

WORK PROJECT

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**Business Cycle Convergence in the Euro Area  
after 20 Years of Single Currency**

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## Abstract

This paper aims to provide new evidence on the convergence of business cycles in the euro area after two decades of common currency and to assess the extent and necessity of the fulfilment of the OCA criteria. A correlation analysis is conducted to investigate convergence of business cycles in the euro zone. Findings show no dominant up- or downward trend in synchronisation after 20 years of common currency. Nevertheless, the recurrent pattern of increasing convergence in crisis times and de-synchronisation in early recovery periods persists in the analysis. Further, the OCA criteria are assessed. While the conditions of openness to trade and production diversification are largely met in the euro area, the homogeneity of preferences is only partly given. Labour market rigidities and the lack of a common fiscal capacity are the biggest hurdles for the euro zone. Solidarity between member states plays a big role in fiscal integration. Prior research on driving factors of convergence underlines the importance of the OCA criteria for business cycle convergence in the euro area.

Keywords: Euro area, convergence analysis, business cycle, optimum currency area.

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## 1. Introduction

The co-movement of business cycles is crucial for the well-functioning of a monetary union. De-synchronised business cycles within a currency union undermine the proper conduct of monetary policy. Stabilisation policies are incapacitated when member states reside in different cyclical phases. In such event, the centralised “one-size-fits-all” monetary policy can lead to the further divergence of cycles among members (Weyerstrass *et al.*, 2011). The cost of abandoning monetary autonomy is thus significantly lower when business cycles are synchronised (Eichengreen, 1993). Optimum Currency Area (OCA) theory stipulates six further criteria that contribute to the smooth functioning of currency unions, namely labour mobility, openness, production diversification, fiscal integration, homogeneous preferences, and solidarity (Baldwin and Wyplosz, 2015). This paper aims to provide new evidence on the convergence of business cycles in the euro area after two decades of common currency and to assess the extent and necessity of fulfilment of the OCA criteria. The convergence of euro area business cycles is pertinent for the smooth functioning of monetary policy in the euro area. Hence, this analysis is crucial for the persistence of the euro area and the European project at large.

Business cycle synchronisation of euro area countries is a widely investigated topic. The interest in the issue was sparked by the European plan to create a monetary union in the late 1980s. Research on the convergence of business cycles before and shortly after the implementation of the euro is abundant but becomes scarcer after the 2008 financial crisis. The following paragraphs aim to summarise the essence of previous findings.

Studies from around the time of the implementation of the common European currency find a significant increase of business cycle convergence between the European countries since the inception of the European Exchange Rate Mechanism (ERM) in the late 1970s (e.g. Belo (2001) or Angeloni and Dedola (1999)). Artis and Zhang’s (1999) research support these results and additionally find that the business cycles of ERM members have moved closer towards the German cycle than to the American cycle. Massmann and Mitchell (2004) go as far as saying that convergence looks promising and there is hope for the emergence of a euro area cycle.

In the 2000s, research results on the cyclical convergence in Europe became more ambiguous. Gayer (2007) finds correlations of euro area cycles to be relatively high since the introduction of the euro but not higher than in the 1990s, meaning that co-movement has not improved after the launch of the common currency. De Haan, Inklaar and Jong-A-Pin (2008) back the substantial increase of convergence in the 1990s. Nevertheless, according to their research not all countries followed that trend. Synchronisation was higher between Austria,

Belgium, France, the Netherlands, Germany, and Italy whereas Portugal, Finland and Ireland showed ample deviations from that movement. They conclude that a joint movement towards a common euro area business cycle cannot be detected. Weyerstrass *et al.* (2011) come to similar conclusions, using data from 1970 to 2007. Their results show that cyclical co-movement has not increased substantially after 1999. No clear increasing or decreasing trend is detected. Synchronisation is unstable with the European currency union experiencing periods of higher and lower convergence.

The Great Financial Crisis (GFC) of 2008 was expected to have a substantial impact on convergence in the euro area, especially as the shock dragged out and morphed into the euro area specific debt crisis. Gaechter, Riedl and Ritzberger-Gruenwald (2012) conduct a correlation analysis to investigate the impact of the downturn on synchronisation. Their empirical findings point to a desynchronisation of euro area business cycles during the period between 2007 and 2009. Although convergence is found to decrease, it persists at high levels.

Franks *et al.* (2018) use the concordance statistics to measure cyclical convergence in the euro area. In line with previous research, their analysis shows a moderate rise in business cycle synchronisation from 1999 to 2007 followed by a sharp increase in the wake of the GFC.

A general finding of the analysis of euro area business cycle synchronisation over time seems to be that there is a recurrent pattern of increased convergence in time of crisis and divergence in the early stages of a recovery (Gayer, 2007; Sorić, Lolić and Logarušić, 2021). It is therefore particularly interesting to investigate the impact of the 2008 shock. Though Gaechter, Riedl and Ritzberger-Gruenwald looked into the matter in 2012, the recovery period had barely started. The authors were thus constrained by their sample in their analysis. This paper aims to conduct a similar analysis and evaluation with an extended data set to newly assess the impact of the 2008 recession on business cycle convergence in the euro area.

This paper contributes to existing convergence research by using a time series thread of 20 years, starting with the implementation of the single currency, and reaching up to the time before the onset of the Covid-19 pandemic. It therefore covers more than a decade of data after the GFC and is therefore apt to answer the question of whether the observed convergence at the time of the GFC has left a permanent mark or is only a glitch after which the typical recovery-based de-synchronisation is happening again. The results are more in line with the latter hypothesis suggesting that even after the common currency moves into its third decade monetary policy continues to face difficulties with regards to persistent insufficient synchronisation of euro area business cycles.

OCA theory delivers criteria that enable the functioning of a currency union despite weak business cycles synchronisation. When fulfilled the OCA criteria help absorb asymmetric

shocks of asynchronous cycles. Reviewing past research on the fulfilment of the OCA criteria in the euro area leads to the conclusion that the OCA criteria are only very partially fulfilled in the euro area. In a further section the relevance of the OCA criteria is assessed in the light of the research on the determinants of synchronisation in the euro area. The empirical results of that research show strong parallels to the OCA criteria and thus support the theory and the importance of the criteria for the well-functioning of a currency union.

In **section 2** the methodology of the correlation analysis will be laid out and details of the data sample reviewed.

**Section 3** presents the results of the analysis. In a first part, the results of the analysis using GDP growth rates are given. However, growth rates are very sensitive to the window length. Thus, in a second part, the results of the analysis using the cyclical component of real GDP levels are presented. Given that the trend component has been extracted from absolute GDP observations, convergence results show less sensitivity to the window length (Gaechter, Riedl and Ritzberger-Gruenwald, 2012).

To assure the accuracy of the empirical findings of section 3, diverse robustness tests are carried out in **section 4**. This includes an alternative filtering technique, the use of weighted instead of simple averages and the exclusion of Irish data from the analysis due to the distortionary effects of data revisions.

**Section 5** comprises three subsections, an introduction to OCA theory, an evaluation of the OCA criteria in the euro area and, with a view to assessing the relevance of the OCA criteria, an overview of research on the driving factors of convergence.

In **section 6**, the empirical findings of section 3 are discussed.

**Section 7** presents concluding remarks and gives recommendations for further research.

## **2. Methodology and Data**

In previous research several different approaches and measures have been utilised to study the convergence of business cycles. This paper will study the issue based on correlation analysis. Alternatively, a dispersion measure instead of a correlation measure could have been applied. However, dispersion measures are usually scale dependent i.e., they increase and decrease with the amplitude of the cyclical changes in the underlying variables and are therefore less suited to investigate the research focus of this paper – synchronisation of business cycles in their periodicity and stage.

Alternative approaches used to analyse business cycle synchronisation have been dynamic factor models and wavelet analysis. The first method estimates unobservable dynamic factors

which drive the business cycle of a group of countries (see e.g., Lehwald, 2012). The second approach analyses the communality of the business cycles among a group of countries by exploiting the properties of the series in both the time and frequency domain (e.g., Aguiar-Conraria and Joana Soares, 2011). However, although these methods are appealing in their way of using advanced econometric techniques their complexity does not necessarily lend itself to better interpretability. For instance, dynamic factor models rely on the computation of unobservable factors based on observable variables. But the relationship between the factors and the observable variables is not stable over time so that the interpretation of how the observables determine these factors changes with an extension of the observation period. Moreover, there is no comparative study to date that would suggest that one method would be superior to the others. For these reasons the method of correlation analysis which is an established and easy-to-interpret method of measuring business cycle synchronisation will be used in this text.

With regard to the question which data should be used to analyse the issue at hand, I noted that that the most utilised variables to measure business cycles are GDP and industrial production (IP). Earlier research is often based on IP data as it has been available on a monthly basis over a substantial period of time while the collection of quarterly GDP data for European countries only started in 1995. Yearly data disregards short-term fluctuations within the year and also provides only a limited number of data points for empirical analysis. It is thus not very suitable for business cycle analysis. Data with higher frequency represents an advantage in terms of the robustness of results. Industrial production is a relatively good approximation to GDP developments, as the two aggregates have been shown to move closely together. The IP index is thus historically a widely used approximation for GDP (Massmann and Mitchell, 2004), particularly in pre-2000 studies due to the scarce availability of quarterly GDP data.

