Eurozone cycles: an analysis of phase synchronization

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Abstract

This paper analyses synchronization, both across and between, business and financial cycles (growth and classical) in a subset of ten countries representative of the Economic and Monetary Union (EMU). Employing an extended data set from 1960 to 2013, we find evidence of synchronization across financial cycles. In case of business cycles, we find contrasting results: there is significant synchronization across growth cycles but no evidence of a common classical cycle. This confirms first, that economic and financial variables in the EMU behave differently and second, that synchronization in business cycles arises from synchronized deviations from the trend but the underlying macroeconomic fundamentals are not in synch. Furthermore, we adopt a novel approach to break down our full sample period into smaller sub-periods to follow the evolution of synchronization over time. Our results highlight the role played by the monetary union in further increasing macroeconomic divergences.

Keywords: business cycles, concordance, Eurozone, financial cycles, macroeconomic divergences/monetary policy, time-frequency analysis.

JEL: C14, E32, E44.

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1. Introduction

This paper evaluates business and financial cycle synchronization in a subset of ten countries representative of Europe's Economic and Monetary Union (EMU) for the period 1960-2013. Employing an extended dataset covering periods both before and after the introduction of the euro, we examine both classical and growth cycles in order to analyse synchronization in recessions and expansions as well as synchronization in high-growth and low-growth periods. In contrast to the existing literature, this allows us to further probe whether the observed patterns of synchronization arise from a co-movement of output level or output gap, i.e. whether it is the classical cycle that exhibits synchronization or the growth cycle. Our paper also augments the existing studies by examining synchronization in smaller sub-periods to follow its evolution more closely. We adopt a novel approach in breaking down the full sample time series into smaller sub-periods based on graphical analysis of the mean and standard deviation of the relevant time series.

Our aim is to assess whether with the introduction of the euro, EMU members spend more time in the same cyclical phase as was posited by some authors at the time of its inception such as Artis and Zhang (1997) and Frankel and Rose (1998). Others such as De Haan *et al.*, (2008: 265) have argued that the monetary union can result in less business cycle synchronization as the exchange rate can no longer act as a shock absorbing mechanism, meaning that all adjustments must be borne by the real economy, with Eurozone (EZ) members relying on either export (Germany) or domestic demand (Spain and France) as drivers of economic recovery (McCarthy, 2006).

This question is of importance in a monetary union as it is linked to the effectiveness of implementing common countercyclical economic policies in response to the euro crisis to revive economic growth. If business cycles are not

synchronized, a one-size-fits-all monetary policy may not be optimal as some countries will be in the contraction phase while others will be in the recovery phase of their cycles. The existence of a common business cycle is under debate (partly because of the use of different data and methods) but the consensus is that there is no common business cycle in the EZ and that the economic trend is one of divergence rather than convergence (Gayer, 2007; Hallett and Richter, 2008). De Haan *et al*. (2008: 266) determine in their business cycle synchronization survey that business cycles in the EZ are "substantially out of synch" and that there is no movement towards the "emergence of a 'European' business cycle." Similarly, Bein *et al*. (2000) find no common cyclical features in the EZ and Kose *et al*. (2003) find no evidence of a European cycle. Camacho *et al*. (2006) also conclude that the establishment of the EMU has not increased the levels of co-movement across these economies. Artis *et al*. (2005) observe low signs of synchronization across the EZ.

Any such divergence would affect the sustainability of the monetary union especially if the dynamics of financial cycles are considered (Borio, 2014). Therefore, drawing on Claessens *et al*. (2012), we also explore the interaction between business and financial cycles. The synchronization of business and financial cycles within each country can magnify fluctuations via a feedback mechanism where financial variables affect real variables and vice versa (Claessens *et al*., 2012). Transmission of this impact via the common monetary mechanism can then influence the EZ as a whole. For instance, if economic recessions are accompanied by financial downturns, the adverse impact may be more severe and prolonged (Claessens *et al*., 2012). It is, therefore, of prime importance to further deepen our understanding of the link between business and financial cycles (Borio, 2014; Claessens *et al*., 2012; Egert and Sutherland, 2014). For this reason, our paper also analyses the interaction between business and financial cycles which has not been done exclusively for the EZ before.

Following this introduction, section 2 presents our data and methodology. Concordance indices are used to investigate the extent of co-movement in economic cycles. Section 3 examines the synchronization of the different phases (recessions and expansions) of classical business cycles (measured by industrial production) across our sample of EMU members; the different phases (downturns and upturns) of classical financial cycles (measured by equity prices) across those same countries participating in EMU; the synchronization of the different phases (high-rate and low-rate) of the growth version of business and financial cycles; and the concordance between business and financial cycles. We test whether this co-movement or concordance is statistically significant and whether it has intensified or diminished over time. Section 4 provides concluding comments.

2. Measuring synchronization in cycles

Observed patterns of synchronization depend on the choice of measurement methods. The choices involved here concern: the cycle (classical versus growth and cycles in growth rates); the concordance (correlation versus concordance index); and the detrending technique (linear, band pass or high pass) (Hallett and Richter, 2008: 73). We follow Hodrick and Prescott (1997: 2) in assuming "that no one approach dominates all the others and that it is best to examine the data from a number of different perspectives". Our methods consist of first detecting cycles by identifying turning points and second determining synchronization by calculating concordance indices. This methodology was developed for studying business cycles and applied to financial cycles by Claessens *et al*. (2012), Drehmann *et al*. (2012) and Pagan and Sossounov (2003).

For detecting cycles, we first focus on classical cycles which consider the level of the underlying time series. Classical cycles have been defined by Burns and Mitchell (1946: 3) as the sequential pattern of expansions (the time period from a

trough to a peak) and recessions (the time period from a peak to a trough) in the level of economic activity, with the rider that "this sequence of change is recurrent but not periodic". The Burns and Mitchell rules guided the National Bureau of Economic Research (NBER) procedure for producing the reference dates of the business cycle for the United States. For classical financial cycles, the expansion phase is termed an upturn and the contraction phase a downturn (Claessens *et al*., 2012: 180).

Second, we focus on growth cycles which involve removing the permanent component (trend) from the underlying time series. Growth cycles are defined by Kydland and Prescott (1990) as the deviation of the variable of interest from its long-term trend. While classical and growth cycles are related, the growth cycle measures the upward and downward deviation of economic or financial activity from its long-term trend rather than the level. Therefore contrary to classical cycles, the trend and cyclical components have to be separated for identifying growth cycles. This requires identifying "the factors determining long run economic growth from those determining cyclical fluctuations" (Stock and Watson, 1999: 9). However, breaking down the relevant time series into trends and cycles is not easy as both the trend and cycle influence each other and an appropriate filtering technique is required.

2.1 Data

The data were obtained from the OECD statistics database for ten countries selected as representative of the present-day EZ: Austria, Belgium, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain.

For business cycles, we use 10 seasonally adjusted monthly time series of the industrial production (IP) index from 1960:1 through 2013:12. The data measure volume changes over time as indices, seasonally adjusted with 2010 as the base year. IP refers to the volume of output generated by production units grouped into

industrial sectors (such as mining, manufacturing, and electricity gas & water) in line with the International Standard Industrial Classification (ISIC) of all economic activities. We reject the view that IP cannot be used as a proxy for total output because "manufacturing activity represents less than 20 per cent of aggregate output in the Eurozone" (De Haan *et al*., 2008: 236) given that most of the cyclical variation in the EZ economy is explained by the industrial sector (Gayer, 2007: 2) and a "historically strong correlation between IP and GDP data" Gayer (2007: 7) has been observed. Moreover, most of the related analyses are based on IP data, for example Artis and Zhang (1997), Artis *et al*. (2004), Camacho *et al*. (2006), Harding and Pagan (2006), Inklaar and De Haan (2001) and Massmann and Mitchell (2004), not only because IP data is available at a monthly frequency from 1960 but also since it displays more cyclical sensitivity than GDP estimates. This allows greater precision in measuring business cycles by capturing more of the high-frequency fluctuations.

In contrast to business cycles, there is no obvious measure for financial cycles (Borio, 2014). Related literature identifies financial cycles in three distinct but interdependent market segments namely credit, residential real estate and equity prices (Claessens *et al*., 2012). We follow Pagan and Sossounov (2003) in using equity prices as they exhibit greater volatility featuring more upturns and downturns. These are also available at a monthly frequency for a longer time period and therefore facilitate greater precision in identifying cycles. For financial cycles, we consider 10 monthly time series of the share price index from 1957:1 through 2013:12. The OECD database defines the share price index as the prices of companies traded on national or foreign stock exchanges. The share price index is an indicator of fluctuations in the equity market and can be viewed as a proxy for fluctuations in the overall financial markets. Monthly data are simple arithmetic averages of the closing daily values with 2010 as the base year.

2.2. Identifying turning points

2.2.1 Classical cycles

For identifying classical cycles we employ the business cycle dating algorithm developed by Harding and Pagan (2002) using the insights of Bry and Boschan (1971) set out in table 1. We apply this algorithm to the natural logarithm y_t of the monthly index of industrial production Y_t over the years 1960-2013 and the natural logarithm p_t of the monthly index of share prices P_t over the years 1957-2013. Our censoring rules follow the NBER definitions: cycles must have a minimum length of 15 months, phases must have a minimum length of 6 months and the window over which local maxima (peaks) and minima (troughs) are computed is 5 months.

[Insert Table 1 here]

A classical business cycle peak is said to occur at time 't' if:

$\{y_t > (y_{t-5}, y_{t-4} \dots y_{t-1})\ and\ y_t > (y_{t+1}, y_{t+2} \dots y_{t+5})\}$

and a trough occurs at time 't' if:

$\{y_t < (y_{t-5}, y_{t-4} \dots y_{t-1})\ and\ y_t < (y_{t+1}, y_{t+2} \dots y_{t+5})\}$.

Similarly, a classical financial cycle peak occurs at time 't' if:

$\{p_t > (p_{t-5}, p_{t-4} \dots p_{t-1})\ and\ p_t > (p_{t+1}, p_{t+2} \dots p_{t+5})\}$

and a trough occurs at time 't' if:

$\{p_t < (p_{t-5}, p_{t-4} \dots p_{t-1})\ and\ p_t < (p_{t+1}, p_{t+2} \dots p_{t+5})\}$.

2.2.2. Growth cycles

For identifying growth cycles, we first filter y_t and p_t before applying a modified version of the Bry-Boschan algorithm to the filtered series. We use the Baxter-King (BK) and the Hodrick-Prescott (HP) filter methods to extract the cyclical component of our IP and share price index series. Filtering works by preserving or

eliminating the movements of time series that are caused by stochastic cycles of specified frequencies. The filtered series is an indicator of the fluctuations in the series, measuring the cyclical component. This cyclical component is the growth cycle, the turning points of which we are interested in locating. The 'ideal' filter needs an infinite number of past and future observations which is not possible with a finite data set (Stock and Watson, 1999: 12). As a result, the advantages and disadvantages of various filtering techniques have been at the centre of a large literature in search of a filter close enough to the 'ideal' filter for finite economic time series (Estrella, 2007; Hodrick and Prescott, 1997; Baxter and King, 1999; Artis *et al.*, 2004; Zarnowitz and Ozyildirim, 2006). The time period from a peak to a trough in growth cycles is referred to as a low-rate phase, characterized by a sequence of increases in the negative deviation of the relevant variable from its trend. Similarly, the time period from a trough to a peak is referred to as a high-rate phase, characterized by a sequence of increases in the positive deviation of the relevant variable from its trend (Cashin, 2004).

The BK is a band-pass linear filter which "isolates the periodic components of an economic time series that lie in a specific band of frequencies" […] eliminating "very-slow moving ("trend") components and very high-frequency ("irregular") components while retaining intermediate ("business-cycle") components" (Baxter and King, 1999: 576). We adopt the NBER business cycle periodicities which range between 1.5 and 8 years.

The HP filter decomposes the behavior of an economic time series into a growth component (trend) and a stationary cyclical component. Trend movements are removed by the HP filter that allows only high frequency movements but blocks the movements with frequencies lower than the 'cutoff' frequency. The assumption is that the trend "varies "smoothly" over time", adjusted by adapting a parameter, λ, to the frequencies of observations and to the phase of the cycle under study (Hodrick and Prescott, 1997: 3). The bigger the λ, the smoother is the trend. For

quarterly data, the value of λ=1600 proposed by Hodrick and Prescott (1997: 4) seems to be broadly accepted by the literature. With annual and monthly frequencies, the choice of the value for λ is more controversial (Baxter and King, 1999; Ravn and Uhlig, 2002). For monthly data, the value of λ=14,400 is used by Zarnowitz and Ozyildirim (2006) while Ravn and Uhlig (2002: 374) prefer a value of λ=129,600. For greater robustness, we use both values for our monthly data. Zarnowitz and Ozyildirim (2006) however note that increasing the value of λ (in their case, from λ=14,400 to λ=108,000) made only minor differences in the HP estimate of the cyclical component.

For the identification of growth cycles in the filtered series, we follow Dungey and Pagan (2000) in modifying the Bry and Boschan (1971) censoring rules, namely that cycles must have a minimum length of 18 months, phases must have a minimum length of 9 months and the window over which local maxima and minima are computed is 8 months. This modification is carried out given that two quarters of negative growth which characterizes a classical business cycle recession is very different from two quarters of below-trend growth, so the same rules cannot be used to date both classical and growth cycles.

2.3. Determining phase synchronization: calculating concordance indices

To determine the extent of synchronization in cycles, we use the Harding and Pagan (2002) concordance index $I^{\wedge}$. This index indicates the proportion of time that two cycles are in the same phase. The concordance index is calculated by first associating the phases of our identified cycles with a binary random variable S_t that takes the values unity (corresponding to expansions, upturns and high-rate phases) and zero (corresponding to recessions, downturns and low-rate phases) (Harding and Pagan, 2006). We define binary random variables S_{xt} and S_{yt} for two time series x_t and y_t such that when series x_t is in an expansionary phase, S_{xt} = 1, else

S_{xt} = 0, and similarly when series y_t is in an expansionary phase, S_{yt} = 1, else S_{yt} = 0. The expected values of S_{xt} and S_{yt} are denoted by μ_{s_x} and μ_{s_y} respectively, and are interpreted as the fraction of the time that the relevant series is in the expansion/upturn/high-rate phase. The concordance index $\hat{I}$ between the two series is then calculated as follows:

$$\hat{I} = \frac{1}{T}\{\sum_{t=1}^{T} S_{xt}S_{yt} + \sum_{t=1}^{T}(1 - S_{xt})\left(1 - S_{yt}\right)\}$$

where T is the sample size.

