these other European economies. This weak performance has to be attributed to the structural characteristics of the Italian production system which have remained largely unchanged for decades and have proved inadequate to cope with competitive pressure on

international markets or exploiting the opportunities arising from technological innovations and European economic integration.

Portugal had allowed considerable slippage in state-managed public works and inflated top management and head officer bonuses and wages in the period between the Carnation Revolution in 1974 and 2010. Persistent and lasting recruitment policies boosted the number of redundant public servants. Risky credit, public debt creation, and European structural and cohesion funds were mismanaged across almost four decades. When the global crisis disrupted the markets and the world economy, together with the US subprime mortgage crisis and the eurozone crisis, Portugal was one of the first economies to succumb, and was affected very deeply.

The results of the variable values of these countries are mostly similar with those of the aforementioned.

To sum up, our results suggest that Ireland experienced a severe downturn in most of the variables, GDP, real house prices and credit to GDP gabs but it lasted less compared to the other PIIGS countries. Greece on the other hand faced an equity price decline. The expansion of GDP, real house prices and credit to GDP gabs was impressive again for Ireland than again lasted more except for Italy's house prices. Moreover, most of the countries are synchronized because of their participation in the same economic zone, the Eurozone, and they have the same currency which means that common policies are implemented. Our findings also imply the real estate market was severe hit and at the same time it will take longer to converge to the difference of their means due to the policies that are implemented which focus to the growth and employment namely the economic recovery and stability.

6. Concluding remarks

The "global" economic crisis of 2007 has highlighted significant attention in the analysis of economic stability and causes of economic crisis. Macroeconomic supervisory policy has emerged as an important political area designed to protect economic stability weaknesses. The economic system is often based on the cyclical movements of economic variables (e.g. booms or busts). These are full with dangers and can cause serious macroeconomic tensions. Therefore, the understanding of the financial cycle and its drivers are essential for the behavior of the macro policy.

Compared with business cycles, financial cycles evolve over the medium term and their analysis goes beyond the short-term focus of business cycle theory. Cyclical movements of financial variables can enhance economic fluctuations, cause imbalances, lead to macroeconomic destabilization and / or threaten financial stability.

In this paper we measure the average magnitude expansion and contraction and at the same time the average duration of the expansion and contraction in quarters for the PIIGS countries, namely Portugal, Italy Ireland, Greece and Spain, in two time period. The first period, short-term, is 12 month interval for measuring peaks and troughs while the second, the long-term, refers to 36 months intervals for measuring peaks and troughs. Furthermore, we investigated the synchronization of financial variables, GDP, equity and housing prices and credit-to GDP, first between them and across countries and secondly between pairs themselves of the same country.

Our results, for the short-term period (annual interval for measuring peaks and troughs), imply that equity prices expanded and contracted more than the other variables followed by the housing prices, credit-to-GDP and GDP respectively. Moreover, the difference between the average

expansion and the average contraction do not differ significantly from all variables, save the GDP of Ireland. The average duration of expansion and contraction is lower for equity prices, while it peaked from house prices for all countries. When we look at the long-term period (three year interval for measuring peaks and troughs), we observe that a quite similar pattern concerning the average magnitude for all countries while at the same time the average duration expands significantly.

There is a positive synchronization between GDP and household prices for both tested periods for all countries except Ireland. Secondly, there is also a positive synchronization between GDP and household prices for the two tested seasons for Italy and Portugal. In addition, there is a negative synchronization between equity prices and gaps between GDP to both countries and the two periods under review. The above result is more or less likely as there is a negative correlation between equity prices and credit expansion. In addition, there is a positive synchronization between short-term equity and housing prices for all countries, with the exception of Italy, with a negative one for all countries, with the exception of Ireland.

The results for the synchronization between the same variable across countries are mixed. Most of the variables are unsynchronized over the tested periods. Housing prices present a more uniform pattern that is positively synchronized with all countries over the two tested periods with the exception of Ireland and Greece and Italy and Portugal.

Understanding synchronization of financial cycles between countries is therefore a central question. Thus, in this paper we are studying the synchronization of financial variables, GDP, equity and housing prices and credit to GDP, between the PIIGS countries (Portugal, Italy, Ireland, Greece, Spain), between 1995–2016. Our empirical results may be useful for building theoretical models that analyze international macroeconomic fluctuations, especially economic crises.

Conflict of interest

All authors declare no conflicts of interest in this paper.

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