The correlation analysis is conducted by using quarterly data of real GDP. Quarterly real GDP data is available from 1995-Q1 on for 17 out of the 19 euro area countries<sup>1</sup>. For the Netherlands and Malta, the data is only available from 1996-Q1 and 2000-Q1, respectively. The analysis focusses on the period from the implementation of the euro as a currency until today. However, since the observations for the last two years, 2020 and 2021, are heavily

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<sup>1</sup> The 19 euro area countries are Belgium, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Austria, Portugal, Slovenia, Slovakia and Finland.

impacted by the Covid-19 pandemic they have been omitted in order not to obtain strongly distorted results at the end of the period.

Given that cyclical convergence or divergence manifests itself in converging or diverging GDP growth rates, a first approach to analyse trends in cyclical synchronicity or disparity between euro area countries is to use seasonally and calendar-adjusted quarterly growth rates of real GDP. However, in literature the preferred approach is to base the analysis on the cyclical part of the level of quarterly real GDP, instead of growth rates.

Various filters have been proposed to separate the cyclical component of economic data from the long-term trend, in particular the Hodrick-Prescott (Hodrick and Prescott, 1997), Baxter-King (Baxter and King, 1999) and Christiano-Fitzgerald (Christiano and Fitzgerald, 2003) decompositions. The most commonly applied filter is the Hodrick-Prescott (HP) filter (Massmann and Mitchell, 2004; De Haan, Inklaar and Jong-A-Pin, 2008). To ensure comparability of the findings of this paper with previous research the main analysis has been conducted using the Hodrick-Prescott filter. Although the HP-filter has a number of favourable features it suffers from some shortcomings such as the end-point-problem, which is due to the fact that data beyond the lower and higher end of the series needs to be projected, and the trend extracted with the help of the filter may exhibit spurious correlation or spurious cycles (Kaiser and Maravall, 1999; Hamilton, 2018). Several alternative filters have been proposed which can alleviate these problems, but they come at the cost of other problems. Which filter best to apply therefore depends on the property of the data at hand. In this thesis, the HP filter will be used but the robustness of the results will be cross-checked by using the alternative filtering method proposed by Christiano and Fitzgerald.

Using GDP growth rates and the cyclical component of the level of real GDP, the correlation analysis is conducted using rolling windows i.e., correlations over a time period of a fixed length are computed between each individual euro area country and the euro area total and then the time period is shifted by one quarter keeping its length unchanged. The length of the window is of crucial importance. Longer window lengths have been found to be more reliable since they entail more observations, but at the same time they potentially neglect important medium-term developments since these fluctuations tend to be smoothed out. Short window lengths, by contrast, are more sensitive to medium-term changes but can lead to artificial, systematic drops at peaks or troughs of cycles. Following Gayer (2007), in this analysis 4-year windows (i.e. a window length of 16 quarters) are used. These results are cross-checked for robustness by using 6-year windows (24 quarters). The first 4-year window in terms of growth rates of real GDP is thus 1995-Q2 to 1999-Q1 and the last 2016-Q1 to 2019-Q4. Equivalently, for the cyclical components of the level of real GDP, the first 4-year window is 1999-Q1 to 1998-Q4 and the last 2016-Q1 to 2019-Q4. For the 6-year windows, in terms of

growth rates the first window is 1995-Q2 to 2001-Q1 and the last one is 2014-Q1 to 2019-Q4 while for the cyclical components of the level of real GDP the first window goes from 1995-Q1 to 2000-Q4 and the last one from 2014-Q1 to 2019-Q4.

The correlation analysis results in a correlation matrix, a row of which represents the correlation coefficients between each euro area country and the euro area total over all rolling windows while a column represents the correlation coefficients for a specific window across all countries. In a final step, the simple average of the correlation coefficients across all countries for each rolling window is calculated. This average is then interpreted as a measure for the synchronisation of business cycles in the euro area. To check for robustness, an alternative calculation uses the weighted average of the correlation coefficients across all countries, with the weights being the share of each country's GDP in the euro area GDP. Since the correlation coefficients are bound between 0 and 1<sup>2</sup>, a coefficient close to 1 is interpreted as high synchronisation while a coefficient close to 0 would mean low synchronisation. In the graphical representation, the average correlation coefficient for a specific window is assigned to the endpoint of this window. For instance, the correlation coefficient for the last window (i.e. from 2016-Q1 to 2019-4 for the 4-year window) is assigned to quarter 2019-4. An alternative way to assign the average correlation for a specific window would have been to use mid-points. However, this would have had the effect that no correlation coefficients would be available after 2017 for the 4-year window and after 2016 for the 6-year window. For presentational purposes the former convention has been used in this paper.

There is an anomaly in the original data set which may lead to biased results. The Irish real GDP jumps from 53,546.2 million euros in 2014-Q4 to 65,601.5 million euros in 2015-Q1, which is equivalent to a growth rate of 22.5 %. The quarters before and after 2015-Q1 record growth of 2% and -2%, respectively. What looks like an extreme outlier can nevertheless be explained. In 2015, the Irish GDP was revised. Low corporation tax rates in Ireland have attracted various multinational firms in recent years. Enticed by the favourable tax regime big companies relocate their tax domicile to Ireland. Often this is done by a practice called "inversion". Multinational firms buy smaller competitors based in a country with advantageous tax systems and relocate their tax domicile to said country. Ireland is a popular candidate for such practices. By relocating their tax domicile to Ireland companies become domestic Irish

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<sup>2</sup> Strictly speaking, the correlation coefficient is bound between -1 and 1. However, in the present case we consider the (simple and weighted) average of the correlation coefficients between each country and the average of these countries. For the simple average, this could only become negative in extreme cases. For the weighted average, a negative value is conceptually impossible.



firms thus boosting Irish GDP. This explains to a large extent the extraordinary growth rate in the first quarter of 2015 (Rojíček, 2017; Khder, Montornès and Ragache, 2020). To understand whether this outlier growth impacts significantly on the results a robustness check was carried out by conducting the analysis without the Irish data.

### 3. Business cycle convergence

To assess business cycle convergence in the euro area as a first point of reference Figure 1 displays a graphical presentation of the cyclical components of real GDP for all euro area member states. For better comparability and easier interpretation, the cyclical components filtered by use of the HP-filter have been divided by their standard deviations (rendering thus series with a standard deviation of 1).

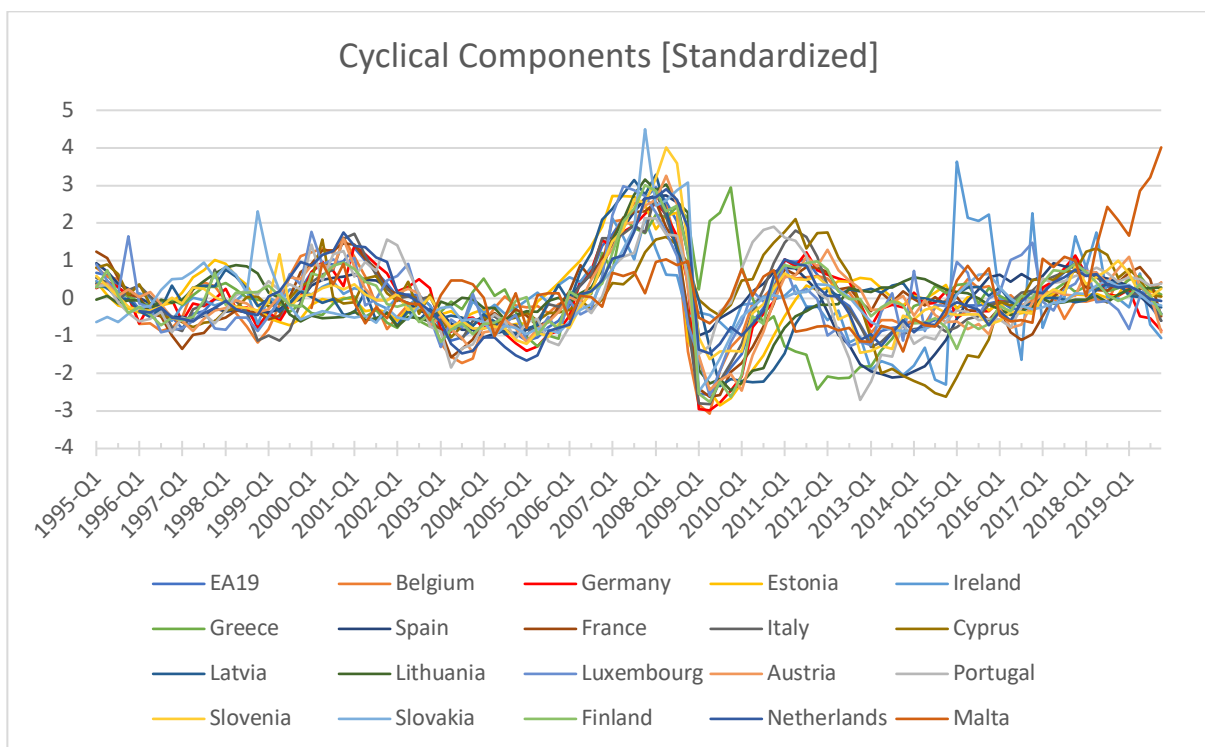


Figure 1: Cyclical components of real GDP levels, of all euro area countries and the euro area, divided by their standard deviations.