The resulting values of this concordance index are defined by its designers as follows: "the concordance index has a maximum value of unity when $S_{xt} = S_{yt}$, and zero when $S_{xt} = (1 - S_{yt})$" (Harding and Pagan, 2006: 65).

Since, on this basis, a value of 0 indicates perfect discordance whereas a value of 1 indicates perfect concordance, a value of 0.5 indicates that there is no systematic relationship between the two series. Harding and Pagan (2006: 68) propose testing the significance of the concordance index by the following regression:

$$\hat{\sigma}_{s_x}^{-1}\hat{\sigma}_{s_y}^{-1}S_{yt} = \alpha_1 + \rho_s\hat{\sigma}_{s_x}^{-1}\hat{\sigma}_{s_y}^{-1}S_{xt} + u_t \qquad (1)$$

where $\hat{\sigma}_{s_x}$ and $\hat{\sigma}_{s_y}$ are the estimated standard deviations of S_{xt} and S_{yt} respectively, ρ_s is the correlation coefficient under the assumption of mean independence and the null hypothesis of no concordance corresponds to $\rho_s = 0$. The t-statistic is used to evaluate the statistical significance of the null hypothesis of no concordance between the two series. To get the correct t-statistic associated with $\hat{\rho}_s$ Harding and Pagan (2006: 68-69) suggest the use of heteroscedastic- and autocorrelation-consistent (HAC) standard errors. Therefore we use GMM estimation with a HAC covariance matrix, selecting the Bartlett kernel and Newey and West fixed bandwidth.

2.4. Determining how concordance evolves over time: breaking the full sample time period into sub-periods

To refine our analysis, we examine the evolution of cyclical concordance over time by adopting a novel approach that involves breaking down the full sample period into sub-periods. For this, we observe the change in the mean and volatility of our IP and share price time series over the full sample. Plotting the rolling 24 month standard deviation (SD) and mean of our IP and share price index series allows us to identify the major points of change in each of the series and to note the dates at which the series appear to break. After jointly analyzing the break dates for the SD and mean showed in figures 3 and 4, the common break dates that best fit the country overall are chosen. Once we have break dates for each country, we analyze them collectively and select our final subsample periods based on the common break dates that best fit all countries.

3. Results

We now turn to the results of our concordance analysis and determine whether concordance, that is, the measure of the proportion of time that two countries are in the same phase of their cycles, has been increasing or decreasing, particularly since the introduction of the euro in 1999. Before interpreting the results, it is important to note that the original European Union (EU) – formerly the European Economic Community (EEC) – members were France, West Germany, Italy, Belgium, the Netherlands and Luxembourg while Ireland joined in 1973, Greece in 1981 and Portugal and Spain in 1986.

3.1. Concordance across business cycles

Table 2 presents the number of peaks and troughs for both classical and growth cycles using both HP and BK filters. We notice that the HP growth cycles (col.2)

are generally more frequent, whether produced by λ=14,400 or λ=129,600, than the BK growth cycles (col.3) and classical cycles. In the rest of the paper, we use only the growth cycles identified by the BK band-pass filter given that it is theoretically superior eliminating both high and low frequency changes (Scott and Watson, 1999). In addition, the literature mentions various risks associated with HP filter such as generating cyclical patterns in series that are not cyclical (Cogley and Nason, 1995), producing arbitrary cycles (Harvey and Jaeger, 1993) and performing sub-optimally at time series endpoints (Artis *et al*., 2003 and Mise *et al*., 2005).

Figure 1 confirms that BK growth cycles are more frequent than classical cycles, more alike and displaying greater instability post 2007. Consistent falling levels of IP post 2007 are shown in the classical cycles of Greece, Portugal and Spain.

[Insert table 2 here]

The main characteristics of classical and growth cycles – namely, average duration, amplitude, slope and cumulative loss (in case of recessions and low-rate phases only) – are shown in table 3.

[Insert table 3 here]

Tables 4.A and 5.A present the statistics $\{\hat{I}, \hat{\rho_s}, \hat{\mu_s}\}$ for the growth and classical cycles in industrial production over the full sample period 1960-2013. The corresponding t-statistics are shown in tables 4.B and 5.B. The concordance indices $\hat{I}$, are reported above the diagonal while the correlation coefficients $\hat{\rho_s}$, are below the diagonal. The fraction of time the IP series spends in the expansion phase (for classical cycles) and the high-rate or above trend growth phase (for growth cycles) denoted by $\hat{\mu_s}$ is provided in the bottom row. The average concordance index for each country with the nine other EMU members is reported in the last column.

[Insert tables 4.A and 4.B here]

Average concordance statistics in table 4.A indicate that for most countries, 65 per cent of time is spend in the same phase of the growth cycle with the exception of Portugal (58 per cent). The concordance indices for classical cycles reported in table 5.A are lower. Concordance across countries results from co-movement of IP deviations from its long-term trend, that is countries' high-rate and low-rate phases are more synchronized than their recessions and expansions (tables 4.A and 5.A). Moreover, cyclical movements in trend-adjusted IP are more significant than cyclical movements in trend-unadjusted IP (tables 4.B and 5.B). This suggests that the concordance in business cycles across countries during 1960-2013 is due to synchronized deviations rather than synchronization of the underlying macroeconomic fundamentals.

[Insert tables 5.A and 5.B here]

Tables 6.A and 6.B show how the concordance indices of growth and classical cycles in IP evolve over 7 sub-periods based on the common break dates reported in figure 3. For each sub-period, the concordance statistic $\hat{I}$ is reported above the diagonal and the t-statistic from regression (1), below the diagonal. The fraction of time spent in expansions (for classical cycles) and high-rate phases (for growth cycles), $\hat{\mu_s}$, is shown in the bottom row for each respective sub-period.

[Insert table 6.A and 6 B here]

The average concordance across classical business cycles in 1960-67 is 72 per cent (table 6.B) while that across growth cycles is 49 per cent (table 6.A), suggesting greater concordance in cyclical movements of the trend-unadjusted IP. It is important to note that the classical cycles of only Austria and Germany, Belgium

and France, and France and Germany exhibit concordances that are statistically significant. Therefore, the 72 per cent concordance may be biased upwards owing to the extended time the countries in this period spent in the expansion phase, as indicated by the exceptionally high values of $\hat{\mu_s}$ (mostly greater than 80 per cent), rather than actual co-movement. This period saw the completion of the free trade customs union between member states, strong economic growth and low unemployment. Activist monetary policy and controls on capital flows were implemented.

The highest average concordance across classical cycles at 87 per cent occurs during 1968-73, when most countries are in the expansion phase at the same time which tends to bias the concordance index upwards. Growth cycles show a sharp rise in concordance from 1960-67 to 1968-1973, from 49 per cent to 75 per cent, an increase of approximately 53 per cent. This period was characterized by more open and competitive international trade, for instance the customs union was created on 1 July 1968. Also the year 1971 marked the end of the Bretton Woods fixed exchange rate system and in September 1973, the first oil shock took place with the price of crude oil increasing from $3 per barrel to nearly $12. During this period, EEC members limited the margin of fluctuation of their currencies (the so-called 'snake'). Both classical and growth cycles display average concordance of 70 per cent in 1974-83. The classical cycles of Greece, Ireland and Portugal exhibited low and mostly insignificant concordance levels. Propelled by the collapse of the Bretton Woods system, the period 1974-1983 is characterized by the 1979 second oil price shock which, according to Gayer (2007) may be a factor in the decline in concordance. The European Monetary System (EMS) replaced the 'snake' in 1979. Concordance in both classical and growth cycles declined during 1984-1992 respectively to 65 per cent and 61 per cent. This period saw the introduction of the Single European Act in 1986 and the agreement to establish a single currency in the Maastricht Treaty signed in 1992. In the sub-period 1993-

2002, concordance rose to 67 per cent for growth cycles while declining to 62 per cent for classical cycles. Concordance was affected by various shocks such as the 1997-98 emerging markets crisis. The euro was introduced first in a non-physical form in 1999, then as physical coins and banknotes in 2002. In the subsequent period 2003-2008, concordance for growth cycles rose to 75 per cent while classical cycles witnessed the lowest level of concordance at 60 per cent. Insignificant concordance indices are observed in the growth cycles of countries that have been badly hit by the financial crisis such as Portugal or Ireland. These observations are supported by the concern raised at the Ecofin meeting in May 2005 about "the divergences of economic trends in the Eurozone" that De Haan *et al.* (2008: 234) refer to. In the period 2009-2013, the large difference in average concordance levels of growth and classical cycles, 96 per cent and 66 per cent respectively, implies that deviations are more synchronized than trends. This is in line with our expectations as this period corresponds to the ongoing EZ crisis characterized by negative deviations from the trend that all EMU countries are experiencing together.

[Insert tables 7 and 8 here]

Comparing the average concordance of growth cycles of each country with the other member states highlights that the highest percentage increase (214 per cent) over the period 1960-2013 occurs in Spain and the smallest in France of 63 per cent (table 7). For classical cycle average concordance, Belgium shows the greatest percentage increase with other countries (9 per cent) and Greece, Ireland and Portugal the greatest percentage decrease of 35 per cent, 22 per cent and 19 per cent respectively (table 8). A comparison of tables 7 and 8 highlights that average concordance of classical cycles is lower in 2003-08 and 2009-13 for all countries except Ireland and relatively higher than the average concordance of growth cycles before 1993-2002. During 2003-2008, most of the countries' classical cycles

exhibited the lowest average concordance while most of the countries' growth cycles showed highest average concordance compared to earlier sub-periods. These results highlight that in the years leading to the crisis, deviations were becoming more synchronized relative to trends.

3.2. Concordance across financial cycles

We only use the BK filter in subsequent empirical work for the same reasons as in the case of business cycles. HP growth financial cycles (table 9, col.2) are more frequent, whether produced by λ=14,400 or λ=129,600, than BK growth (col.3) and classical financial cycles (col.1).

Figure 2 shows that both classical and growth cycles exhibit similarities across countries. Classical equity cycles demonstrate sharp fluctuations due to the large swings – both upside and downside – in the equity price indices. Growth equity cycles are marked by cyclical movements of a relatively larger magnitude compared to their IP counterparts.

[Insert table 9 here]

Table 10 records the variations in the average duration, amplitude, slope and cumulative loss (in case of downturns and low-rate phases only) of both classical and growth financial cycles.

[Insert table 10 here]

The statistics $\{\hat{I}, \hat{\rho_s}, \hat{\mu_s}\}$ for growth and classical financial cycles are presented respectively in tables 11.A and 12.A, with the corresponding t-statistics in tables 11.B and 12.B.

[Insert tables 11.A and 11.B here]

Most countries spend more than 75 per cent of the time in the same phase of their financial growth cycles. Spain and Greece spent the smallest fraction of time in the upturn phase (0.38 and 0.39 respectively), contrary to Belgium which spent the greatest proportion of time in the upturn phase (0.53). Portugal has the highest concordance spending on average 81 per cent of its time in the same financial cycle phase as the other members (89 per cent with Germany and only 71 per cent with Italy), while the lowest concordance of 72 per cent is held by Greece and Ireland (last column of table 11.A). The average concordance level of 81 per cent in the growth financial cycles of Portugal is in contrast with 58 per cent average concordance exhibited in its growth business cycles. These results are explained by data availability, with the share price index time series starting in 1988 while the IP series start in 1960 meaning that the initial sub-periods' low levels of concordance reduces the overall average concordance of Portugal's business cycles with the rest of the sample.

[Insert tables 12.A and 12.B here]

The concordance indices for classical financial cycles are also mostly above 70 per cent and most countries spend more than 50 per cent of time in a financial upturn, with France exhibiting the highest $\hat{\mu_S}$(0.63).

The comparison of business and financial cycles' concordance results points to greater evidence of concordance, both in magnitude and significance in financial cycles than in business cycles. While there is not much difference in financial growth and classical cycle results, growth business cycles exhibit greater concordance, both in magnitude and significance, than classical business cycles.

[Insert table 13.A and 13 B here]

The average concordance across growth financial cycles during 1957-64 is 66 per cent (table 13.A) compared to 61 per cent for classical financial cycles (table 13.B). 1965-1974, a period characterized by the gradual liberalization of financial markets, saw a decline in concordance to 64 per cent for growth cycles and a sharp increase in concordance to 76 per cent for classical cycles. In 1975-1981, the average concordance level of growth financial cycles falls further to 61 per cent and that of classical cycles to 58 per cent before increasing to 67 per cent and 69 per cent respectively in 1982-1993. This period was characterized by the liberalization of the financial sector and by exchange rate instability (Gayer, 2007; Massmann and Mitchell, 2004). From 1994 to 2001, average concordance levels of growth and classical cycles increased to 73 per cent and 69 per cent respectively. This period was marked by the 1994 Mexican crisis and the subsequent 1997-98 emerging market country crises as well as the introduction of the euro. Most countries exhibit significant concordance with the exception of Ireland where none of the country pairwise concordance indices is statistically significant. Average concordance level peaks in 2002-2008 at 91 per cent for growth cycles and 90 per cent for classical cycles. In 2009-2013, average concordance levels of growth cycles fell to 90 per cent with significant results only between Greece and Ireland, Greece and Spain and Ireland and Spain. Similarly average concordance levels of classical cycles in this sub-period fell to 82 per cent with significant results only between Italy and Spain.

In short, more variability appears in the average concordances calculated over the sub-periods for classical financial cycles compared to growth financial cycles. But overall, growth and classical financial cycle concordance shows more similarity compared to growth and classical business cycle concordance.

