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Abstract

This paper investigates the effects of fiscal policy and public-sector size on the bilateral business cycle synchronisation between 14 EU countries, while controlling for the effects of factor productivity, trade, inflation, sectorial specialisation and trade intensity. A time-varying framework is employed to measure bilateral business cycle synchronisation in the first instance, and a panel approach is used to establish the role of fiscal variables in determining these bilateral synchronisations. The findings suggest similarities in the size of the public sector, as well as, divergence in fiscal policy matter for the determination of business cycle synchronisation. Hence, increased fiscal federalism in EMU will contribute to increased business cycle synchronisation. In addition, we show that trade intensity, inflation differentials and differences in capital productivity also matter for the level synchronization. These results remain robust to different specification and sub-periods.

Keywords: Time varying correlation, EU business cycles, business cycle synchronisation, fiscal policy.

JEL: C32, C33, E32, E62, O52, F44.

1. Introduction

The Global Financial Crisis of 2007-09 and European Debt crisis since 2010 have revived the discussion of the suitability of the EMU as a common currency area. Business cycles synchronisation is considered a pre-requisite for a well-functioning common currency area, according to the Optimum Currency Area theory (Alesina and Barro, 2002). Kappler and Sachs (2013) maintain that "In the absence of a certain degree of synchronicity, a common monetary policy may not satisfy the needs of all member countries and may even contribute to cyclical divergence" (p.1).

Hence, the level of synchronisation is a matter of importance to policy makers, particularly in a common currency zone. Even more, business cycle synchronisation enables a more effective coordination of fiscal and monetary policies (Mundell, 1961). Business cycle synchronisation may also impact upon the long run viability of monetary union, particularly in the presence of evidence of 'decoupling' of business cycles, such as in the EMU, where decoupling between the periphery countries relative to the core EU countries is observed in the post-financial crisis period (Ahmed *et al.*, 2017; Degiannakis *et al.*, 2014).

A vast amount of research has focused on business cycles synchronisation and their determinants. Belke *et al.* (2017) provide an extensive review of the literature, along with the earlier research by Degiannakis *et al.* (2014), Papageorgiou *et al.* (2010), de Haan *et al.* (2008) and Altavilla (2004). The aim of the present study is not to present a thorough account of the existing findings, but rather to highlight the gaps in the literature so to highlight how it contributes to filling these gaps. In short, the literature related to the determinants of business cycle synchronisation focuses mainly on bilateral trade, industrial specialisation, monetary and financial integration, distance between countries, political ideology, and global economic shocks[1].

Nevertheless, according to Kappler and Sachs (2013, p.1), business cycle synchronisation is determined by "the degree of symmetry between macroeconomic shocks, transmission channels and institutional features (including fiscal policy), as well as, the level of economic integration" between countries. This claim is rather important as the fact that the level of synchronisation might be impacted by fiscal policy decisions and other institutional features, has been rather neglected by the literature. There are only a handful of studies

[1] See, *inter alia*, Montinari and Stracca, 2016; Kappler and Sachs, 2013; Cerqueira and Martins, 2011, 2009; Kose *et al.*, 2008; Inklaar *et al.*, 2008; de Haan *et al.*, 2008; Calderon *et al.*, 2007; Kose and Yi, 2006; Imbs, 2006; Camacho *et al.*, 2006; Böwer and Guillemineau, 2006; Babestkii, 2005; Imbs, 2004; Morgan *et al.*, 2004; Kose *et al.*, 2003a, 2003b; Kalemli-Ozcan *et al.*, 2001; Frankel and Rose, 1998; Krugman, 1993; Canova and Dellas, 1993.

focusing on the potential impact of fiscal policy on business cycles synchronisation (see, for instance, Gächter *et al.*, 2017; Degiannakis *et al.*, 2016; Gächter and Riedl, 2014; Furceri and Karras, 2008; Inklaar *et al.*, 2008; Böwer and Guillemineau, 2006; Darvas *et al.*, 2005). Interestingly, there is no consensus among this limited number of studies as to whether fiscal policy can be beneficial to business cycle synchronisation or not. Gächter *et al.* (2017), Gächter and Riedl (2014), Inklaar *et al.* (2008) and Darvas *et al.* (2005), for example, maintain that similarity in fiscal policies may lead to higher synchronisation, whereas, Furceri and Karras (2008) suggest that fiscal policy does not really explain synchronisation of business cycles. In contrast, Böwer and Guillemineau (2006) find that fiscal policy differentials have driven differences between countries' business cycles only prior to the establishment of the Stability and Growth Pact. On the other hand, Degiannakis *et al.* (2016) show that the effects of fiscal policy on business cycle synchronisation is time-varying, and it is not always used to promote greater synchronisation levels. These studies mainly use either the budget balance or the cyclically adjusted budget deficits to approximate national fiscal policies.

Overall, the current strand in this line of research has neglected several important aspects when considering the impact of fiscal policy on business cycle synchronisation. First, unlike in the present research, previous studies have not considered the size of the government sector (by means of government expenditure) along with discretionary fiscal policy (proxied by the cyclically adjusted net lending) in order to explain business cycle synchronisation, with the only exception being the study by Camacho *et al.* (2006). This is rather important as understanding the role of fiscal policy and government size will help shape policy design and implementation to support monetary union.