Source: Eurostat, and author's calculation.

As shown by the figure, the cyclical components of euro area countries seem to be largely synchronised. The sharp fall in 2008 due to the GFC is clearly recognisable. The slump is followed by an upward trend, which slows down in 2010. Overall, cycles look more synchronised before the shock in 2008 than after, in line with the hypothesis that convergence is higher during recessions but recovery periods are dominated by dis-convergence in (Sorić, Lolić and Logarušić, 2021).

Taking a closer look at the recovery phase a couple of countries can be seen to diverge particularly from the common movement. Greece, for example, peaks in 2009 when most euro area countries have already crashed after the 2008 shock. The countries' cycle hence only reaches its trough in 2011 and thus makes a delayed start to recovery.

Moreover, a few countries see a second dip after 2010. This second slump can be traced back to the euro area debt crisis, with Cyprus, Portugal, Ireland, and Spain standing out as particularly affected by the shock. Portugal experiences a cyclical trough in 2013. Cyprus only starts to recover in 2014. The second crisis (Sovereign Debt Crisis) that hit the euro zone asymmetrically delayed recovery of those economies and those caused dis-convergence within the currency union.

The sharp rise in Ireland's cycle in 2015-Q1 is explained by the countries' GDP revision in the same year (discussed at the end of section 2).

#### **a. GDP growth rates of real GDP**

Figure 2 exhibits the results of the euro area correlation analysis with GDP growth rates. The figure shows the (unweighted) average correlation of each euro area country with the euro area total<sup>3</sup>. As explained above, for the 4-year rolling windows the correlation for the window 1995-Q2 to 1999-Q1 is assigned to quarter 1999-Q1 and for the 6-year windows the correlation for the period 1995-Q2 to 2001-Q1 is assigned to quarter 2001-Q1.

As can be seen, from the late 1990s up to the late 2000s the correlation coefficient remains virtually stable at around 0.3. A short period of increasing synchronisation can be observed following the burst of the dotcom bubble in 2000 but this was reversed again after 2003. The figure then shows a dramatic surge in 2008, when the Global Financial Crisis (GFC) hit. The synchronised downturn in 2008-2009 led the correlation values rally to around 0.8 for both the 4-year and the 6-year window. Thereafter, the measured synchronisation remained at elevated levels with a moderate decline until 2013 for the 4-year window and until 2015 for the 6-year window. In 2013, when the strong cyclical synchronicity due to the GFC faded out, the curve for the 4-year window experiences a slump to around 0.5. The drop for the 6-year

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<sup>3</sup> The euro area total includes the country for which the correlation is computed. As mentioned in the introduction, a major aim of determining the degree of cyclical synchronisation in a monetary union is to determine whether monetary policy can be conducted efficiently. The aggregate which the monetary authorities need to target is the euro area as a whole or, in other words, the average cyclical position of the euro area. For this reason, the country for which the correlation is computed is not excluded from euro area aggregate in the present analysis.

window occurs in 2015 since the effect of the synchronised downturn and following upswing lingers on for two more years. After a period of approximately 3 years during which the correlation coefficients remain rather stable a further drop to a value of around 0.3 occurs, in 2016 for the 4-year window and in 2018 for the 6-year window. This second drop can be explained by the fact that the GCF prompted a second crisis in the euro area, the European debt crisis, which led to depressed growth rates between 2011 and 2013 across the board. With the end of this second crisis this effect faded out and pushed the measured synchronisation down to levels seen before the GFC. At the very end of the observation period a slight upward tick can be observed for both window lengths.

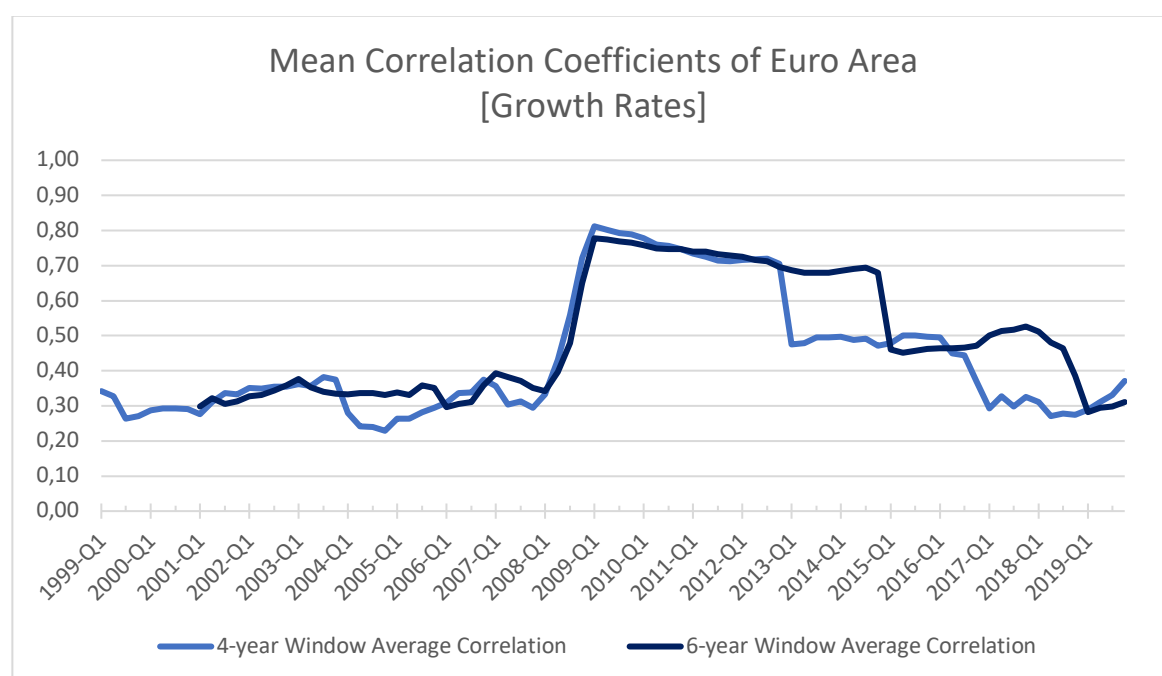


Figure 2: Mean euro area correlations of real GDP growth rates.

Source: Eurostat, and author's calculations.

It is remarkable that the results are very sensitive to the window length. The higher sensitivity of the shorter window length to short- and medium-term events is displayed in the early 2000s after the dotcom crisis. Coefficient levels fall to almost 0.2 for the 4-year window whereas they remain close to stable above 0.3 for the 6-year window. However, the vulnerability of the analysis to window length is most noticeable in the period from 2013 to 2015 where the 4-year window values dive first followed only two years later by the 6-year window values. This two-year gap corresponds precisely to the difference in window length. Coefficients remain elevated in the period following 2008 during the time the values from those crisis years remain in the window. As soon as those crisis values drop out from the window, correlation coefficients fall sharply. This is the case for the for 4-year window in 2013 and for the 6-year window in 2015. This lagged reaction is obviously due to the choice not to centre correlations on the

midpoints of the windows but on their endpoints. Since at the beginning of the observation period the correlation coefficients remain rather stable over a longer period this reaction lag is not visible for the sharp increase in the correlation values at the start of the GFC. Both curves take off at approximately the same moment, as the crisis observations are first recorded by both windows simultaneously in 2008-Q1. Explaining the parallel conduct of the curves at the start of the crisis and diverging reaction as it fades out.

Due to its strong sensitivity to the window length and the impact of strong common shocks on the results, the analysis based on real GDP growth rates is not fully satisfactory. But it will serve as the reference with which to compare the results for subsequent analysis based on the cyclical component of real GDP levels.

### **b. Cyclical components of real GDP levels**

Equivalent to the analysis behind Figure 2, Figure 3 displays the correlations averages of the cyclical components of real GDP levels between each euro area country and the euro area total. The first value on the figure, 1998-Q4, is derived from the 4-year window comprising the observations from 1995-Q1 to 1998-Q4. The 6-year window curve's first value in 2000-Q4 is derived from the window starting in 1995-Q1 up to 2000-Q4.