[Insert tables 14 and 15 here]

Tables 14 and 15 compare the average concordance of growth and classical financial cycles for each EMU country with the other member states over the sample sub-periods. The last column of tables 14 and 15 indicates that for both growth and classical cycles Germany experienced the highest percentage increase in concordance over 1960-2013 (85 per cent and 51 per cent respectively). After Germany, the three more important EZ members – France, Italy and Spain experienced an increase in concordance respectively of 36 per cent, 35 per cent and 30 per cent in growth cycles (table 14) and 43 per cent, 28 per cent and 19 per cent in classical cycles (table 15). The smallest increase in growth and classical cycle concordance occurred respectively in Ireland (15 per cent) and Portugal (10 per cent). Generally the percentage increase in the average concordance of growth cycles has been greater compared to classical cycles, supporting our observation so far that deviations are more concordant than trends.

The comparison of average concordance between business cycles (classical and growth, tables 8 and 9 respectively) and financial cycles (classical and growth, tables 14 and 15 respectively) highlights that the percentage increase in average concordance over the sample sub-periods has been much higher for each countries' growth business cycle than for its growth financial cycle. In addition, several countries' classical business cycles show a decrease in average concordance levels over the sample sub-periods which is not observed in the case of their classical financial cycles.

3.3. Concordance between business and financial cycles

The concordance indices and correlation between business and financial cycles are presented in tables 16.A and 17.A and the corresponding t-statistics in tables 16.B to 17.B.

[Insert tables 16.A and 16.B here]

For the period 1960-2013, tables 16.A and 16.B show that within each country, business and financial growth cycles are significantly concordant, being in the same phase at least 60 per cent of the time except for Greece where the concordance index of 0.57 is not statistically significant (table 16.B). Therefore economic slowdowns are accompanied by the financial low-rate phase and economic booms by the financial high-rate phase more than 60 per cent of the time.

[Insert tables 17.A and 17.B here]

Regarding classical business and financial cycles, table 17.B indicates that, apart from Germany, Greece and Spain, most of the concordance indices stated in table 17.A are not statistically significant. This signifies that business and financial cycle concordance also arises from synchronized deviations from the trend rather than a synchronized trend.

[Insert tables 18.A and 18.B here]

Tables 18.A and 18.B display how the concordance between business and financial cycles has evolved over time. The average level of concordance between business and financial (classical and growth) cycles is calculated for seven sub periods starting in 1960.

Tendencies of synchronized deviations in business and financial growth cycles recorded in table 18.A are most common in the period 2003-2008, where most of the countries' business and financial growth cycles are significantly concordant except for Italy and Ireland. Germany and Austria display the highest percentage increase in concordance levels over the period 1960-2013, while the Netherlands exhibits a decrease. Table 18.B shows that for most countries apart from Germany,

the concordance levels between business and financial classical cycles recorded in each sub-period are statistically insignificant. While significant concordance was observed between growth business and financial cycles in table 18.A during 2003-2008 except for Ireland and Italy, table 18.B indicates significant concordance in classical cycles only in Germany, Greece and Italy.

This confirms our earlier full sample results that concordance arises from synchronized deviations rather than synchronized trends. The observed concordance is due to co-movement in deviations rather than levels of the underlying economic and financial variables.

4. Conclusion

Our paper has made several key contributions: first, unlike previous studies, we employ an extended dataset spanning periods before and after the launch of the euro and with more than ten years of data for the period in which the euro existed. Second, we consider both classical and growth definitions of cycles to better assess the true nature of any observed synchronization – whether it can be traced to co-movement of output levels or of output gaps. Third, we analyse financial cycles as well as the interaction between business and financial cycles which has not been done specifically for the EZ before. Fourth, our approach is also innovative in relation to previous studies in the way that we break down our full sample time series into smaller sub-periods to follow the evolution of synchronization more closely. The conclusion we draw from our results is in line with the findings in related literature.

We find significant concordance across growth cycles (both business and financial) and across classical financial cycles, but not across classical business cycles. We also find that concordance between business and financial cycles in each country arises from synchronized deviations rather than synchronized trends.

However, expansions and recessions are not accompanied by, respectively, financial upturns and downturns to any significant degree in the majority of countries.

In the case of financial cycles we find significant concordance in both classical and growth cycles, confirming that financial variables behave differently in a monetary union. Most countries spend more than 75 per cent of the time in the same phase of their financial cycles. The only insignificant concordance occurs between the growth financial cycles of Greece and Belgium. Belgium spent the greatest proportion of time in the upturn of its growth financial cycle while Spain and Greece, the smallest fraction of time. France spent the greatest proportion of time, 63 per cent, in the classical financial upturn. These results are consistent with the experiences of Spain and Greece in the EZ crisis, whilst France and Belgium were amongst the countries that fared relatively better.

We find no evidence of a common classical business cycle in the EZ. This implies that synchronization in business cycles arises from co-movements in deviations rather than through a common trend. Economic variables across the EZ deviate together as a result of exogenous shocks but the underlying macroeconomic fundamentals are not in synch, which is likely to pose challenges for optimal monetary and fiscal policies. These results are reinforced by our sub-sample results which indicate that there has been no evidence of increased concordance in classical business cycles following the introduction of the euro. Moreover, in the period 2003-2008 preceding the EZ crisis, most of the classical business cycles exhibited the lowest average concordance while most of the growth business cycles showed the highest average concordance compared to earlier sub-periods. Compared to growth cycles, classical business cycles demonstrate relatively much higher levels of average concordance before 1993-2002 which marks the introduction of the euro.

Our results point to economic dissimilarities in the EZ even before its inception and highlight the role played by the monetary union in further increasing macroeconomic divergences after the introduction of a common currency. In these circumstances, a common policy creates a negative feedback loop, exacerbating the divergences as well as increasing vulnerabilities to exogenous shocks.

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Tables

TABLE 1: BRY BOSHAN (BB) PROCEDURE FOR PROGRAMMED DETERMINATION OF TURNING POINTS

Step	Procedure
1.	Determination of extremes and substitution of values.
2.	Determination of cycles in 12-month moving average (extremes replaced).
	A. Identification of points higher (or lower) than 5 months on either side.
	B. Enforcement of alternation of turns by selecting highest of multiple peaks (or lowest of multiple troughs).
3.	Determination of corresponding turns in Spencer curve (extremes replaced).
	A. Identification of highest (or lowest) value within ±5 months of selected turn in 12-month moving average.
	B. Enforcement of minimum cycle duration of 15 months by eliminating lower peaks and higher troughs of shorter cycles.
4.	Determination of corresponding turns in short-term moving average of 3 to 6 months, depending on MCD (months of cyclical dominance).
	A. Identification of highest (or lowest) value within ±5 months of selected turn in Spencer curve.
5.	Determination of turning points in unsmoothed series.
	A. Identification of highest (or lowest) value within ±4 months, or MCD term, whichever is larger, of selected turn in short-term moving average.
	B. Elimination of turns within 6 months of beginning and end of series.
	C. Elimination of peaks (or troughs) at both ends of series which are lower (or higher) than values closer to end.
	D. Elimination of cycles whose duration is less than 15 months.
	E. Elimination of phases whose duration is less than 5 months.
6.	Statement of final turning points.

Source: Bry and Boschan (1971, p.21; Table 1)

TABLE 2 – CLASSICAL AND GROWTH BUSINESS CYCLES (INDUSTRIAL PRODUCTION): 1960:1-2013:12.

	Classical Cycles (1)		Growth Cycles (HP) (2)		Growth Cycles (BK) (3)	
			λ=14400 (λ=129 600)	λ=14400 (λ=129 600)		
	Peaks	**Troughs**	**Peaks**	**Troughs**	**Peaks**	**Troughs**
Austria	13	12	17 (16)	16 (15)	13	13
Belgium	15	16	18 (15)	19 (16)	16	16
France	12	12	18 (17)	18 (17)	15	15
Germany	13	13	18 (16)	18 (15)	15	16
Greece	12	11	15	15	18	18
Ireland	11	10	13	12	12	12
Italy	12	11	17 (16)	17 (15)	18	18
Netherlands	14	14	19 (15)	19 (15)	16	16
Portugal	13	13	20 (19)	20 (19)	16	17
Spain	9	9	15	15	14	14

TABLE 3: – BASIC FEATURES OF CLASSICAL AND GROWTH BUSINESS CYCLES: 1960:1-2013:12.

	Growth cycles in industrial production: 1960:1-2013:12									
	High-rate phase					Low-rate phase				
	No. of events	Average duration	Average Amplitude	Average Slope	Cumulative Loss	No. of events	Average duration	Average Amplitude	Average Slope	Cumulative Loss
AT	12	22.6	5.65%	0.27%	-	13	20.7	-6.08%	-0.31%	-61.4%
BE	15	18.6	5.20%	0.28%	-	16	16.7	-5.65%	-0.36%	-44.5%
FR	14	19.2	4.83%	0.26%	-	15	18.3	-5.42%	-0.30%	-45.0%
DE	15	20.5	5.59%	0.27%	-	15	16.3	-6.47%	-0.37%	-49.7%
EL	18	16.7	4.01%	0.23%	-	17	14.0	-4.16%	-0.28%	-28.5%
IE	11	16.5	5.44%	0.34%	-	12	14.9	-5.96%	-0.40%	-41.7%
IT	17	17.6	5.60%	0.28%	-	18	13.8	-6.30%	-0.42%	-41.7%
NL	15	17.1	4.47%	0.26%	-	16	17.8	-4.70%	-0.28%	-38.8%
PT	16	17.3	5.10%	0.28%	-	16	17.2	-5.17%	-0.28%	-49.9%
ES	13	18.5	4.53%	0.22%	-	14	16.9	-5.11%	-0.29%	-40.6%
Sample	146	18.4	5.01%	0.27%	-	152	16.6	-5.48%	-0.33%	-43.8%
	Classical cycles in industrial production: 1960:1-2013:12.									
	Expansions					Recessions				
	No. of events	Average duration	Average Amplitude	Average Slope	Cumulative Loss	No. of events	Average duration	Average Amplitude	Average Slope	Cumulative Loss
AT	12	39.0	21.11%	0.53%	-	12	13.3	-5.35%	-0.45%	-27.1%
BE	15	28.3	17.18%	0.70%	-	15	12.6	-6.69%	-0.68%	-35.4%
FR	11	32.1	15.56%	0.41%	-	12	16.8	-9.45%	-0.67%	-42.6%
DE	12	35.1	18.26%	0.52%	-	13	14.0	-9.06%	-0.74%	-45.5%
EL	11	34.4	20.24%	0.70%	-	11	16.1	-11.5%	-0.90%	-121%
IE	10	30.3	33.24%	1.30%	-	10	12.3	-10.9%	-1.04%	-54.7%
IT	11	32.6	18.09%	0.64%	-	11	18.9	-10.4%	-0.73%	-89.3%
NL	13	31.6	19.32%	0.73%	-	14	14.9	-8.45%	-0.59%	-63.2%
PT	12	36.1	22.24%	0.68%	-	13	13.3	-9.94%	-0.90%	-57.0%
ES	8	39.5	15.22%	0.46%	-	9	15.9	-12.3%	-0.88%	-79.3%
Sample	115	33.6	19.96%	0.67%	-	120	14.8	-9.21%	-0.74%	-60.2%

Note: AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain

TABLE 4. A: CONCORDANCE INDICES AND CORRELATIONS OF GROWTH CYCLES IN INDUSTRIAL PRODUCTION: 1960:1-2013:12.

	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES	$\bar{x}$
AT	1	0.81	0.84	0.77	0.64	0.66	0.75	0.82	0.58	0.68	0.73
BE	0.63***	1	0.88	0.74	0.7	0.68	0.78	0.74	0.56	0.7	0.73
FR	0.68***	0.75***	1	0.77	0.73	0.69	0.82	0.77	0.59	0.75	0.76
DE	0.55***	0.49***	0.54***	1	0.74	0.64	0.7	0.73	0.64	0.73	0.72
EL	0.29***	0.39***	0.47***	0.48***	1	0.67	0.71	0.63	0.55	0.7	0.67
IE	0.33***	0.36***	0.39***	0.28***	0.34***	1	0.71	0.63	0.61	0.67	0.66
IT	0.50***	0.55***	0.64***	0.40***	0.42***	0.42***	1	0.71	0.55	0.75	0.72
NL	0.64***	0.49***	0.54***	0.47***	0.27***	0.26***	0.42***	1	0.6	0.64	0.70
PT	0.15***	0.12***	0.18***	0.27***	0.10***	0.22***	0.11***	0.20***	1	0.57	0.58
ES	0.36***	0.39***	0.50***	0.45***	0.40***	0.34***	0.49***	0.28***	0.15***	1	0.69
$\hat{\mu_s}$	0.50	0.50	0.49	0.48	0.48	0.50	0.53	0.48	0.43	0.50	

Notes:
AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain
The correlation coefficients marked *** indicate significance at 1%.

TABLE 4. B: T-STATISTICS OF GROWTH CYCLES IN INDUSTRIAL PRODUCTION: 1960:1-2013:12.

	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT		10.04	10.55	6.14	3.01	3.69	5.44	8.37	**1.41**	3.78
BE			15.35	5.18	4.15	3.52	7.54	5.63	**1.12**	3.92
FR				5.71	5.63	4.39	10.02	7.9	**1.53**	6.75
DE					5.98	2.64	3.68	4.21	2.22**	5.08
EL						3.83	4.97	3.4	**1.32**	5.3
IE							4.7	2.49	1.91*	4.07
IT								4.5	**1.02**	6.8
NL									1.77*	2.58
PT										1.29
ES										

Notes:
Insignificant t-statistics are in bold characters.

AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain

TABLE 5.A: CONCORDANCE INDICES AND CORRELATIONS OF CLASSICAL CYCLES IN INDUSTRIAL PRODUCTION: 1960:1-2013:12.

	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES	$\bar{x}$
AT	1	0.68	0.71	0.72	0.64	0.61	0.68	0.68	0.65	0.70	0.68
BE	0.26***	1	0.76	0.71	0.64	0.64	0.66	0.64	0.57	0.71	0.67
FR	0.32***	0.47***	1	0.80	0.71	0.61	0.76	0.65	0.64	0.76	0.71
DE	0.32***	0.34***	0.53***	1	0.72	0.65	0.71	0.68	0.72	0.77	0.72
EL	0.12***	0.17***	0.33***	0.32***	1	0.56	0.68	0.55	0.68	0.73	0.66
IE	0.01	0.17***	0.14***	0.06	0.03	1	0.52	0.63	0.58	0.62	0.60
IT	0.28***	0.27***	0.47***	0.37***	0.30***	0.02	1	0.69	0.71	0.80	0.69
NL	0.24***	0.19***	0.21***	0.26***	-0.02	0.21***	0.32***	1	0.63	0.69	0.65
PT	0.11***	0.01	0.17***	0.33***	0.25***	0.02	0.36***	0.14***	1	0.71	0.66
ES	0.23***	0.35***	0.45***	0.44***	0.37***	0.18**	0.58***	0.27***	0.29***	1	0.72
$\hat{\mu_s}$	0.74	0.66	0.67	0.70	0.69	0.72	0.63	0.67	0.71	0.73	

Notes:

AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain
The concordance indices marked ** and *** indicate significance at 5% and 1% respectively.