At first sight, Figure 3 displays an overall pattern that seems to be similar to the one observed in Figure 2. Nevertheless, looking at the initial levels of the curves, differences can already be detected. Both curves in Figure 3 start at higher initial levels than in Figure 2. The 4-year window curve's initial value in 1998-Q4 is at 0.5, compared to 0.34 in 1999-Q1 in Figure 2. The same goes for the 6-year window curve that starts at 0.46 in 2000-Q4 in Figure 3, in contrast to the 0.3 for 2001-Q1 in Figure 2. Furthermore, both curves in Figure 3 experience a more pronounced rise in the early 2000s following the burst of the dotcom bubble. The 4-year correlation curve reaches a local high in 2003 when convergence wears off again. In terms of the 6-year window the convergence materialises more gradually and a tad later, with its local peak only in 2005. Due to the elevated sensitivity of the shorter window to medium-term fluctuations the respective curve also plunges sooner and deeper after 2003, down to 0.5, whereas the 6-year window curve reaches its local trough one year later in 2006, only falling to 0.6. In 2006, both curves take off simultaneously reaching their peak in 2008, the year when the GFC hit. It is interesting to note that in Figure 2 the increase in correlation values only started to rise in late 2007, whereas in Figure 3 the convergence begins its increase in early 2006. It is important to note that, each value on the figure is solely described by past observations. As each window describes the point in time of the last observation it withholds. Therefore, the sooner rise in correlation coefficients is not influenced by the integration of 2008 crisis data in the 2006 values. It appears that the boom experienced prior

to the crisis was a “true boom” as such. Meaning that most euro area countries experienced a cyclical upswing. Figure 1 exhibits evidence for that phenomenon. The individual cycles of euro area member states show a coordinated surge from 2005 on until the cyclical peak in 2008. Further, the Hodrick-Prescott filter interprets slumps purely cyclical. As part of the smoothing process the filter will shift some of the downturn’s effect into previous years. That process contributes to the sharp increase in convergence in the run-up years to the crisis (2006 and 2007).

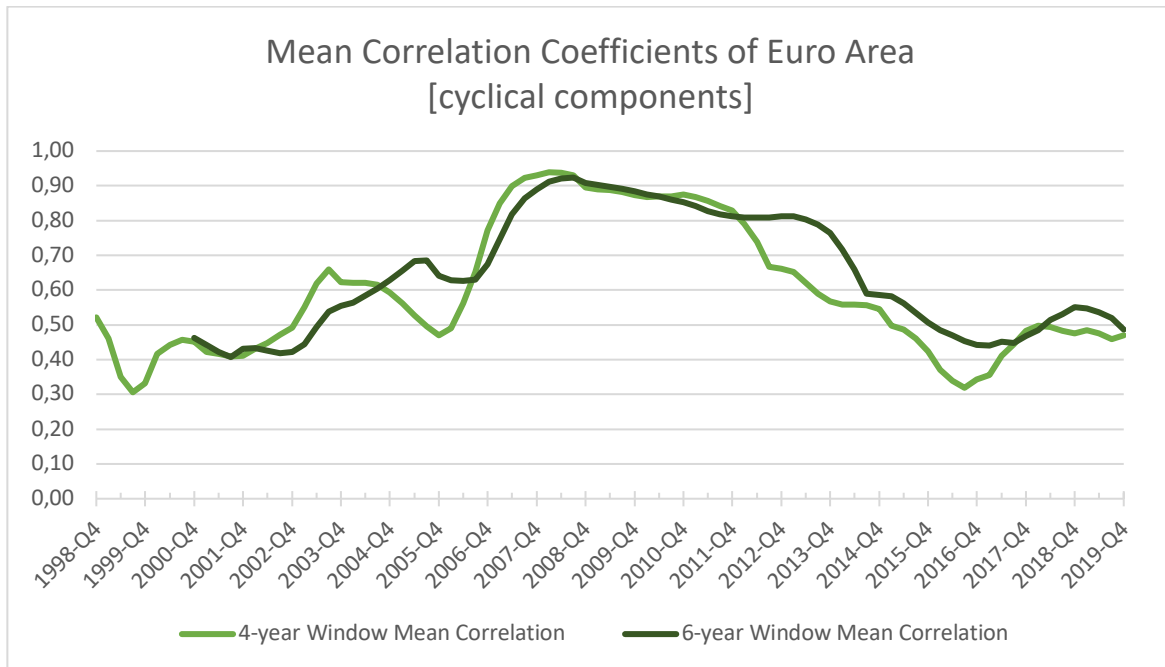


Figure 3: Mean euro area correlations of cyclical components of GDP levels.

Source: Eurostat, and author’s calculations.

Like in Figure 2, the dramatic surge induced by the GFC is followed by a gradual decrease in coefficients from 2008 onwards. The 4-year curve sees the decline accelerating in 2011-Q4 and the 6-year curve in 2013-Q1. Although the lag in the reaction between the two curves is still visible, the lag is shorter and the sharper decent starts sooner than in the analysis using real GDP growth rates. The 4-year window curve hits a local low of 0.32 in 2016 and the 6-year window curve falls to 0.44 at the end of 2016. Thereafter, both curves see small increase settling at levels of synchronisation of about 0.5, similar to the values at beginning of the observation period.

Overall, no clear upward or downward trend in the convergence of euro area business cycles can be detected.

#### 4. Robustness

The robustness of the results in the previous section will be checked in three ways. First, the correlation analysis will be conducted based on cyclical components of real GDP levels but using the Christiano-Fitzgerald (CF) filtering technique instead of the HP-filter. Second, weighted, and unweighted results of the correlation analysis as per cyclical components of real GDP levels will be compared. Lastly, to rule out any distortive impact of the extreme values of the Irish cycle, the correlation analysis will be carried out conducted once more excluding Ireland.

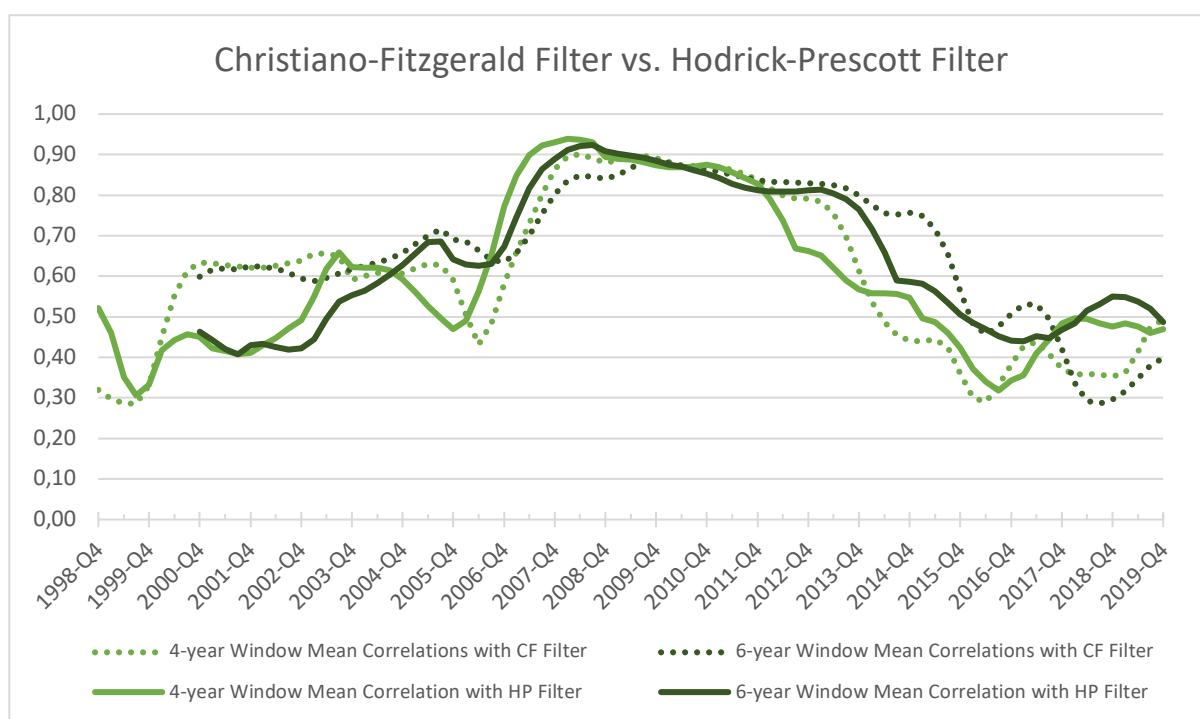


Figure 4: Mean euro area correlations of cyclical components of GDP levels filtered for with Christiano-Fitzgerald and Hodrick-Prescott filter.

Source: Eurostat, and author's calculations.

For the first robustness test a different filtering technique for the extraction of the cyclical component from the real GDP is applied. This cross-check is conducted to investigate the effects of the well-known problem that different trend-cycle decomposition techniques can lead to diverging business cycle estimations. The results from these computations are displayed in Figure 4. The two filtering methods produce overall similar outcomes. The sharp rise in convergence in pre-2008 shock and the gradual decline thereafter are displayed by both approaches. However, at the end of the sample the filters induce different behaviours in the curves. The CF filtered data show a rise in convergence in 2019 whereas the HP analysis sees a slump at the end of the sample, perhaps linked to the end of sample bias the HP filter

suffers from (Gaechter, Riedl and Ritzberger-Gruenwald, 2012). Nonetheless, the overall picture remains qualitatively unchanged.

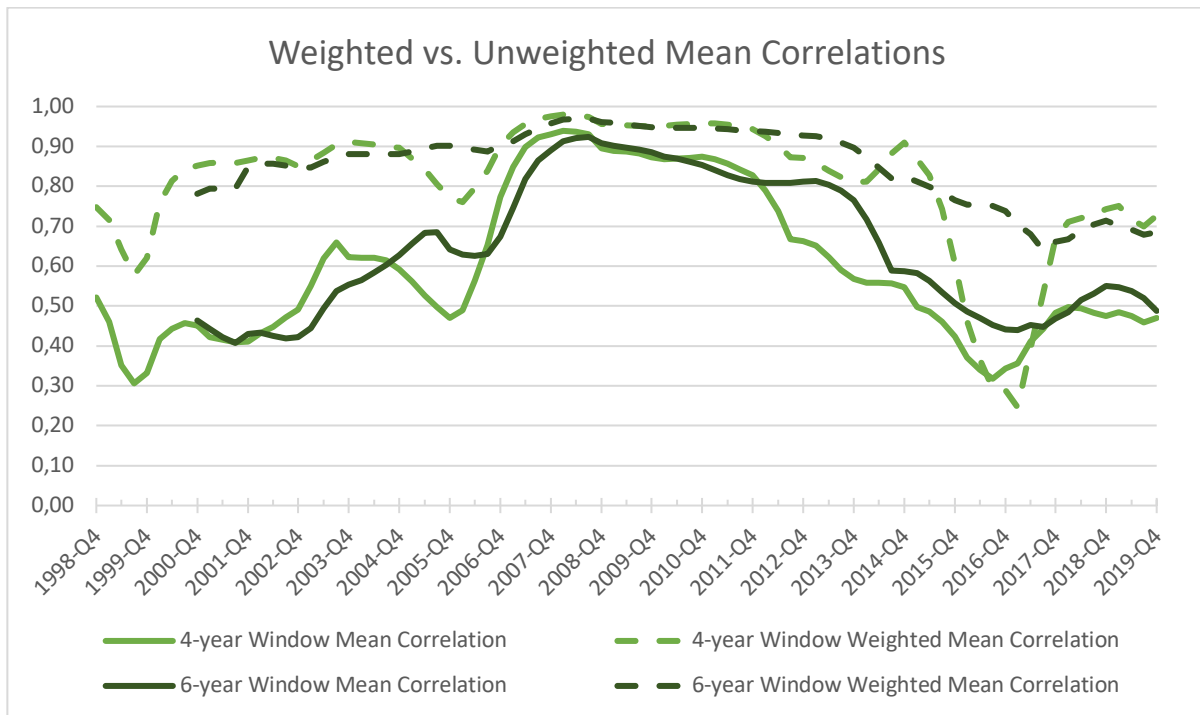


Figure 5: Weighted and unweighted mean correlations of euro area countries.

Source: Eurostat, and author's calculations.

Using a weighted mean approach to measure the convergence of business cycles in the euro area, the degree of convergence is overall higher suggesting higher synchronisation between the major contributors to the euro area GDP. Previous research supports that assumption. Ferroni and Klaus (2015) investigate convergence between the major European economies Germany, France, Italy, and Spain. Finding strong convergence between all four prior to the 2008 shock, Spain derives in the post-crisis recovery period. Belke, Domnick and Gros (2017) examine different convergence patterns between core and periphery countries of the euro area in the aftermath of the GFC. The authors find increased synchronisation among core countries, as opposed to de-synchronisation of periphery countries with each other and with core countries. The sharp decrease in the more sensitive 4-year window curve from 2014-Q1 to 2015-Q1 can equally be explained by taking a closer look at cyclical data of the four major economies in the euro area. Germany, Spain, France, and Italy show strongly diverging behaviour in the respective period. While Italy and Spain are on a cyclical rise, France finds itself in a cyclical downturn. By contrast, Germany's cyclical development in that period is unstable and does not show a specific trend. The four biggest economies of the euro area being in different cyclical phases cause a sharp fall in convergence when operating with weighted means (see Figure A in appendix for graphical representation). Nevertheless, the

overall pattern of the weighted analysis is similar to the unweighted analysis. Findings of the main analysis are thus confirmed.

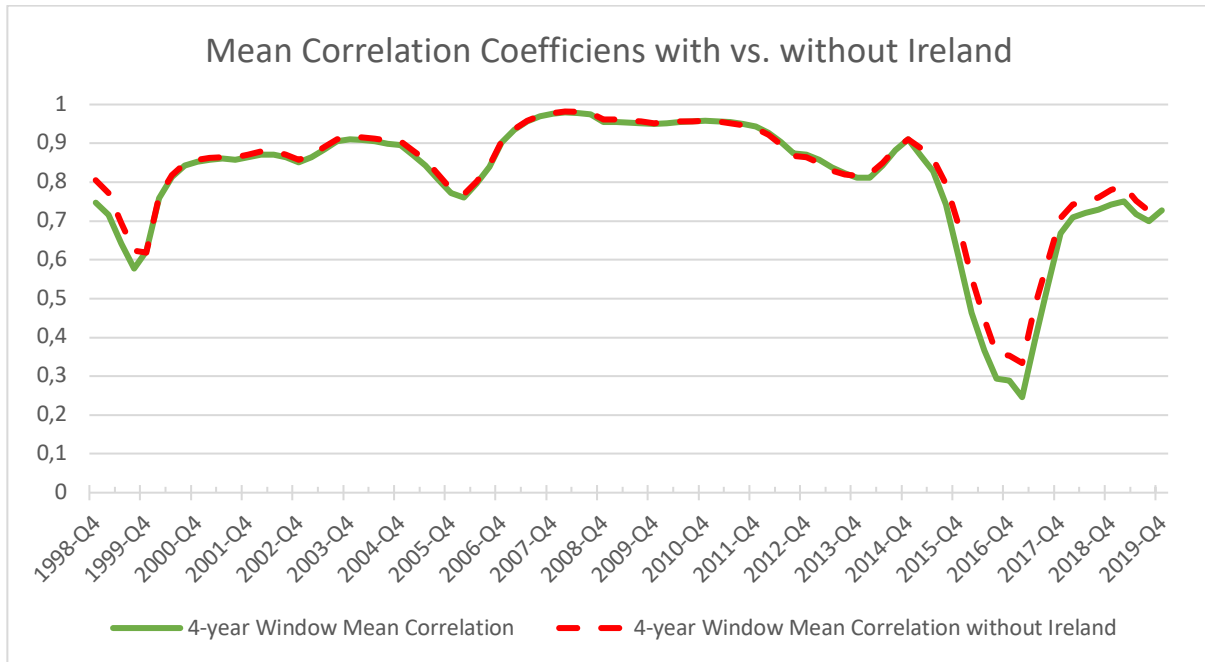


Figure 6: Weighted mean euro area correlations with and without Ireland.

Source: Eurostat and author's calculations.

Figure 6 exhibits the mean correlation findings with and without Ireland. This check was conducted to rule out distorting effects of the jump in Irish GDP in 2015-Q1. The two curves barely differ, it can thus be said that the analysis is robust to the outliers in Irish GDP data.

## 5. Optimum Currency Area theory in the euro area

The empirical results in section 3 have shown that business cycles in the euro area do not display apparent synchronicity. In other words, business cycle synchronisation is not given in the euro area. Optimum Currency Area theory delivers criteria which if fulfilled can support the functioning of a currency union in the face of weak synchronicity of members' business cycles. Therefore, the following section will discuss the extent to which the OCA criteria are fulfilled in the euro area. To corroborate the relevance of the OCA criteria, the last subsection of this chapter provides an overview of empirical research on factors that drive business cycle convergence in the euro area.

### a. The theory of Optimum Currency Areas

Optimum currency area theory is a theoretical approach to assess whether it is desirable for a group of countries to give up their national currencies to adopt a common one – or rather which countries should form a currency union. An optimum currency area (OCA) is a



geographically limited region for which it would be economically efficient to share a currency. In theory this region is not bound to national borders. In reality though currency unions are commonly formed by countries that are within geographical proximity of each other. The introduction of a common currency in a region withholds many benefits but the abandonment of national monetary autonomy also has its cost.

Through the implementation of a common currency transaction costs are strongly reduced and exchange rate risks are eliminated within the union. Prices are also more transparent, as they are all in the same currency and there is no longer the necessity for banks to hold large reserves in foreign currencies to enable exports or imports. Furthermore, a joint central bank is more independent and less likely to be politically biased than national central banks since it is not related to one government but conducts a single monetary policy for multiple countries.

While the utility of a currency increases the more widespread it is, not each and every country should participate in a single currency as costs increase with the size and diversity of the union. With the formation of a currency union countries lose sovereignty over monetary policy and the adjustability of exchange rates between members. Therefore, the mitigation of asymmetric shocks to the group become challenging. As exchange rates are no longer flexible between member states, adjustments must be made via prices and wages, not only affecting one country but the entirety of the union. In the case of an asymmetric shock within a currency union, prices will decrease in the country hit by the shock and appreciate in the other countries. Though nominal exchange rates are fixed, a gap in real exchange rates emerges. Diverging real exchange rates of union members, in turn amplify future asymmetric shocks. This makes the formation of a currency area a delicate choice as costs can outweigh benefits if not considered carefully.

Optimum Currency Area theory premiered in the 1960s. It was first introduced by Canadian economist Robert Mundell (1961) who later won the Nobel prize (in part for having created OCA theory). Mundell's work was further elaborated by Ronald McKinnon (1963) and Peter Kenen (1969). The approach was to build a framework of criteria for which, if fulfilled, economic benefits would outweigh the costs of forming a currency union. The theory provides three classic economic criteria:

- **Labour mobility (Mundell):** Production factors must be able to move freely across the currency union. Where this is easily fulfilled for capital with the formation of the union, free movement of the labour force proves more challenging. In theory, unemployment in one country and inflationary pressure in the other are solved by the free movement of production factors throughout the single currency region. After basic labour market theory workers leave a region, rich in labour force where wages fall due

to high supply of the factor, to go find hire in a region dominated by unemployment, where wages are high due to excessive labour demand.