TABLE 5. B: T-STATISTICS OF CLASSICAL CYCLES IN INDUSTRIAL PRODUCTION: 1960:1-2013:12.

	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT		2.43	3.32	3.48	**1.35**	**0.12**	3.12	3.64	**1.08**	3.29
BE			5.00	3.75	3.07	1.71	2.72	2.29	**0.08**	3.80
FR				7.46	3.64	**1.38**	4.38	2.20	**1.56**	4.79
DE					3.27	**0.61**	3.48	2.60	3.28	5.14
EL						**0.28**	3.37	**-0.23**	2.06	3.45
IE							**0.17**	2.13	**0.19**	**0.85**
IT								2.73	3.81	6.87
NL									**1.41**	2.18
PT										2.11
ES										

Notes:
AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain
Insignificant t-statistics are in bold characters.

TABLE 6.A: SUB-PERIOD CONCORDANCE INDICES OF GROWTH CYCLES IN INDUSTRIAL PRODUCTION: 1960:1-2013:12.

1960-1967 (average= 0.49)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.90	0.81***	0.38	0.33		0.59	0.94***	0.41	0.06
BE		1	0.88	0.27**	0.47		0.7**	0.9	0.3**	0
FR	3.76		1	0.35	0.47		0.78***	0.81***	0.43	0.28
DE	-1.24	-2.33	-1.05	1	0.44		0.2***	0.38	0.89***	0.44
EL			-0.37	-1.32	1		0.54	0.33	0.57	0.39
IE										
IT	0.47	2.47	3.63	-3.54			1	0.59	0.23**	0.72
NL	11.37		3.55	-0.71			0.53	1	0.41	0.14
PT	-0.50	-2.38	-0.27	7.45	0.32		-2.12	0.54	1	0.47
ES										1
$\mu_s^{\wedge}$	0.60	0.50	0.63	0.35	0.19		0.74	0.60	0.32	1.00
1968-1973 (average=0.75)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.69	0.6	0.75**	0.5**		0.68*	0.78**	0.68	0.67
BE	1.16	1	0.9***	0.86***	0.75**		0.74**	0.83***	0.85	0.94
FR	0.66	6.20	1	0.76***	0.71**		0.72**	0.74**	0.81	0.9
DE	1.90	5.35	2.73	1	0.7		0.63	0.94***	0.85	0.83***
EL	-2.03	2.08	2.04	1.53	1		0.51	0.64	0.82***	0.81**
IE										
IT	1.64	1.95	2.21	0.66	-1.11		1	0.65	0.64	0.71**
NL	2.19	6.64	2.07	25.66	0.72		1.00	1	0.82***	0.81***
PT	0.72				3.46		0.79	4.86	1	0.9
ES	0.79			3.92	2.16		2.20	3.34		1
$\mu_s^{\wedge}$	0.72	0.64	0.60	0.64	0.75		0.65	0.67	0.79	0.69
1974-1983 (average=0.70)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.78***	0.79***	0.84***	0.63**	0.63***	0.81***	0.92***	0.48	0.72**
BE	4.92	1	0.93***	0.86***	0.83***	0.74***	0.84***	0.83	0.49	0.65**
FR	5.12	15.93	1	0.88***	0.84***	0.72***	0.88***	0.84***	0.47	0.68**
DE	5.19	8.92	13.84	1	0.79***	0.67***	0.87***	0.86***	0.52	0.61
EL	2.45	5.75	7.25	7.16	1	0.74***	0.78***	0.68***	0.44	0.57
IE	2.67	4.28	4.38	2.94	3.03	1	0.66*	0.64**	0.47	0.65***
IT	6.02	11.27	10.43	12.83	5.99	1.65	1	0.78***	0.5	0.64*
NL	16.42		7.73	7.05	3.86	2.46	6.27	1	0.46	0.72***
PT	-0.29	0.00	-0.28	0.08	-0.53	-0.35	0.00	-0.50	1	0.46
ES	2.53	2.41	2.42	1.49	1.21	3.08	1.76	2.73	-0.61	1

$\hat{\mu_s}$	0.44	0.56	0.50	0.45	0.54	0.75	0.50	0.39	0.43	0.41
1984-1992 (average=0.61)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.77***	0.83***	0.76***	0.68*	0.59	0.6	0.8***	0.63	0.45
BE	3.47	1	0.86***	0.73**	0.74***	0.6	0.63	0.56	0.44	0.61**
FR	5.21	6.87	1	0.67*	0.75***	0.59	0.66*	0.63	0.56	0.62
DE	3.01	2.55	1.73	1	0.73***	0.41	0.55	0.67*	0.46	0.55
EL	1.85	3.10	3.01	2.67	1	0.55	0.7*	0.47	0.36	0.72***
IE	0.91	1.15	0.97	-0.90	0.54	1	0.66*	0.5	0.41	0.6
IT	0.94	1.15	1.74	0.30	1.77	1.71	1	0.55	0.6	0.61
NL	4.13	0.99	1.36	1.89	-0.28	0.01	0.55	1	0.78***	0.38
PT	1.19	-0.45	0.45	-0.16	-1.58	-0.96	1.26	3.97	1	0.42
ES	-0.48	1.92	1.43	0.63	3.25	1.18	1.24	-1.53	-1.31	1
$\hat{\mu_s}$	0.52	0.56	0.48	0.59	0.53	0.48	0.56	0.52	0.41	0.42
1993-2002 (average=0.67)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.72***	0.92***	0.87***	0.7***	0.7**	0.79***	0.61	0.49	0.82***
BE	3.50	1	0.75***	0.75***	0.5	0.68***	0.79***	0.51	0.58	0.7**
FR	12.32	3.57	1	0.85***	0.65**	0.7**	0.84***	0.64	0.53	0.8***
DE	9.48	4.63	7.77	1	0.75***	0.68**	0.81***	0.64	0.43	0.82***
EL	2.71	0.02	2.00	3.89	1	0.65*	0.66**	0.74***	0.43	0.67**
IE	2.46	2.79	2.38	2.35	1.89	1	0.73**	0.61	0.66**	0.62
IT	5.96	4.46	6.38	4.80	2.37	2.15	1	0.7***	0.47	0.81***
NL	0.99	0.08	1.58	1.21	3.37	1.02	2.71	1	0.5	0.63
PT	-0.08	0.95	0.24	-0.79	-0.82	2.44	-0.38	-0.02	1	0.36**
ES	4.79	2.45	5.12	7.61	2.08	1.39	9.14	1.28	-1.82	1
$\hat{\mu_s}$	0.52	0.52	0.48	0.55	0.47	0.60	0.54	0.54	0.53	0.57
2003-2008 (average=0.75)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.96	0.94***	0.92***	0.82***	0.49	0.88***	0.79***	0.57	0.78***
BE		1	0.9***	0.88***	0.78***	0.44	0.83***	0.75***	0.53	0.74***
FR	25.85	11.77	1	0.94***	0.88***	0.54	0.93	0.84	0.6	0.83***
DE	9.28	6.07	12.60	1	0.9***	0.57	0.93***	0.82***	0.6	0.83***
EL	3.61	2.98	4.72	7.11	1	0.67***	0.94	0.75***	0.69***	0.88***
IE	0.06	-0.41	0.83	1.04	2.9	1	0.61**	0.53	0.69**	0.63**
IT	5.94	4.53		11.08		2.29	1	0.81***	0.67	0.85***
NL	3.46	2.56		3.50	2.87	0.55	3.46	1	0.47	0.71***
PT	0.83	0.44	1.22	1.03	2.64	1.97	1.61	-0.27	1	0.74
ES	3.72	2.88	4.42	4.85	8.97	2.08	5.48	4.04		1
$\hat{\mu_s}$	0.64	0.60	0.64	0.61	0.63	0.43	0.57	0.49	0.40	0.67
2009-2013 (average= 0.96)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	1	1	1	0.83	1	1	1	1	1
BE		1	1	1	0.83	1	1	1	1	1
FR			1	1	0.83	1	1	1	1	1
DE				1	0.83	1	1	1	1	1
EL					1	0.83	0.83	0.83	0.83	0.83
IE						1	1	1	1	1
IT							1	1	1	1
NL								1	1	1
PT									1	1
ES										1
$\hat{\mu_s}$	0	0	0	0	0.17	0	0	0	0	0

Notes:
AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain
The concordance indices marked *, ** and *** indicate significance at 10%, 5% and 1% respectively.

TABLE 6.B: SUB-PERIOD CONCORDANCE INDICES OF CLASSICAL CYCLES IN INDUSTRIAL PRODUCTION: 1960:1-2013:12

1960-1967 (average=0.72)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.67	0.73	0.53***	0.63		0.65	0.57	0.55	0.47
BE	0.50	1	0.81**	0.61	0.81		0.69	0.61	0.59	0.72
FR	1.44	2.28	1	0.80*	0.88***		0.77	0.70	0.78	0.58
DE	-2.62	-0.80	1.74	1	0.86		0.72	0.77	0.92	0.61
EL	-0.35	1.36	3.48	6.80	1		0.71	0.61	0.83	0.61
IE										
IT							1	0.78	0.76	1.00
NL								1	0.81	1.00
PT								2.19	1	0.72
ES										1
$\hat{\mu_s}$	0.72	0.76	0.84	0.79	0.81		0.93	0.85	0.83	1.00
1968-1973 (average=0.87)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.68	0.90	0.78	0.83		0.83	0.83	0.83	0.83
BE	0.91	1	0.72	0.60	0.65		0.65	0.65	0.65	0.65
FR	-	-	1	0.88	0.93		0.93	0.93	0.93	0.93
DE	-	-	-	1	0.94		0.94	0.94	0.94	0.94
EL					1		1	1	1	1
IE										
IT							1	1	1	1
NL								1	1	1
PT									1	1
ES										1
$\hat{\mu_s}$	0.83	0.65	0.93	0.94	1		1	1	1	1
1974-1983 (average=0.70)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.85***	0.85***	0.86***	0.70	0.74	0.73***	0.67***	0.71	0.77***
BE	3.46	1	0.80***	0.77***	0.67	0.68	0.68**	0.73***	0.61	0.73**
FR	8.37	6.37	1	0.82***	0.72	0.82*	0.68**	0.62*	0.69	0.82***
DE	6.48	3.72	4.92	1	0.66	0.73	0.68***	0.63**	0.73***	0.75**
EL	1.53	1.34	0.55	0.81	1	0.75	0.66	0.48	0.69	0.68
IE	1.27	0.82	1.83	1.01	0.90	1	0.51	0.52	0.70	0.67
IT	4.27	2.10	2.29	2.59	-	-0.27	1	0.68**	0.52	0.85
NL	2.51	5.44	1.89	2.11	0.17	0.69	1.99	1	0.47	0.77
PT	1.51	0.41	0.83	4.14	-	-	-0.11	-0.05	1	0.63
ES	3.21	2.19	3.31	2.49	0.42	0.57	-	-	0.21	1
$\hat{\mu_s}$	0.67	0.63	0.73	0.66	0.88	0.77	0.54	0.47	0.81	0.69
1984-1992 (average=0.65)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.77***	0.69	0.78**	0.61	0.54	0.60	0.73*	0.62	0.65
BE	2.63	1	0.82***	0.86***	0.68	0.60	0.72*	0.61	0.67	0.73*
FR	1.51	2.69	1	0.78***	0.80***	0.43***	0.75**	0.44	0.62	0.72**
DE	2.49	3.45	2.90	1	0.70	0.52	0.69	0.53	0.71	0.70
EL	0.18	0.96	3.94	1.10	1	0.52**	0.64	0.45	0.56	0.69
IE	-	-0.17	-2.27	-	-1.89	1	0.53	0.68	0.64	0.56
IT	1.05	1.63	1.94	1.57	1.25	0.10	1	0.50	0.72***	0.82
NL	1.83	0.85	-1.13	-0.41	-1.35	0.91	-0.12	1	0.56	0.49
PT	0.00	0.90	0.75	1.61	-0.46	0.01	3.03	-0.09	1	0.82***
ES	0.68	1.80	1.95	1.04	1.14	-1.42	-	-1.05	5.37	1
$\hat{\mu_s}$	0.75	0.70	0.62	0.73	0.69	0.79	0.54	0.63	0.74	0.71
1993-2002 (average=0.62)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES

AT	1	0.68	0.63*	0.71	0.73	0.71	0.68	0.65	0.69	0.86***
BE	1.57	1	0.69***	0.64	0.60	0.71*	0.55	0.63**	0.47	0.69**
FR	-	3.06	1	0.68***	0.56	0.53	0.76***	0.54	0.47	0.60*
DE	1.80	1.57	2.50	1	0.71**	0.53	0.56	0.49	0.55	0.73***
EL	-	0.73	0.71	2.36	1	0.46*	0.60	0.55	0.52	0.73***
IE	-0.18	1.63	0.78	-0.42	-1.84	1	0.51	0.64	0.73	0.57
IT	-	0.50	3.56	0.52	1.12	-0.22	1	0.70**	0.61	0.57
NL	0.19	1.92	0.47	-0.75	0.18	0.43	2.31	1	0.63	0.51**
PT	-	-	-0.34	-0.45	-0.46	0.46	1.37	-0.04	1	0.63
ES	5.16	2.40	1.73	3.52	2.77	-1.58	0.54	-2.19	-0.83	1
$\hat{\mu_s}$	0.86	0.64	0.48	0.60	0.59	0.80	0.54	0.69	0.83	0.75
2003-2008 (average=0.60)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.43	0.61	0.72***	0.54	0.42	0.72***	0.61	0.71	0.53
BE	-0.70	1	0.57	0.57	0.53	0.63	0.46	0.43	0.25**	0.60
FR	0.77	-0.23	1	0.81***	0.54	0.72***	0.56	0.78***	0.38	0.69
DE	2.64	-0.26	3.74	1	0.63	0.67	0.64*	0.78***	0.54	0.78*
EL	0.23	-0.14	-0.02	0.69	1	0.63	0.74***	0.49	0.67	0.85
IE	-0.85	0.96	2.52	1.25	0.71	1	0.50	0.75**	0.29	0.78***
IT	2.81	-0.42	0.69	1.64	4.89	0.06	1	0.44	0.79	0.67***
NL	0.92	-0.86	3.72	3.02	-0.21	2.46	-0.90	1	0.46	0.64
PT	-	-2.36	-0.24	-	-	-1.61	-	-0.17	1	0.51
ES	0.00	-0.09	0.91	1.73	-	2.58	2.96	1.24	-	1
$\hat{\mu_s}$	0.56	0.71	0.72	0.72	0.60	0.64	0.47	0.56	0.26	0.75
2009-2013 (average=0.66)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.53	0.53*	0.63**	0.32	0.60**	0.57	0.75**	0.33	0.48
BE	0.89	1	0.93	0.90***	0.48	0.50	0.97***	0.78***	0.77***	0.92
FR	1.86	-	1	0.90	0.55	0.57	0.93	0.78	0.70*	0.95***
DE	2.43	6.52	-	1	0.45	0.60	0.93***	0.88	0.70***	0.85***
EL	-	-	-	-	1	0.45	0.48	0.33	0.65	0.57
IE	2.11	-0.07	0.48	1.23	-	1	0.53	0.58	0.33***	0.58
IT	1.35	22.13	-	11.03	-	0.33	1	0.82***	0.77***	0.92
NL	2.09	4.76	-	-	-	1.17	4.22	1	0.58	0.73***
PT	-0.31	4.07	1.80	2.60	-	-3.68	3.41	1.42	1	0.68
ES	1.07	-	19.72	5.80	-	1.10	-	3.07	1.33	1
$\hat{\mu_s}$	0.78	0.42	0.35	0.45	0.10	0.45	0.42	0.57	0.25	0.33

Notes:
AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain
The concordance indices marked *, ** and *** indicate significance at 10%, 5% and 1% respectively.

TABLE 7: AVERAGE CONCORDANCE OF GROWTH CYCLES IN INDUSTRIAL PRODUCTION: 1960:1-2013:12.

Country	1960-67	1968-73	1974-83	1984-92	1993-02	2003-08	2009-13	% change 1960-13
Austria	0.55	0.67	0.73	0.68	0.74	0.79	0.98	78
Belgium	0.55	0.82	0.77	0.66	0.66	0.76	0.98	78
France	0.60	0.77	0.78	0.69	0.74	0.82	0.98	63
Germany	0.42	0.79	0.77	0.61	0.73	0.82	0.98	134
Greece	0.44	0.68	0.70	0.63	0.64	0.81	0.83	88
Ireland			0.66	0.55	0.67	0.57	0.98	49
Italy	0.54	0.66	0.75	0.62	0.73	0.83	0.98	80
Netherlands	0.56	0.78	0.75	0.59	0.62	0.72	0.98	74
Portugal	0.46	0.80	0.48	0.52	0.49	0.62	0.98	112
Spain	0.31	0.82	0.63	0.55	0.69	0.78	0.98	214

TABLE 8: AVERAGE CONCORDANCE OF CLASSICAL CYCLES IN INDUSTRIAL PRODUCTION: 1960:1-2013:12.

Country	1960-67	1968-73	1974-83	1984-92	1993-02	2003-08	2009-13	% change 1960-13
Austria	0.60	0.82	0.76	0.66	0.70	0.59	0.53	-12
Belgium	0.69	0.66	0.72	0.72	0.63	0.50	0.75	9
France	0.76	0.89	0.76	0.67	0.61	0.63	0.76	0
Germany	0.73	0.87	0.74	0.70	0.62	0.68	0.76	4
Greece	0.74	0.92	0.67	0.63	0.61	0.62	0.48	-35
Ireland			0.68	0.56	0.60	0.60	0.53	-22
Italy	0.76	0.92	0.66	0.66	0.62	0.61	0.77	1
Netherlands	0.73	0.92	0.62	0.55	0.59	0.60	0.69	-5
Portugal	0.75	0.92	0.64	0.66	0.59	0.51	0.61	-19
Spain	0.71	0.92	0.74	0.69	0.65	0.67	0.74	4

TABLE 9 – CLASSICAL AND GROWTH FINANCIAL CYCLES (SHARE PRICES INDEX): 1957:1-2013:12.

	Classical Cycles (1)		Growth Cycles (HP) (2)		Growth Cycles (BK) (3)	
			λ=14400 (λ=129 600)	**λ=14400 (λ=129 600)**		
	Peaks	**Troughs**	**Peaks**	**Troughs**	**Peaks**	**Troughs**
Austria	14	15	17(15)	18(16)	14	14
Belgium	7	7	11(8)	11(8)	7	7
France	13	13	15(15)	15(15)	16	16
Germany	16	16	16(15)	16(15)	15	15
Greece	6	6	8(8)	8(9)	7	7
Ireland	14	15	18(17)	18(18)	17	16
Italy	16	16	18(15)	19(16)	12	12
Netherlands	16	16	19(18)	19(18)	17	17
Portugal	6	7	8(7)	9(8)	6	6
Spain	6	7	7(7)	8(8)	8	8

TABLE 10: BASIC FEATURES OF CLASSICAL AND GROWTH FINANCIAL CYCLES: 1957:1-2013:12.

	Growth equity cycles (1957-2013)									
	High-rate phase					Low-rate phase				
	No. of events	Average duration	Average Amplitude	Average Slope	Cumulative Loss	No. of events	Average duration	Average Amplitude	Average Slope	Cumulative Loss
AT	13	20.9	26.65%	1.31%	-	14	21.1	-30.6%	-1.41%	-355%
BE	6	21.7	21.02%	0.72%	-	7	15.0	-25.7%	-1.59%	-184%
FR	15	18.5	25.72%	1.44%	-	16	17.9	-26.8%	-1.39%	-266%
DE	14	18.5	26.41%	1.42%	-	15	18.5	-27.4%	-1.44%	-258%
EL	7	19.6	51.00%	2.69%	-	6	18.5	-51.6%	-2.56%	-669%
IE	16	19.1	32.78%	1.79%	-	16	17.9	-33.5%	-1.89%	-282%
IT	11	21.5	42.01%	2.07%	-	12	28.3	-43.5%	-1.60%	-725%
NL	16	17.9	21.43%	1.17%	-	17	17.2	-23.5%	-1.24%	-208%
PT	5	19.8	38.46%	2.01%	-	6	18.0	-35.6%	-2.01%	-355%
ES	8	16.4	23.80%	1.47%	-	7	17.6	-27.6%	-1.48%	-282%
sample	111	19.2	29.71%	1.57%	-	116	19.2	-31.2%	-1.58%	-338%
	Classical equity cycles (1957-2013)									
	Upturns					Downturns				
	No. of events	Average duration	Average Amplitude	Average Slope	Cumulative Loss	No. of events	Average duration	Average Amplitude	Average Slope	Cumulative Loss
AT	14	21.2	55.61%	2.80%	-	14	26.0	-34.1%	-1.5%	-537%
BE	6	25.3	52.49%	1.81%	-	7	16.3	-37.3%	-2.5%	-274%
FR	12	35.3	71.02%	2.05%	-	13	17.4	-46.0%	-3.3%	-383%
DE	15	23.7	48.51%	2.19%	-	16	16.0	-36.7%	-2.4%	-267%
EL	5	29.2	123.77%	5.91%	-	6	25.0	-99.7%	-4.0%	-1346%
IE	14	29.3	71.22%	2.59%	-	14	16.6	-41.2%	-2.5%	-344%

IT	15	21.7	66.19%	3.12%	-	16	20.8	-46.7%	-2.3%	-574%
NL	15	23.8	46.03%	2.11%	-	16	15.5	-32.1%	-2.2%	-211%
PT	6	23.3	67.83%	3.40%	-	6	24.0	-50.9%	-2.6%	-585%
ES	6	30.0	83.39%	3.35%	-	6	24.0	-47.9%	-2.1%	-503%
sample	108	25.8	63.70%	2.71%	-	114	19.4	-43.4%	-2.4%	-444%

Note: AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain

TABLE 11.A - CONCORDANCE INDICES AND CORRELATIONS OF EQUITY GROWTH CYCLES: 1957:1-2013:12.

	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES	$\bar{x}$
AT	1	0.77	0.8	0.69	0.76	0.65	0.78	0.7	0.84	0.79	0.75
BE	0.56***	1	0.83	0.76	0.61	0.79	0.78	0.81	0.8	0.7	0.76
FR	0.59***	0.67***	1	0.76	0.7	0.71	0.77	0.78	0.86	0.82	0.78
DE	0.39***	0.54***	0.52***	1	0.76	0.76	0.67	0.83	0.89	0.81	0.77
EL	0.49***	0.23***	0.38***	0.49***	1	0.65	0.74	0.7	0.72	0.81	0.72
IE	0.31***	0.58***	0.42***	0.52***	0.32***	1	0.68	0.82	0.71	0.73	0.72
IT	0.56***	0.58***	0.54***	0.33***	0.45***	0.36***	1	0.69	0.84	0.78	0.75
NL	0.41***	0.63***	0.55***	0.66***	0.38***	0.64***	0.38***	1	0.84	0.8	0.77
PT	0.68***	0.60***	0.72***	0.78***	0.44***	0.41***	0.69***	0.68***	1	0.81	0.81
ES	0.56***	0.43***	0.63***	0.61***	0.60***	0.49***	0.55***	0.60***	0.63***	1	0.78
$\hat{\mu_s}$	0.48	0.53	0.50	0.48	0.39	0.52	0.42	0.49	0.46	0.38	

Notes:

AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain
The correlation coefficients marked *** indicate significance at 1%.

TABLE 11.B: T-STATISTICS OF GROWTH CYCLES IN EQUITY: 1957:1-2013:12.

	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT		4.22	10.25	3.24	4.08	3.06	8.14	3.88	6.41	5.52
BE			9.53	5.17	1.71	5.95	6.24	7.61	6.43	3.35
FR				5.29	3.00	4.11	7.38	5.42	7.58	6.51
DE					4.43	7.70	2.93	8.63	10.38	10.78
EL						2.07	3.67	2.79	6.50	5.18
IE							4.12	11.23	3.31	6.69
IT								5.20	8.57	5.22
NL									7.98	6.84
PT										5.59
ES										

Notes:
AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain

TABLE 12.A - CONCORDANCE INDICES AND CORRELATIONS OF EQUITY CLASSICAL CYCLES: 1957:1-2013:12.

	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES	$\bar{x}$
AT	1	0.7	0.71	0.66	0.66	0.58	0.68	0.64	0.73	0.64	0.67
BE	0.43***	1	0.85	0.76	0.75	0.71	0.75	0.94	0.73	0.74	0.77
FR	0.48***	0.69***	1	0.76	0.76	0.71	0.76	0.78	0.72	0.74	0.75
DE	0.34***	0.50***	0.51***	1	0.79	0.75	0.77	0.82	0.78	0.76	0.76
EL	0.32***	0.50***	0.54***	0.59***	1	0.82	0.79	0.72	0.87	0.9	0.78
IE	0.20***	0.39***	0.38***	0.50***	0.64***	1	0.66	0.74	0.84	0.83	0.74
IT	0.36***	0.50***	0.55***	0.56***	0.59***	0.33***	1	0.68	0.84	0.76	0.74
NL	0.31***	0.88***	0.53***	0.63***	0.44***	0.46***	0.37***	1	0.72	0.73	0.75
PT	0.46***	0.47***	0.52***	0.60***	0.73***	0.69***	0.69***	0.48***	1	0.92	0.79
ES	0.28***	0.49***	0.50***	0.53***	0.80***	0.66***	0.52***	0.48***	0.84***	1	0.78
$\hat{\mu_s}$	0.43	0.60	0.63	0.56	0.52	0.60	0.49	0.60	0.45	0.52	

Notes:

AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain
The correlation coefficients marked *** indicate significance at 1%.

TABLE 12.B: T-STATISTICS OF CLASSICAL CYCLES IN EQUITY: 1957:1-2013:12.

	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT		3.61	5.65	3.20	2.17	1.85	4.06	3.36	3.05	1.76
BE			6.51	6.56	5.85	2.54	3.84	28.98	3.87	3.85
FR				5.34	4.24	4.20	7.41	5.41	5.30	4.15
DE					5.10	6.79	5.49	7.04	6.02	5.99
EL						6.83	5.35	3.02	9.74	12.53
IE							3.41	5.28	8.70	6.75
IT								4.08	9.08	4.20
NL									4.14	5.46
PT										16.81
ES										

Notes:

AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain

TABLE 13.A: SUB-PERIOD CONCORDANCE INDICES OF EQUITY GROWTH CYCLES: 1957:1-2013:12.