- **Openness (McKinnon):** Countries that have a general tendency to be open to trade are more likely to engage in heavier trade with each other. Meaning, prices in countries that already engage in (heavy) trade with each other (pre currency union) are adjusted by competition. Although, those countries may have different currencies exchange rates do not influence the price at which they are exporting (in foreign currency). A change in exchange rate is compensated by an adjustment in domestic export prices, so that prices in the foreign currency remain the same. Prices of exports (in domestic currency) rise with depreciation and fall with appreciation. The flexibility of prices voids the loss of policy independence (exchange rate instruments) when forming a Currency Union.
- **Production diversification (Kenen):** Countries of one currency area should have similarly diverse export and production structures. They should have diversified production and produce similar goods. Through diversification of production within the union shocks are either symmetric or of small over-all impact if asymmetric.

In addition to these three classic economic criteria to determine the optimality of a currency union three political criteria have been developed. The recent 2008 crisis has particularly demonstrated the importance of the latter. The political criteria are determined as follows:

- **Fiscal integration:** Countries of one currency union should be prepared to conduct fiscal transfers within the union to offset regions facing economic difficulties. This type of risk sharing enables the group to better absorb asymmetric shocks. Additionally, to ease the downturn in the country hit by a shock, the fiscal transfers lead to increased fiscal expenditures in the countries spared by the shock without being spent in the countries and thus do not generate expansionary effects there. Therefore, fiscal transfers contribute to hamper the boom in the countries spared by the shock. This helps offset the inflationary pressure in the latter.
- **Homogenous preferences:** Currency union members should have a similar approach on how to handle crises. This criteria's relevance persists regardless of the shock is symmetric or asymmetric. Consensus on how to deal with a shock should be given. Else any policy response of the central bank will be controversial and leave some of the countries unhappy. Which can in the worst-case lead to the dissolution of the union.
- **Solidarity:** Unanimity should be extended to the entirety of the union and dominate nationalism. The tie to a joint monetary policy can give rise to conflicting national interests. Disagreements on the verge of asymmetric shock are not uncommon even in a national setting. Nevertheless, within a country solidarity towards fellow citizens is

more prevalent. Cohesion between members of a currency union should be strong and a certain acceptance for “shared destiny” given.

Optimum Currency Area theory does not deal with optimality in the classical sense. It rather balances benefits and costs of the formation of a union. The criteria for OCAs are not pass or fail criteria. Rather it is evaluated to what extent currency areas fulfil each of the criteria. Furthermore, the theory concedes that it is unlikely that all criteria are ever fully satisfied. Thus, no currency union is ever prone to be optimal. In the next subsection will be discussed to what extent the euro area fulfils the OCA criteria.

### **b. Assessment of OCA Theory in the Euro Area**

Labour mobility is the oldest OCA criteria and very essential to the internal functioning of a currency area, as asymmetric shocks can be mitigated through the labour market. Ideally, the free movement of labour force will slow unemployment in one country and inflationary pressure in the other. In the EU, the free movement of persons was implemented in 1993 as one of the 4 freedoms established in the treaty of Maastricht<sup>4</sup>. The free movement of labour is thus legally enforced in the euro area. Nevertheless, the actual displacement of people is more complex and rigid than procured by the perfect labour market in Mundell's theory (1961). Appendix Figure B exhibits labour mobility in 2008, comparing mobility between the then 15 euro area member countries, within these member countries and between the states in the US. Labour mobility between euro zone members is by far lower than between US states. Curiously the movement of labour within euro countries also amounts to only half of the US's. Reasons for the higher rigidity in labour mobility are language and other cultural barriers as well as the cost of moving. Compared to the US, language and cultural factors weigh a lot heavier in Europe due to the region's multiculturalism. Furthermore, less obvious issues must be considered like differing social systems (health insurance, pension system, etc.) and education systems across countries. Finally, personal ties like family (partner's career, children, parents to care for) and friends equally play a major role in labour mobility (Baldwin and Wyplosz, 2015).

Evidence of the rigidity of euro area labour markets can also be drawn from unemployment rates. If labour mobility was fulfilled unemployment rates of euro area countries should be somewhat similar (Georgieva Svrutinov *et al.*, 2015). This is not the case. Spain and Greece for example have higher unemployment rates than Germany (see Appendix Figure C). The

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<sup>4</sup> The treaty of Rome, signed in 1957, only proposed the formation of a customs union. The policy came into effect with the Single Market as part of the Maastricht Treaty in 1993 enabling the free movement of goods, services, capital and people.

Eurobarometer survey of 2010 give further evidence of the immobility of labour in the euro zone. 85% of participants have never lived or worked in another country within the euro area. Only 14% envisage to do so. Although, half of the participants say they would move abroad in the event of unemployment (European Commission, 2014). Nevertheless, data from 2020 suggests only 3.3% of EU citizens of working age live in another member state (Eurostat, 2021). By and large, labour mobility in the euro zone is low and thus the Mundell criterion not fulfilled.

The second criterion is the McKinnon criteria - trade openness. Trade has been at the heart of the European project since early on. The European Economic Union in 1957, common external trade policies, the single market and the single currency have promoted trade between European countries. Although the explosive rise in intra-euro-area trade that was expected with the formation of the currency union did not materialise, trade has nonetheless very much increased since the single currency (Krugman, 2012). The share of imports and exports of European countries from and to other member states is greater than trade with third party nations. Overall, most European countries are very open to trade. Specifically, small countries depend on imports to satisfy their internal demand. This also explains the increased enthusiasm of small countries about the currency union (Vrňáková and Bartusková, 2013; Baldwin and Wyplosz, 2015). The euro area largely meets the openness criterion of OCA theory.

Production diversification is the third economic criteria. Kenen's argument is that countries with similarly diverse productions are less likely to suffer asymmetric shocks. Baldwin and Wyplosz (2015) present a dissimilarity index of European trade, differentiating three classes of goods, manufacturing, minerals and agriculture. Vrňáková and Bartusková (2013) use Standard International Trade Classification (SITC) as export indicator. Both works find production in the euro area sufficiently diversified to satisfy the OCA criterion.

Moving on to the political criteria, fiscal integration is perhaps the most debated of the three. The ability of the European Union to take fiscal actions is strongly limited. The supranational fiscal budget amounts to only 1% of the EU's GDP. For the euro area there is no fiscal budget at all. Additionally, the European Commission can only advise countries to follow fiscal plans, the actual implementation of fiscal policies is in the competence of the member states. In terms of expenditure, the largest share of the EU budget goes to the Commission's operating expenses, and reducing disparities between member states, regardless of shocks. Agriculture, fisheries, regional development, and the protection of the environment also account for a substantial share of the budget. Thus, the criterion of fiscal integration is certainly not fulfilled in the euro area. Now the non-fulfilment of this criterion is slightly more ambiguous than the rest of them. Compared to labour mobility which is enacted on paper but just is not as easy to

implement as it depends on individual's choices and preferences, the fiscal non-integration is a purely political decision. Although the framework for a common fiscal capacity has been put in place, it is not extensive enough to enable fiscal transfer at the euro area level. The reason behind this is political and strongly linked to the two last OCA criteria – homogeneous preferences and solidarity.

Homogeneous preferences are a general “issue” and will never be entirely fulfilled. It is unlikely that even just two governments consistently agree on everything. The OCA criterion on homogeneous preferences is thus only partly satisfied in the euro area (Baldwin and Wyplosz, 2015). The homogeneity of preferences also plays a role in fiscal integration in Europe. Diverging socio-cultural attitudes, such as how to conduct fiscal policy diverge between member states. Budgetary discipline in terms of public expenditure in Germany and other “frugal” countries co-exists with leaner approaches in other countries. These different attitudes to budgetary discipline have given rise to conflicting interests of net contributors and beneficiaries of a potential common fiscal capacity at European level.

This raises the solidarity question i.e., whether net contributor countries like Germany and the Netherlands are willing to pay for less disciplined countries. The European Stability Mechanism (ESM) is an attempt at a solution. Countries are granted financial support but must implement structural reforms in exchange. These reforms are usually linked to austerity or other frugal restrictions. Most recently the dialogue has moved in a different direction. Public investment in the euro area is of existential importance for the euro project and should surpass the fear of growing public debt. The ongoing Covid-19 pandemic and the euro crisis have corroborated this issue. The rule of keeping structural budgets balanced over the terms of business cycles do not have the stabilizing implications that were intended when put in place. Countries should take up debt in cyclical downturns and save when on the upswing. Balancing budgets at all times hampers sustainable growth and will lead to lower tax revenues in the future. Moreover, lesser tax income will further burden government debt in later periods. The prevailing fear of rising public debt of European nations needs to be surmounted (De Grauwe, 2021). The sustainability of government debt is strongly linked to the ECB's bond purchasing programs. By purchasing the right bonds and potentially holding them for a long time the ECB can substantially alleviate government debt. The recent pandemic years have shown that government debt is less burdening when policy actions (bond purchasing programs) are undertaken on time and in a determined matter. The euro zone's debt has increased by 1.1 € trillion in 2020 but this was almost matched by the ECB's purchase of government bonds amounting to 0.9 € trillion. From an economic point of view, euro area debt thus only increased by 0.2 € trillion in 2020. It follows that fiscal discipline should only be reinstated when GDP returns to pre-pandemic levels. The survival of the euro zone is more threatened by the

premature termination of fiscal stimulus than growing public debt. De Grauwe states “The need for public investment has acquired an existential dimension and should override the current dogmas that underlie the fiscal rules” (2021, p.27). It follows that solidarity in form of a common fiscal capacity is essential to the persistence of the euro area – the pandemic rescue fund was a big step in that direction. Thus, while the solidarity criterium is not entirely met recent developments have shown a promising change in member states’ attitudes.

### **c. Determinants of synchronisation**

Complementary research to the analysis of business cycle convergence and OCA theory investigates which factors are driving the convergence of business cycles. Determinants of business cycle synchronisation exhibit strong parallels to the OCA criteria, potentially due to the endogeneity hypothesis of the OCA criteria (Frankel and Rose, 1998) according to which the implementation of a common currency will drive the economies towards a fulfilment of the OCA criteria.

Evidence from Europe partially supports this hypothesis. The implementation of the Single Market has promoted bilateral trade between member countries. Furthermore, intra-industry trade has intensified with the implementation of the single currency and became a driver of convergence (Böwer and Guillemineau, 2006). More recent research suggests the dominance of intra-industry trade and similarities in production structures as a driving force of business cycle synchronisation in the euro area. These two components make up a substantial part of the bilateral trade variable and thus significantly reduce its explanatory power (Beck, 2019). Nonetheless, bilateral trade as well as intra-industry trade and the production structure of countries can be summarised under the two economic criteria of openness and production diversification from OCA theory. Those findings thus endorse the endogeneity hypothesis as the factors impact on convergence with the advance of European integration (Böwer and Guillemineau, 2006)

In line with OCA theory, capital mobility and risk sharing are found to be robust determinants of business cycle convergence in the euro area (Beck, 2019). The negative effect of labour market rigidities on convergence also concords with the OCA criteria of labour mobility (Duran and Ferreira-Lopes, 2017). However, rather surprisingly migration is found to cause de-synchronisation of business cycle in contrast to the predictions of OCA theory (Beck, 2019). The smoothing mechanism of asymmetric shocks through the labour market in OCA theory reduces unemployment in a depressed region by emigration of its labour force to a booming region. Krugman (1993) argues that the migration of production factors from a problem region to a successful region, the former is robbed of the means to recover and create new specialization. Following business cycles of the two regions will compulsively dis-converge. If

growth in one member country of the euro area is based on recession in another member country, synchronicity of business cycles simply cannot be achieved. Therefore, migration contributes to the divergence of business cycles within a currency union (Krugman, 1993; Beck, 2019).

Another interesting finding from the research on determinants of synchronisation is that dissimilarities in production structures deliver a more suitable explanation for de-synchronisation than trade and capital mobility. The common currency has a positive but relatively small effect on convergence. Nevertheless, the introduction of the euro has intensified the negative impact of diverging production structures on the co-movement of European business cycles (Azcona, 2021). Those results underline the amplified negative effect of unfulfilled criteria ex-ante on the currency union ex-post.

One determinant that tends to robustly predict de-synchronisation but is not treated in OCA theory is uncertainty. The negative effect of uncertainty on convergence is more pronounced for countries whose business cycles were less synchronised with the remaining member states to start with (Crespo Cuaresma, 2021). Considering that uncertainty is a side effect of crises that often hampers recovery, those findings support the evidence from classic business cycle convergence analysis that business cycle synchronisation is reduced in early recovery stages.

## **6. Discussion**

As the most recent monetary integration project, the euro area has been a popular subject of research. The convergence of business cycles within the union but also the fulfilment of OCA criteria are widely discussed issues. The innovation of this paper is to use time series data from 20 years of common currency, allowing to investigate the impact of the GFC on convergence in the euro area.

Past research has reported the recurrent pattern of increased cyclical convergence in times of crisis as opposed to dis-convergence in early years of recovery (Gayer, 2007; Sorić, Lolić and Logarušić, 2021). Surging convergence during crisis occurs due to the fact that shocks, will often hit a region or several countries at the same time. The impact of the shock as, for instance, the burst of a bubble is one punctual event, whereas the recovery after a recession is a lengthier and more country specific process. There is no recovery plan 101, each government develops their own recovery strategy. The effectiveness of the latter depends on the shock (dept, length, etc.) and on the prevailing situation the country is in (austerity, level of debt, discipline). Recovery measures are overall very country specific. A successful policy in one country might not work for its neighbour. Therefore, even if countries are simultaneously hit by the same shock recoveries can strongly diverge in speed and amplitude. Structural

differences play an important role in those disparities. In general, more flexible economies are swifter with their recovery. Thus follows the pattern of dis-convergence in recovery phases. Contrasted by convergence in times of crisis as countries enter recession simultaneously.

Considering the 2000s the same inference can be drawn from the correlation analysis in section 3. Synchronisation increases after the burst of the dotcom bubble in 2001. Equally, increased correlation can be observed at the time of the eruption of the Global Financial Crisis in 2008. Nevertheless, those periods of synchronisation wear off as countries enter recovery after the crises have reached their troughs, as in 2003 for the dotcom crisis and around 2012/13 after the 2008 shock. However, both these shocks differ drastically in their amplitude and thus have a different impact on convergence. While the dotcom crisis is just a kink in the curve, the developments the GFC procured are far greater (see Figure 3). The dotcom shock was not as severe in Europe as it was in the US. The bubble burst and the ensuing recovery period were brief and tailed each other closely over a period of 5 years, between 2000 and 2005. By contrast, the GFC including its build up and recovery lasted for close to a decade (2006 to 2015). The Great Recession was the biggest economic meltdown since its namesake, the Great Depression in the 1930s. Although the shock was rooted in the American subprime crisis before it turned into a global crisis, it uncovered major flaws in the European financial system and the currency union, as it evolved into the European Sovereign Debt Crisis (or euro crisis). The immediate succession of these two crises is what made the recession long and deep and thus induced a lengthy recovery.

As can be seen in Figure 1, the GFC and euro area debt crisis are clearly depicted as two shocks. The GFC peak to trough goes from 2008 to 2009, when cycles pick up to peak in 2011 as the euro crisis sets in. The trough of the Sovereign Debt Crisis is less obvious to determine graphically but happens around 2013 for most countries. Considering Figure 3, in terms of convergence GFC and euro crisis cannot exactly be told apart. Following the pattern of increased convergence in recession and de-synchronisation in recovery periods, it could have been expected for the two shocks to show up as a succession of increase and slump followed by a second increase and slump in convergence. But Figure 3 displays a rather smooth transition between the two crises. Correlation coefficients exhibit a gradual decline from 2008 to 2010, which accelerates thereafter until 2015. Two plausible explanations present themselves. First, convergence did not fall after the GFC as the period between the shocks was too short. The euro crisis set in before recovery implemented. Thus, the decline in convergence is only very gentle. Second, there is no renewed surge in correlation coefficients with the euro crisis. The acceleration of the economy in the run-up to the crisis sparked synchronization from 2006 on, so that when the crisis erupted in 2008 convergence was already at a high level. But most importantly the euro crisis was not a symmetric shock to the



euro area like the GFC was. Not all euro countries were defaulting. Greece was the first country to become insolvent in 2010 closely followed by Ireland and Portugal in 2011. Further, Cyprus and Spain were bailed out in June 2012. In contrast Germany, France, the Netherlands, and Austria were barely affected by the crisis. The emergence of these two groups within the euro area has led to the steepening in the decline of convergence. Considering the evidence from Figure 3, the spread of the euro crisis coincides with the accelerating slump in convergence in 2011. Since the euro crisis did not hit all euro area countries business cycle synchronisation was not sparked by the shock like during the GFC but rather pushed its deterioration. When Mario Draghi, the ECB's president at the time gave his famous "whatever it takes" speech<sup>5</sup> in July 2012 is a turning point of the euro crisis. The crisis then cooled off and recovery begins. Figure 1 exhibits a trough in 2012 and Figure 3 shows a kink in correlations. Coefficients drop even further in the recovery period. The pattern of rising business cycle synchronisation during crises and dipping convergence in recovery periods is considered to persist in the analysis. Although, the succession of the GFC and euro crisis was so swift that the two shocks appear as one in the convergence analysis. This also explains the more drastic movement of convergence, particularly the higher surge and longer and more gradual decline in the recovery.