1957-1964 (average=0.66)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1		0.90***	0.43		0.65	0.83	0.66		
BE										
FR	4.77		1	0.50		0.56	0.85	0.61		
DE	-		0.00	1		0.67	0.30	0.62		
EL										
IE	0.47		-0.57	0.90		1	0.71*	0.93		
IT	-		-	-0.32		1.76	1	0.76***		
NL	0.77		0.50	-		-	2.75	1		
PT										
ES										
$\mu_s^{\wedge}$	0.71		0.69	0.90		0.77	0.54	0.70		
1965-1974 (average=0.64)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1		0.73**	0.45		0.61	0.66**	0.55		
BE										
FR	2.37		1	0.64**		0.68**	0.73***	0.73***		
DE	-0.50		2.00	1		0.77***	0.38	0.82***		
EL										
IE	1.17		2.37	6.82		1	0.45	0.88***		
IT	1.99		4.07	-1.40		-0.78	1	0.46		
NL	0.53		3.17	7.36		11.56	-0.54	1		
PT										
ES										
$\mu_s^{\wedge}$	0.52		0.49	0.50		0.34	0.46	0.37		
1975-1981 (average=0.61)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1		0.77***	0.40		0.40	0.51	0.44		
BE										
FR	3.05		1	0.61		0.58	0.55	0.62		
DE	-0.84		0.88	1		0.88***	0.49	0.89		

EL										
IE	-0.90		0.59	10.39		1	0.56	0.87***		
IT	0.23		0.52	-0.30		1.28	1	0.57		
NL	-0.65		0.90	-		14.46	1.03	1		
PT										
ES										
$\hat{\mu_s}$	0.55		0.54	0.48		0.55	0.37	0.58		

1982-1993 (average=0.67)

	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.55	0.63	0.85	0.75	0.67	0.82	0.69	0.63	0.67
BE		1	0.81	0.64	0.32	0.83	0.68	0.72	0.74	0.52
FR			1	0.75	0.47	0.86	0.67	0.75	0.65	0.67
DE				1	0.63	0.75	0.78	0.75	0.71	0.62
EL					1	0.44	0.61	0.53	0.57	0.73
IE						1	0.72	0.79	0.67	0.62
IT							1	0.65	0.64	0.58
NL								1	0.69	0.74
PT	-	-			-				1	0.61
ES									-	1
$\hat{\mu_s}$	0.40	0.70	0.53	0.52	0.26	0.56	0.40	0.53	0.82	0.29

1994-2001 (average=0.73)

	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.67*	0.83***	0.81***	0.59	0.55	0.76***	0.83***	0.86***	0.83***
BE	1.74	1	0.69**	0.63	0.53	0.61	0.61	0.69**	0.66**	0.67**
FR	6.68	2.27	1	0.90***	0.66*	0.55	0.80***	0.85***	0.89***	0.90***
DE	5.15	1.53	9.58	1	0.70***	0.59	0.86***	0.81***	0.93***	0.94***
EL	0.81	0.37	1.79	2.50	1	0.52	0.69**	0.59	0.65*	0.70**
IE	0.44	1.22	0.51	0.92	0.16	1	0.63	0.61	0.56	0.57
IT	3.61	1.61	4.58	11.06	2.12	1.31	1	0.70**	0.90***	0.89***
NL	6.23	2.18	5.54	3.92	0.91	1.56	2.11	1	0.78***	0.77***
PT	7.82	2.19	9.09	15.02	1.80	0.55	6.86	4.56	1	0.95***
ES	6.97	2.20	10.34	17.44	2.42	0.68	7.16	4.04	29.44	1
$\hat{\mu_s}$	0.44	0.58	0.48	0.40	0.49	0.47	0.39	0.52	0.43	0.40

2002-2008 (average=0.91)

	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.99	0.90	0.89	0.90***	0.96***	0.96***	0.92	0.88	0.89***
BE	-	1	0.89***	0.88***	0.89***	0.95***	0.95***	0.90***	0.87***	0.88***
FR	-	4.80	1	0.96***	0.95	0.89***	0.89***	0.99	0.90***	0.94***
DE	-	4.10	23.70	1	0.94	0.86***	0.86***	0.98	0.92***	0.93***
EL	5.55	5.17	-	-	1	0.89***	0.89***	0.96	0.88***	0.94***
IE	14.94	13.56	9.17	6.69	7.74	1	1.00	0.88***	0.85***	0.90***
IT	14.94	13.56	9.17	6.69	7.74		1	0.88***	0.85***	0.90***
NL	-	4.66	-	-	-	4.73	4.73	1	0.92***	0.93***
PT	-	4.44	6.58	6.96	5.35	3.66	3.66	6.37	1	0.85***
ES	5.11	5.02	15.21	19.29	19.06	5.92	5.92	16.93	4.78	1
$\hat{\mu_s}$	0.65	0.64	0.56	0.55	0.61	0.64	0.64	0.57	0.54	0.60

2009-2013 (average=0.90)

	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	1.00	1.00	1.00	0.82	0.78	1.00	1.00	1.00	0.80
BE		1	1.00	1.00	0.82	0.78	1.00	1.00	1.00	0.80
FR			1	1.00	0.82	0.78	1.00	1.00	1.00	0.80
DE				1	0.82	0.78	1.00	1.00	1.00	0.80
EL					1	0.90***	0.82	0.82	0.82	0.95***
IE					5.08	1	0.78	0.78	0.78	0.95***
IT							1	1.00	1.00	0.80
NL								1	1.00	0.80
PT									1	0.80
ES					9.76	17.71				1

$\hat{\mu_s}$	0	0	0	0	0.18	0.22	0	0	0	0.2

Notes:
AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain

The concordance indices marked *, ** and *** indicate significance at 10%, 5% and 1% respectively.

TABLE 13.B: SUB-PERIOD CONCORDANCE INDICES OF EQUITY CLASSICAL CYCLES: 1957:1-2013:12.

1957-1964 (average=0.61)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1		0.89***	0.33		0.58	0.73*	0.51		
BE										
FR	6.20		1	0.30*		0.47	0.78***	0.56		
DE	-1.37		-1.75	1		0.77	0.62	0.82***		
EL										
IE	0.89		-0.56	-		1	0.48	0.74		
IT	1.85		3.47	-		0.32	1	0.64		
NL	0.35		0.44	3.52		1.52	-	1		
PT										
ES										
$\hat{\mu_s}$	0.46		0.55	0.53		0.71	0.38	0.74		
1965-1974 (average=0.76)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1		0.88***	0.82***		0.66*	0.62	0.77***		
BE										
FR	8.47		1	0.89***		0.74***	0.65	0.84***		
DE	4.94		7.16	1		0.78***	0.68*	0.93		
EL										
IE	1.67		4.10	4.86		1	0.57	0.85***		
IT	1.19		1.38	1.76		0.71	1	0.64		
NL	3.95		5.02	-		7.92	1.38	1		
PT										
ES										
$\hat{\mu_s}$	0.50		0.43	0.46		0.44	0.40	0.39		
1975-1981 (average=0.58)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1		0.64***	0.38		0.42	0.49	0.48		
BE										
FR	2.79		1	0.60		0.75**	0.65*	0.48		
DE	-0.58		0.44	1		0.82***	0.42	0.83***		
EL										
IE	-0.25		2.14	5.31		1	0.60	0.68**		
IT	-0.14		1.66	-0.75		1.14	1	0.46		
NL	-0.14		-0.30	3.87		2.37	-0.32	1		
PT										
ES										
$\hat{\mu_s}$	0.33		0.67	0.64		0.70	0.49	0.52		
1982-1993 (average=0.69)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.52	0.56	0.84	0.63	0.62	0.82***	0.53*	0.79***	0.56
BE	1.03	1	0.76	0.55	0.58	0.67*	0.57	0.93***	0.61***	0.66
FR	-	0.92	1	0.69**	0.58	0.63*	0.69***	0.80*	0.47	0.50
DE	-	0.36	2.48	1	0.69*	0.69*	0.94***	0.64	0.74	0.57
EL	1.18	0.52	0.51	1.73	1	0.90***	0.69	0.55	0.81***	0.82***
IE	1.47	1.89	1.76	1.82	7.44	1	0.74***	0.65**	0.92***	0.89
IT	6.36	0.63	2.71	19.59	1.36	3.02	1	0.62	0.75	0.59

NL	1.76	11.83	1.70	1.28	-0.20	2.20	1.31	1	0.54**	0.59
PT	4.57	2.74	-	-	2.90	10.64	-	2.43	1	0.92***
ES	0.57	-	0.73	0.65	4.79	-	0.82	-	12.09	1
$\hat{\mu_s}$	0.41	0.80	0.85	0.57	0.58	0.57	0.56	0.79	0.35	0.44
1994-2001 (average=0.71)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.68	0.41	0.45	0.57	0.25	0.51***	0.57	0.59**	0.50
BE	-	1	0.73	0.75***	0.81***	0.47	0.67	0.90	0.69*	0.76***
FR	-	-	1	0.90***	0.83	0.68	0.81***	0.83	0.77***	0.91
DE	-	3.52	4.80	1	0.85***	0.64	0.92	0.75***	0.83	0.93***
EL	-	3.63	-	7.16	1	0.57	0.77***	0.71	0.79***	0.93
IE	1.02	-0.20	-0.06	-0.31	0.27	1	0.55	0.57	0.66	0.65
IT	2.85	1.60	4.08	-	3.17	-0.99	1	0.67	0.85***	0.84***
NL	-	-	-	3.28	1.43	0.62	1.49	1	0.69**	0.76***
PT	2.46	1.76	3.82	-	3.94	-	9.67	2.37	1	0.86***
ES	-	2.81	-	9.57	-	0.57	5.14	4.30	8.43	1
$\hat{\mu_s}$	0.15	0.47	0.74	0.70	0.57	0.88	0.61	0.57	0.53	0.65
2002-2008 (average=0.90)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.88***	0.89***	0.79***	0.89***	0.94	0.88***	0.89***	0.99	0.94
BE	6.10	1	0.99	0.86***	0.89***	0.94***	1.00	0.96***	0.87***	0.82***
FR	5.81	-	1	0.87***	0.90***	0.95***	0.99	0.98	0.88***	0.83***
DE	3.09	4.29	4.43	1	0.89***	0.82***	0.86***	0.89***	0.80***	0.82***
EL	5.37	6.01	7.49	6.75	1	0.93***	0.89***	0.93***	0.90***	0.93
IE	-	8.15	10.84	6.98	7.31	1	0.94***	0.93***	0.93	0.88
IT	6.10	.	-	5.69	5.49	12.60	1	0.96***	0.87***	0.82***
NL	5.97	20.26	-	7.60	8.90	13.72	20.26	1	0.90***	0.86***
PT	-	4.87	6.30	4.57	7.32	-	4.87	6.87	1	0.95
ES	-	4.10	5.06	4.45	-	-	4.10	5.76	-	1
$\hat{\mu_s}$	0.67	0.64	0.63	0.62	0.65	0.61	0.64	0.65	0.68	0.73
2009-2013 (average=0.82)										
	AT	BE	FR	DE	EL	IE	IT	NL	PT	ES
AT	1	0.78	0.78	0.78	0.52	0.62	0.65	0.78	0.52	0.55
BE	-	1	1.00	1.00	0.73	0.83	0.87	1.00	0.73	0.77
FR	-		1	1.00	0.73	0.83	0.87	1.00	0.73	0.77
DE	-			1	0.73	0.83	0.87	1.00	0.73	0.77
EL	-	-	-	-	1	0.90	0.87	0.73	1.00	0.97
IE	-	-	-	-	-	1	0.77	0.83	0.90	0.93
IT	-	-	-	-	-	1.13	1	0.87	0.87	0.83***
NL	-				-	-	-	1	0.73	0.77
PT	-	-	-	-		-	-	-	1	0.97
ES	-	-	-	-	-	-	3.44	-	-	1
$\hat{\mu_s}$	0.60	0.38	0.38	0.38	0.12	0.22	0.25	0.38	0.12	0.15

Notes:
AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain
The concordance indices marked *, ** and *** indicate significance at 10%, 5% and 1% respectively.

TABLE 14: AVERAGE CONCORDANCE OF EQUITY GROWTH CYCLES: 1957:1-2013:12

Country	1957-64	1965-74	1975-81	1982-93	1994-01	2002-08	2009-13	% change 1957-13
Austria	0.69	0.60	0.50	0.70	0.75	0.92	0.93	34%
Belgium				0.65	0.64	0.91	0.93	45%
France	0.68	0.70	0.63	0.70	0.79	0.92	0.93	36%
Germany	0.50	0.61	0.65	0.72	0.80	0.91	0.93	85%

Greece				0.56	0.63	0.92	0.84	50%
Ireland	0.70	0.68	0.66	0.71	0.58	0.91	0.81	15%
Italy	0.69	0.54	0.54	0.68	0.76	0.91	0.93	35%
Netherlands	0.72	0.69	0.68	0.70	0.74	0.93	0.93	30%
Portugal				0.66	0.80	0.88	0.93	42%
Spain				0.64	0.80	0.91	0.83	30%

TABLE 15: AVERAGE CONCORDANCE OF EQUITY CLASSICAL CYCLES: 1957:1-2013:12.

Country	1957-64	1965-74	1975-81	1982-93	1994-01	2002-08	2009-13	% change 1957-13
Austria	0.61	0.75	0.48	0.65	0.50	0.90	0.66	8
Belgium				0.65	0.72	0.91	0.86	32
France	0.60	0.80	0.62	0.63	0.76	0.92	0.86	43
Germany	0.57	0.82	0.61	0.71	0.78	0.84	0.86	51
Greece				0.70	0.76	0.91	0.80	14
Ireland	0.61	0.72	0.65	0.75	0.56	0.92	0.83	36
Italy	0.65	0.63	0.52	0.71	0.73	0.91	0.83	28
Netherlands	0.65	0.81	0.59	0.65	0.72	0.92	0.86	32
Portugal				0.73	0.75	0.90	0.80	10
Spain				0.68	0.79	0.87	0.81	19

TABLE 16.A - CONCORDANCE BETWEEN BUSINESS AND FINANCIAL GROWTH CYCLES: 1960:1-2013: 12

Country	Concordance index
Austria	0.70
Belgium	0.65
France	0.67
Germany	0.62
Greece	0.57
Ireland	0.60
Italy	0.62
Netherlands	0.65
Portugal	0.64
Spain	0.72

TABLE 16.B - T-STATISTICS BETWEEN BUSINESS AND FINANCIAL GROWTH CYCLES: 1960:1-2013:12.

Country	t-stat
Austria	4.42
Belgium	2.63
France	3.90
Germany	2.28
Greece	**0.88**
Ireland	2.09
Italy	2.89
Netherlands	3.63
Portugal	2.08
Spain	4.17

TABLE 17.A - CONCORDANCE BETWEEN BUSINESS AND FINANCIAL CLASSICAL CYCLES: 1960:1-2013:12.

Country	Concordance index
Austria	0.46
Belgium	0.58
France	0.57
Germany	0.65
Greece	0.64

Ireland	0.57
Italy	0.51
Netherlands	0.49
Portugal	0.58
Spain	0.73

TABLE 17.B – T-STATISTICS BETWEEN BUSINESS AND FINANCIAL CLASSICAL CYCLES: 1960:1-2013:12.

Country	t-stat
Austria	**-0.30**
Belgium	**0.84**
France	**0.64**
Germany	2.89
Greece	2.32
Ireland	**0.38**
Italy	**0.77**
Netherlands	**-0.75**
Portugal	**1.35**
Spain	4.24

Note: Insignificant t-statistics are in bold characters.

TABLE 18.A: SUB-PERIOD CONCORDANCE INDICES BETWEEN BUSINESS AND FINANCIAL GROWTH CYCLES: 1960:1-2013:12.

	1960-67	1968-73	1974-83	1984-92	1993-02	2003-08	2009-13
AT	0.45	0.65	0.78***	0.71***	0.67**	0.74*	1
BE				0.6	0.47	0.71*	1
FR	0.6	0.76***	0.63	0.52	0.67**	0.74***	1
DE	0.32	0.61	0.42	0.7***	0.72***	0.78***	1
EL				0.4	0.43	0.83***	0.78**
IE			0.68**	0.44	0.56	0.68	0.78
IT	0.58**	0.51	0.56	0.56	0.63*	0.65	1
NL	0.68*	0.65***	0.54	0.6	0.63	0.63**	1
PT				0.6	0.43	0.72***	1
ES				0.63*	0.72***	0.81***	0.8

Notes:

AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain

The concordance indices marked *, ** and *** indicate significance at 10%, 5% and 1% respectively.

TABLE 18.B: SUB-PERIOD CONCORDANCE INDICES BETWEEN BUSINESS AND FINANCIAL CLASSICAL CYCLES: 1960:1-2013:12.

	1960-67	1968-73	1974-83	1984-92	1993-02	2003-08	2009-13
AT	0.32	0.56	0.37	0.62***	0.28	0.53	0.75***
BE				0.60	0.40	0.54	0.97
FR	0.40	0.54	0.48*	0.60	0.50	0.72	0.97
DE	0.47	0.61	0.66*	0.71***	0.53	0.79**	0.90***
EL				0.52	0.58	0.75***	0.78
IE			0.53**	0.33***	0.70	0.74	0.60
IT	0.39	0.38	0.43	0.56	0.45	0.69*	0.83
NL	0.55	0.47	0.41	0.43	0.36***	0.64	0.78***
PT				0.45	0.57	0.50	0.80
ES				0.61**	0.65	0.93	0.82

Notes:

AT: Austria; BE: Belgium; FR: France; DE: Germany; EL: Greece; IE: Ireland; IT: Italy; NL: Netherlands; PT: Portugal; ES: Spain

The concordance indices marked *, ** and *** indicate significance at 10%, 5% and 1% respectively.

Figures

FIGURE 1 - BUSINESS CYCLES

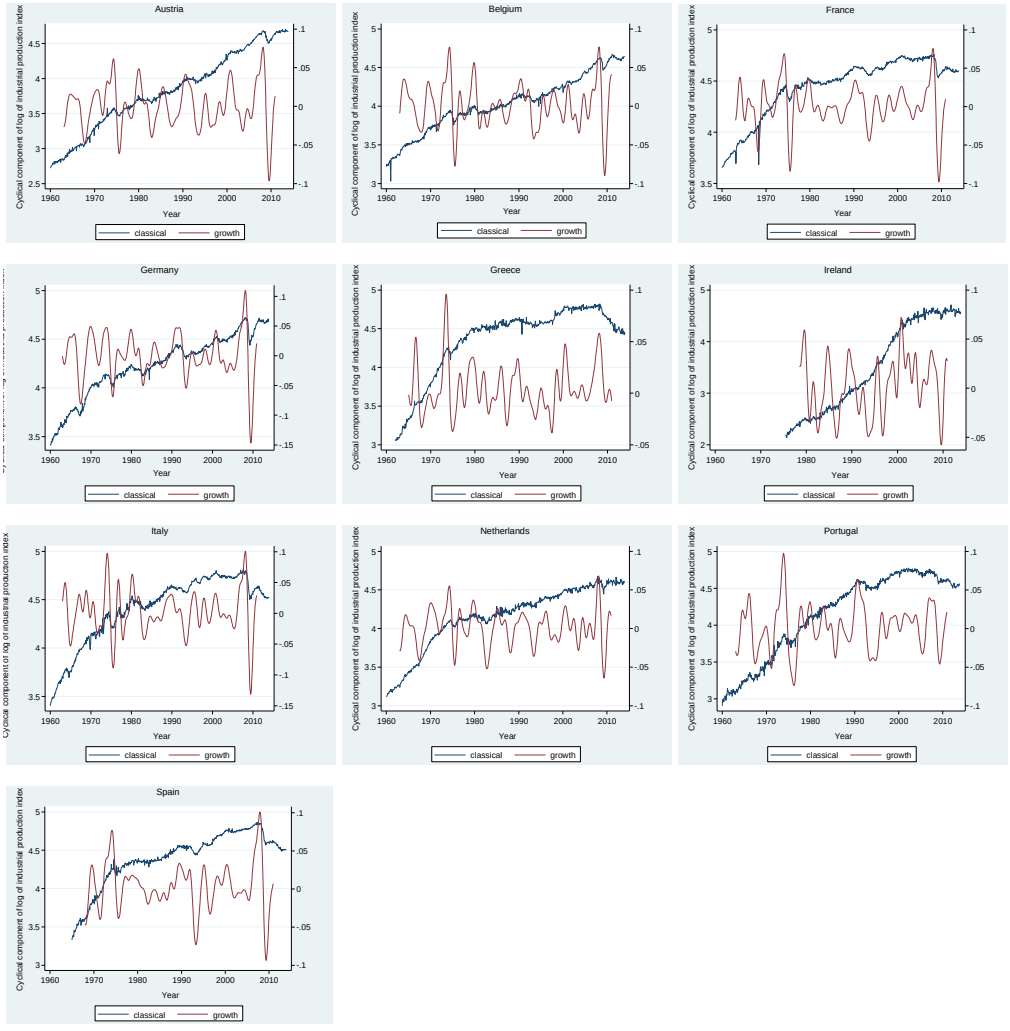


FIGURE 2 – FINANCIAL CYCLES

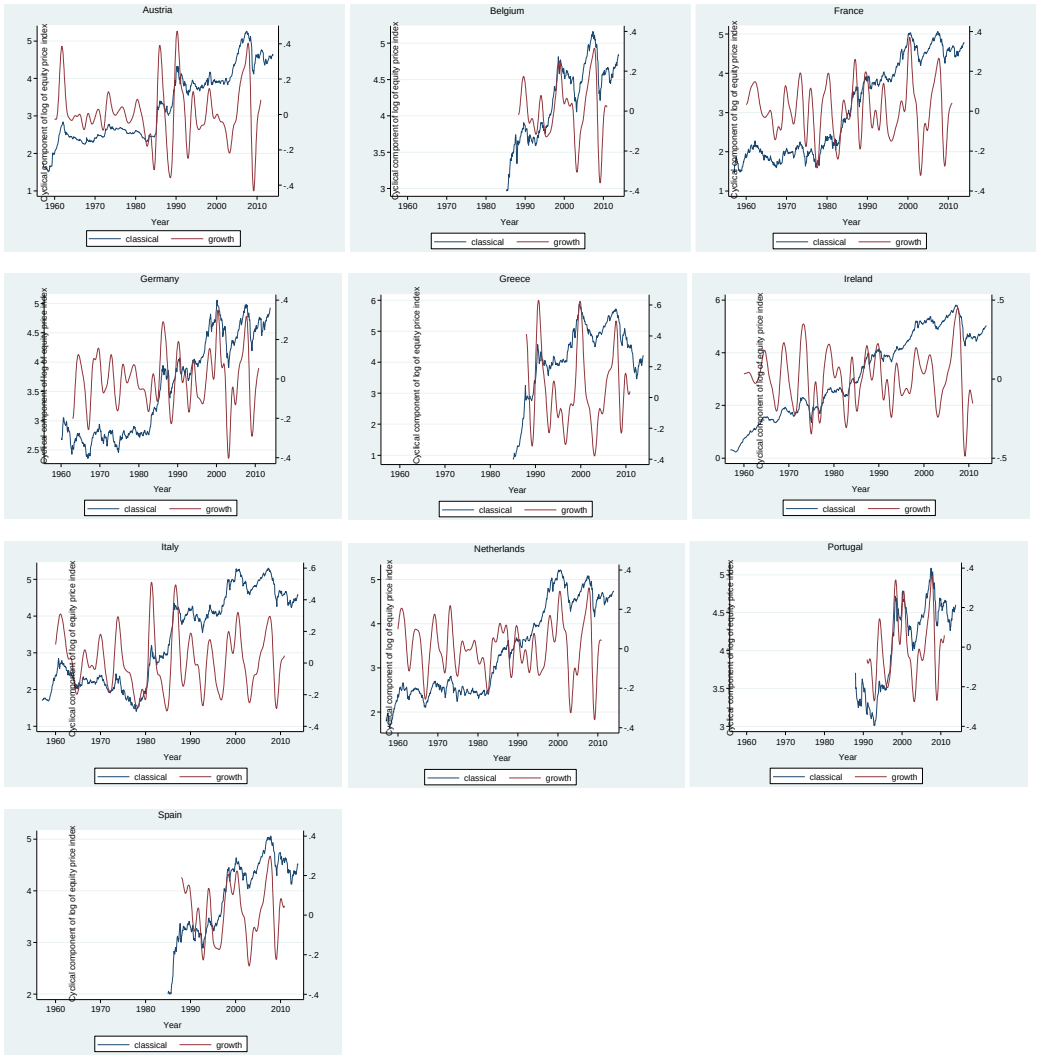
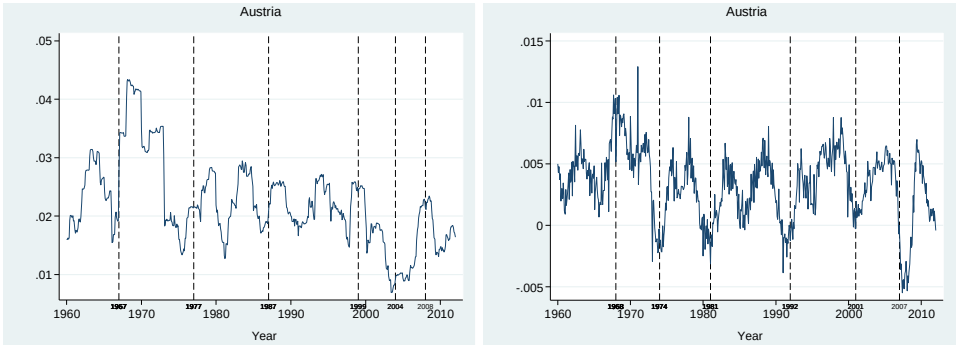
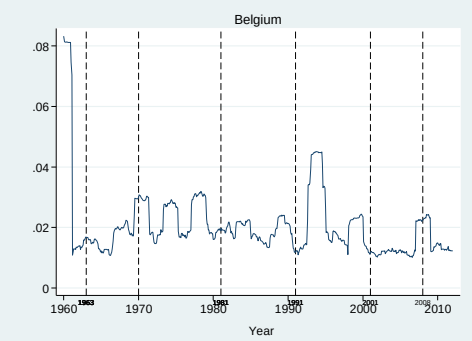