But how did the symmetric, global financial shock of 2008 lead to such different outcomes in euro countries? Imbalances that have persisted since before the creation of the common currency have been unveiled by the heavy 2008 shock. Higher inflation, lower competitiveness, and a dependency on international funding (mostly coming from core countries) of periphery countries, were the base of the euro areas unstable construct. The GFC exposed those flaws that resulted in the euro crisis, further deepening the imbalances between core and periphery countries of the euro area (Gros, 2012). Belke, Domnick and Gros (2017) investigate the diverging effects of the crisis in core and periphery countries on business cycle convergence. The authors find evidence of de-synchronisation between the two groups. While core countries face increased convergence among each other after the crisis, the correlation of periphery countries decrease. There is evidence of de-linking business cycles of periphery countries with core countries but also with each other. Asymmetric shocks

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<sup>5</sup> On the 26th of July 2012, the then president of the ECB, Mario Draghi, gave a speech at the Global Investment Conference in London where he announced: "Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough." One week later, the ECB announced the program to buy the bonds of distressed euro area countries, known as the OMT. The speech had a strong impact on containing the crisis and re-establishing trust in the euro. It is considered a turning point of the European Sovereign Debt Crisis.

like the euro crisis are the main threat to a currency area, as is vigorously stressed by the OCA theory, and can be better endured when business cycles are synchronised. The empirical analysis has revealed though business cycle convergence increases in times of crisis and falls when economies recover, no trend of growing (or falling) synchronisation can be detected in the euro zone. Synchronisation levels pre and post crisis revolve around 0.5 but are unstable and not sufficient to promote lasting synchronisation in the short- to medium term. On the one hand, greater convergence in crisis enables the effective conduction of expansionary monetary policy in the shock phase. On the other hand, dis-convergence in recovery and overall instability in synchronisation developments do not build a sustainable base for a currency union.

## **7. Conclusion**

The main takeaway from the empirical analysis is that, while the recurrent pattern of growing business cycle synchronisation during crisis times followed by de-synchronisation during cyclical upswings persists overall, after 20 years of single currency no clear-cut long-term pattern of a strengthened business cycle synchronisation can be found in the euro area. The pre-requisite for an Optimum Currency Area of synchronised business cycles is thus not met in the euro area. Further, the assessment of the remaining OCA criteria has shown that only two out of six criteria are satisfied, and one is partly met. The conditions of openness to trade and the diversification of production are fulfilled in the euro area. Countries are heavily engaged in trade and all of them display a sufficiently and similarly diversified production. The homogeneity of preferences on how to conduct policy and handle crises is partly met in the euro area. The main issues are the rigidity of the labour market and the lack of fiscal integration. Though the free movement of labour between euro countries is legally enforced the displacement of people is not as fluid as suggested by theory and thus does not enable the absorption of shocks through the labour market. The non-existence of a common fiscal capacity between euro area countries has proven to be a major threat to the financial system and the monetary union. The 2008 crisis and the covid-19 pandemic have each emphasised the necessity and induced temporary attempts of a shared fiscal budget (bailouts and rescue fund). Nevertheless, fiscal transfers need to be regular and unconditional to smoothen asymmetric shocks, linking fiscal integration strongly to solidarity between member states. Recent evidence suggests the importance of public investment for the survival of the euro zone, demanding the abandonment of frugal fiscal behaviour. The more member states will acknowledge these findings the more the acceptance of a common destiny and the feeling for solidarity will be strengthened and hopefully lead to deepened fiscal integration.

Research aiming to define determinants of business cycle synchronisation in the euro area is largely coherent with OCA theory and emphasizes the endogeneity of the criteria. The results highlight the importance of the OCA criteria for business cycle convergence and their significance for the well-functioning of a currency union.

Further research could analyse the business cycle divergence between core and periphery countries, particularly in view of the diverging impact the GFC and the euro area debt crisis had on these countries' economies. Additionally, the contributions of individual countries to overall business cycle synchronisation in the euro area could be investigated.

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## 9. Appendix

Figure A: Cyclical components of real GDP, for four major economies of the euro area.

Source: Eurostat, and author's calculations.

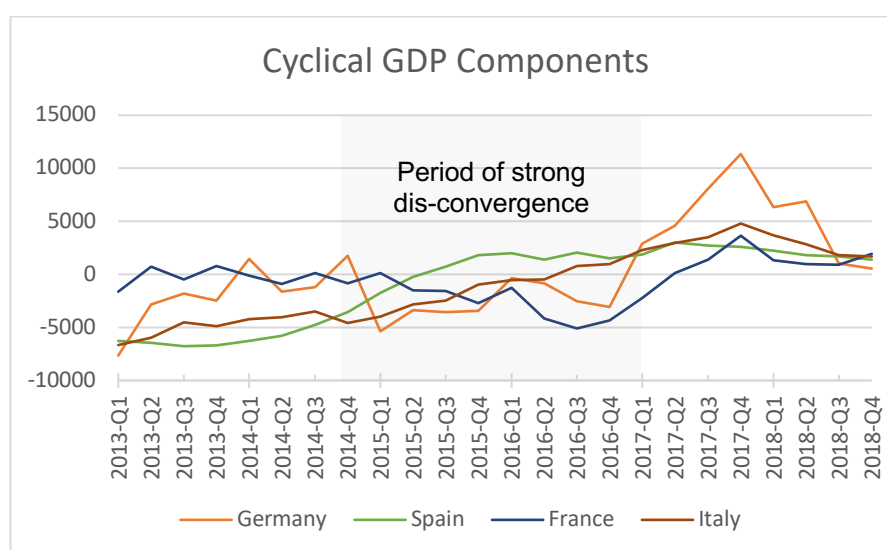


Table A: Irish outlier due to GDP revision in 2015.

Source: Eurostat, and author's calculations.

Date	2014-Q1	2014-Q2	2014-Q3	2014-Q4	2015-Q1	2015-Q2	2015-Q3	2015-Q4
Growth Rate	3,10	3,90	-0,60	2,00	22,50	-2,00	2,00	2,70
GDP in million €	50821	52811,2	52498,7	53546,2	65601,5	64298,5	65566,8	67317,6
Cyclical Component	-3235,78	-2384,59	-3914,26	-4152,76	6559,50	3870,79	3720,97	4029,12

Figure B: Labour Mobility in Europe and in the USA, 2008.

Source: Baldwin and Wyplosz (2015).

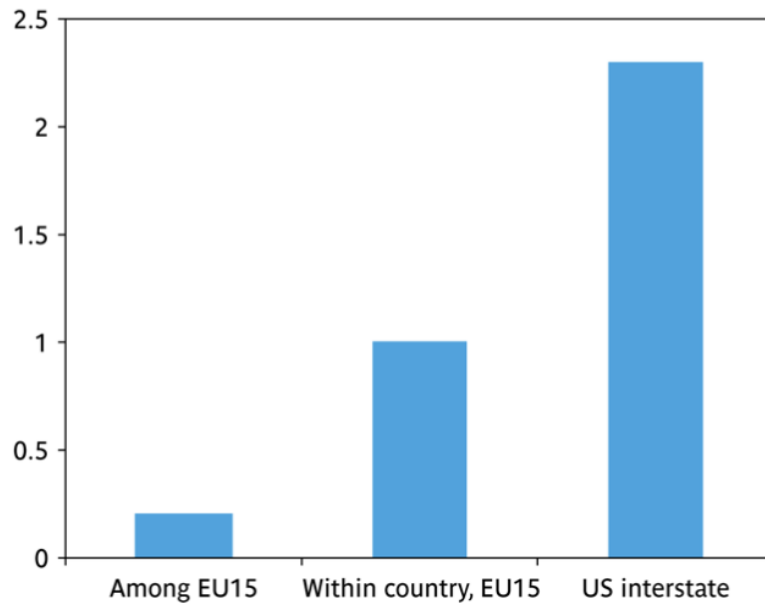
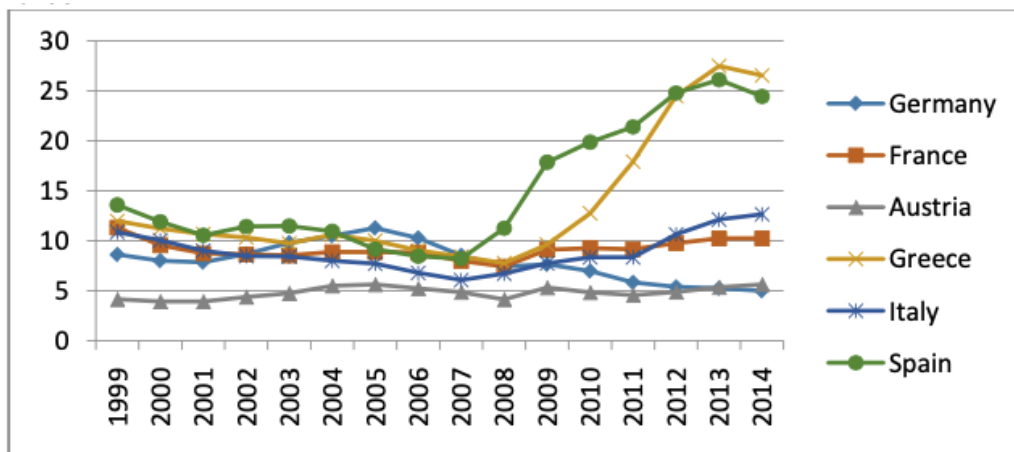


Figure C: Harmonized unemployment rate (HUR), total, as a % of labour force.

Source: Georgieva Svrčinov et al. (2015)



Source: OECD.