FIGURE 3 - BUSINESS CYCLE BREAK DATES

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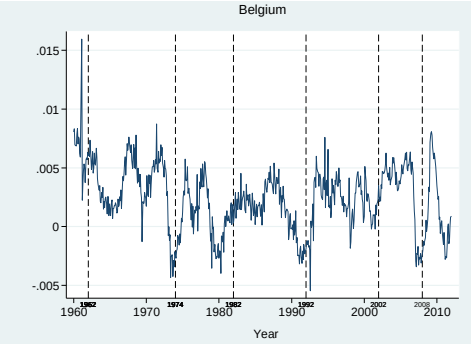
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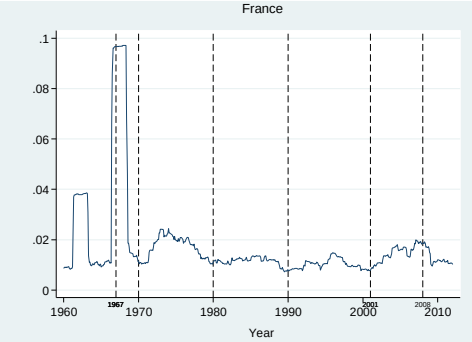
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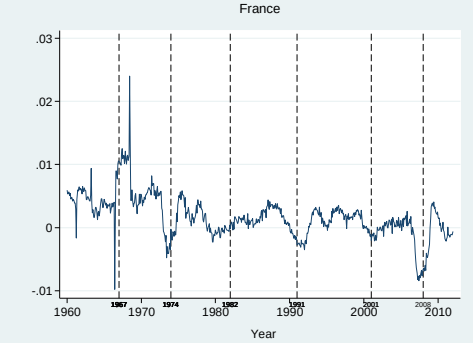
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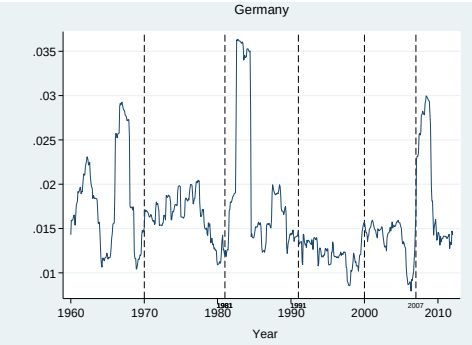
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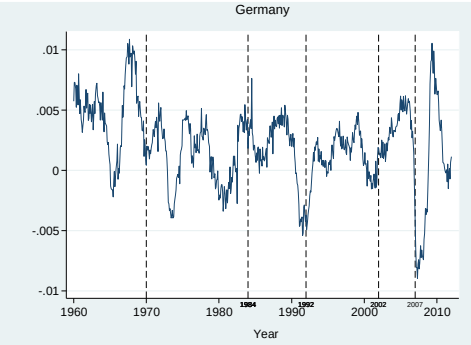
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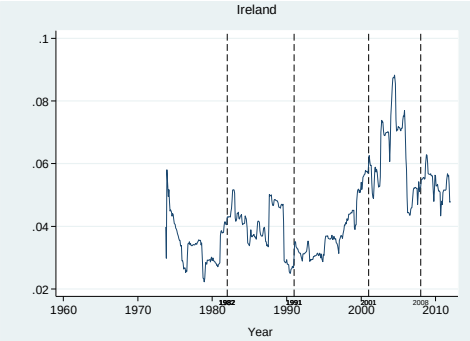
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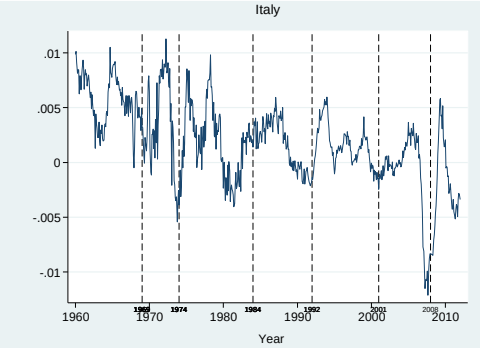
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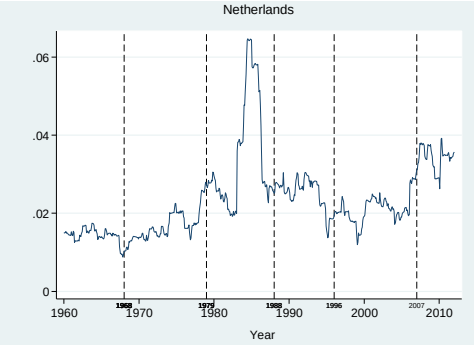
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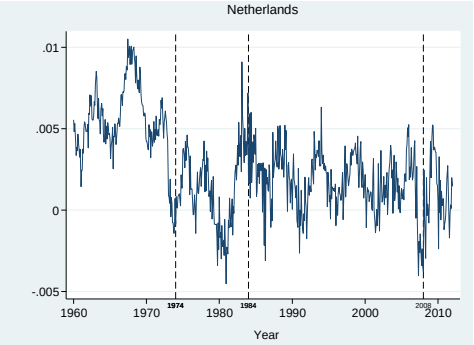
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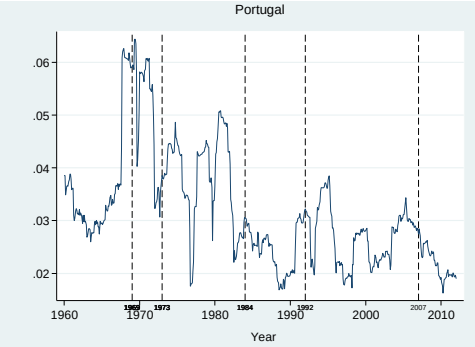
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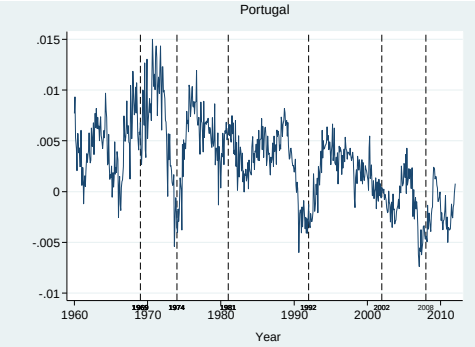
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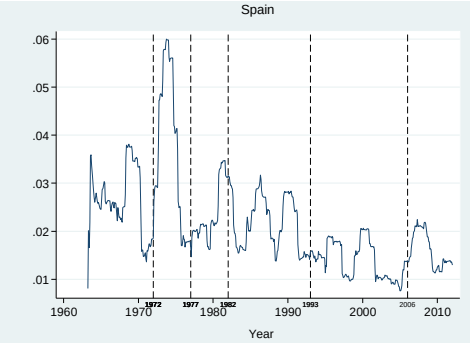


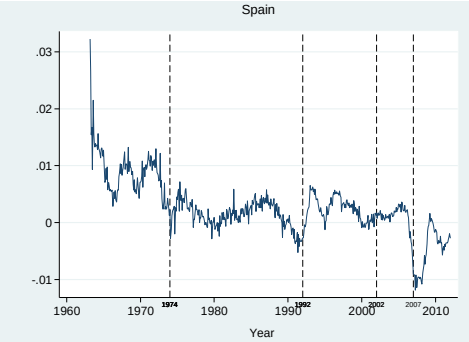
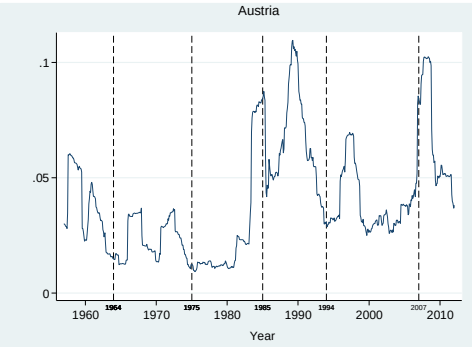
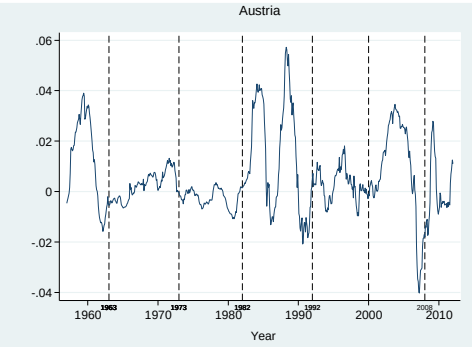
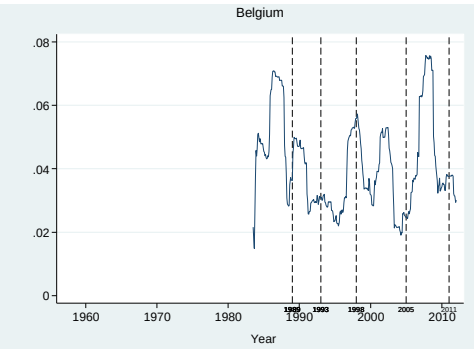
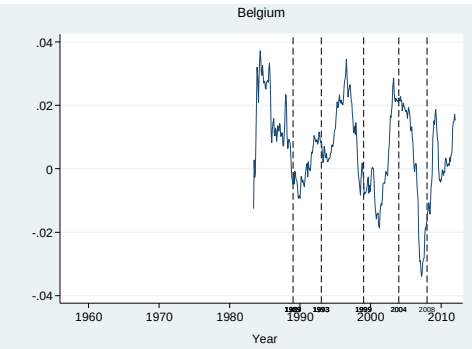


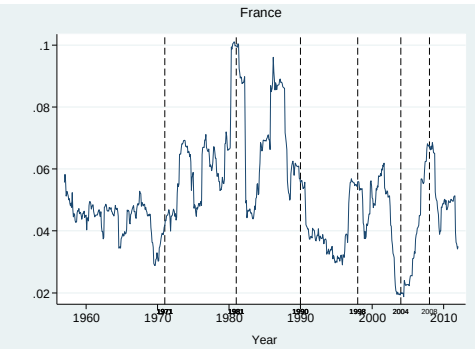
FIGURE 4 - FINANCIAL CYCLE BREAK DATES

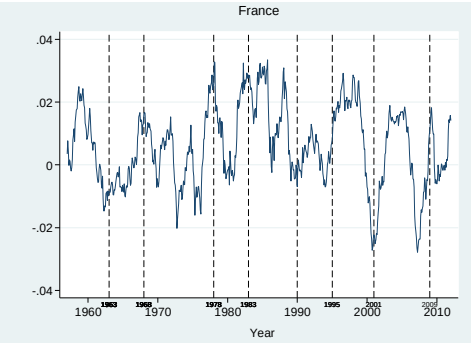


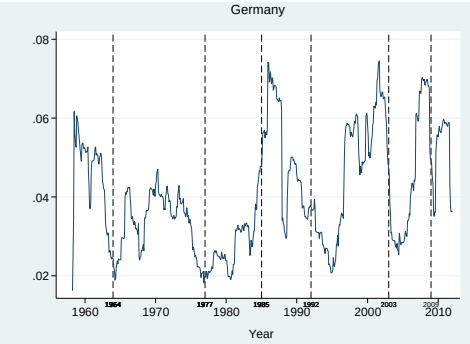








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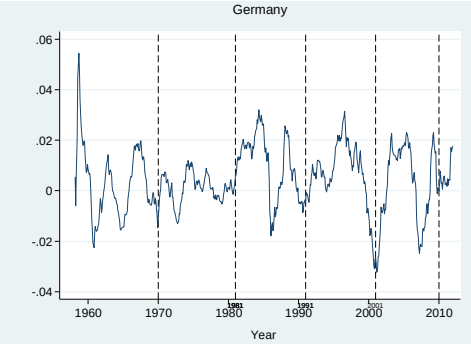
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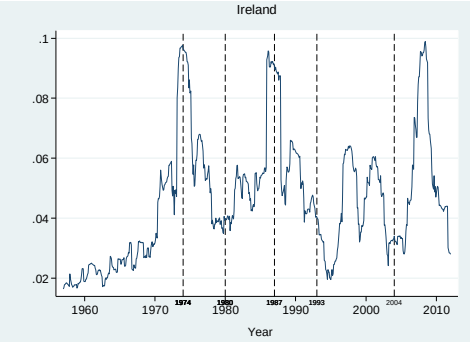
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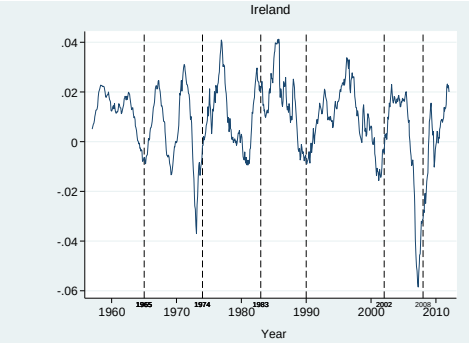
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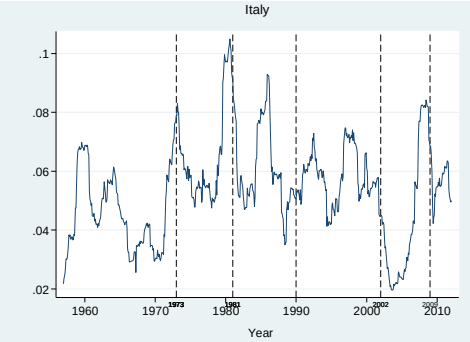
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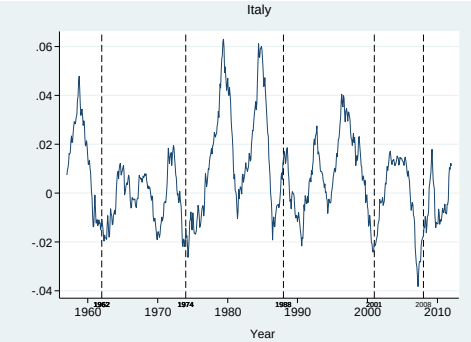
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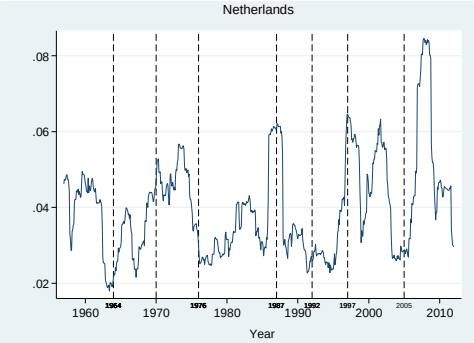
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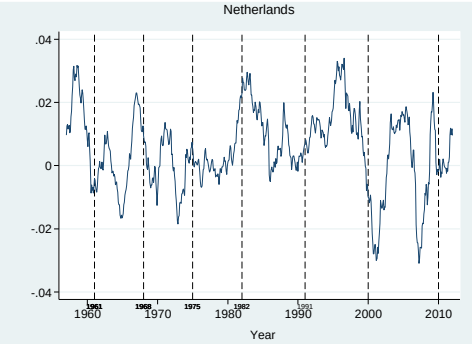
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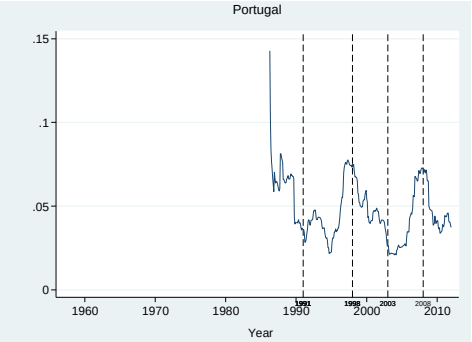
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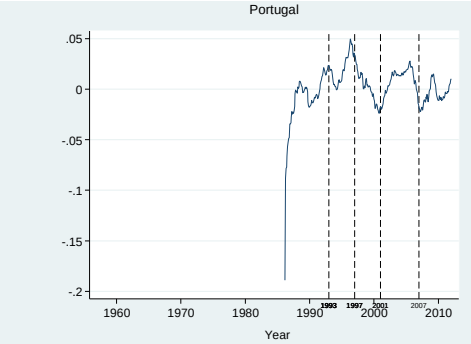
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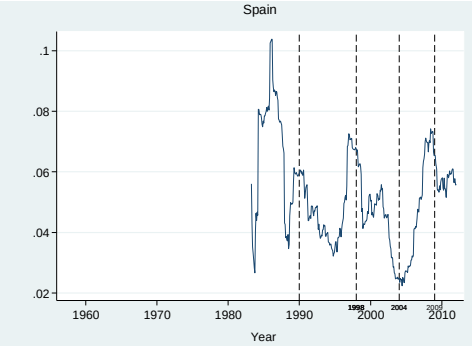
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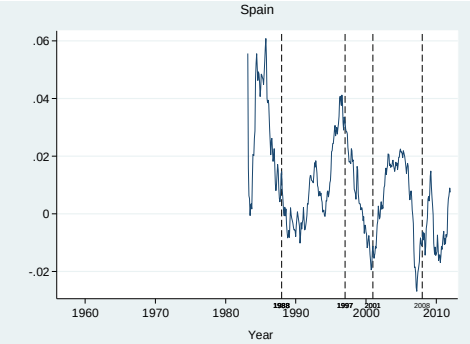
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