Second, we do not assume an EU-wide business cycle to estimate the level of synchronisation between this EU aggregate business cycle and the individual countries' business cycles. Rather, we consider bilateral synchronisation levels across country-pairs, in a similar fashion to Gächter *et al.* (2017) and Darvas *et al.* (2005). This approach overcomes the need to assume that a specific country acts as an "attractor" or that there is a force which drives a common business cycle. It also means that we do not assume the existence of any common European or world business cycle.

Third, we employ a robust time-varying measure of business cycle synchronisation, which overcomes issues related to the use of rolling-window correlations. Results based on the latter approach are influenced by the choice of the window length, whereas no such decision is required for the time-varying measure that we apply in this study.

Fourth, given that Degiannakis *et al.* (2016) show the fiscal policy effects to be time-varying, we also consider several sub-periods in our analysis. Changes in the determinants of business cycle synchronisation during different phases of European integration can help in understanding why countries may have synchronous or asynchronous business cycles[2].

Hence, the contributions of this paper are as follows. Firstly, we investigate both the role of fiscal policy and government size on business cycle synchronisation across bilateral country-pairs. Second, the co-movement of business cycles across country-pairs is calculated using a time-varying approach. A time-varying measure of business cycle synchronisation is essential to capture the substantial changes in business cycle synchronisation that occur overtime, as discussed by Degiannakis *et al.* (2014, 2016). Third, a broad range of explanatory variables are used, including, bilateral trade, sectorial specialisation, the size of government, fiscal policy, inflation, and savings rates. The choice of these variables is informed by theoretical expectations, previous studies and data availability, in an attempt to capture as many potential determinants, to yield, as much as possible, unbiased and meaningful results. Finally, we examine the determinants of business cycle synchronisation over different time periods, which are characterised by important institutional changes, in order to evaluate potential differences in the determinants of business cycle synchronisation as these institutions change.

The main findings of the study show that both the fiscal policy variables matter for country-pair business cycle synchronisation in the EU. In particular, we show that countries with similarly sized public sectors, and fiscal divergence, have more synchronised business cycles. With respect to the control variables, we find that trade intensity, inflation differentials and differences in capital productivity growth rates matter for synchronisation. Country-pairs that trade more intensely and have similar capital productivity growth rates have more synchronised business cycles, while differences in inflation rates (i.e. higher inflation differentials) across country-pairs leads to increased business cycle synchronisation. Importantly, the evidence suggests that the set of determinants of synchronisation does differ

[2] It is noted that a synchronisation measure does not indicate whether cycles are synchronised due to the impact of common shocks or due to the transmission of idiosyncratic shocks from one country to another. There is a strand of the literature that specifically looks at the transmission of economic shocks rather than synchronisation, see Montinari and Stracca (2016) for example. By contrast, this current paper is in the tradition of papers investigating the determinants of business cycle synchronisation. We should also highlight that business cycle synchronisation does not necessarily mean economic convergence. Synchronisation in business cycles may exist; however, the cycles could exhibit different amplitudes due to non-convergence. Synchronisation refers to the co-movements of countries' growth rates over time, whereas convergence is associated with the catch-up effect between countries' growth rates (Crowley and Schultz, 2010). We should also note that if synchronisation exists, it can lead to economic convergence.

during different sub-periods (e.g. Great Recession and the subsequent European Debt Crisis). These findings are useful for policy design with an aim to promote the synchronisation of business cycles for the efficient operation of EMU.

The remainder of the paper is structured as follows. Section 2 presents the data and methodological approach, Section 3 provides a description of business cycle synchronisation in the EU and Section 4 analyses the empirical findings on the effects of fiscal policy on the level of business cycle synchronisation. Finally, Section 5 concludes the study and presents the policy implications.

2. Data and methods description

2.1 Data description

We obtain annual country-level data from 14 EU countries, namely, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden and the UK. The period of the study is 1981-2014. This group of countries are the members of the EU for the full sample period that have, as such, followed similar institutional changes in trading relationships and monetary arrangements over the sample period, except for the three non-EMU countries (Denmark, Sweden and the UK). Our choice to use annual data is motivated by Degiannakis *et al*. (2016) who maintain that when dealing with fiscal variables, then annual data is the most appropriate sampling frequency. The data have been retrieved from AMECO, Datastream and IMF direction of trade database.

Unlike many of the papers in this area of research that focus on business cycle synchronisation between each EU member country and an EU-wide business cycle, or core country business cycle, we focus on pairwise synchronisation between countries. The 14 countries of our sample generate $N(N-1)/2$ unique pairs of synchronisation, i.e. 91. Thus, our sample has 3094 country-pair-years. All variables are winsorised at the 1% level to reduce the influence of outliers, leaving 3063 country-pair-years. The actual data series used in this study are shown in Table 1.

[TABLE 1 HERE]

2.1.1 Data construction

In this section we describe how the variables that are used in Eq. 3 (see Section 2.2) are constructed from the series shown in Table 1.

Dependent variable: Business cycle synchronisation measure (*BCS*)

The cyclical component of GDP is first extracted from the GDP data series. This cyclical component is then used to measure the time-varying level of synchronisation between countries *i* and *j*. We first extract the cyclical component using the Hodrick-Prescott filter, although other filters were also used for robustness purposes (e.g. Band-pass filter)[3], they generated qualitatively similar results.

Once the cyclical component of country *i*'s GDP is extracted, the level of its time-varying synchronisation relatively to country *j*'s cyclical component is estimated using the Diag-BEKK multivariate GARCH model. Dynamic business cycle synchronisation $(BCS_{ij,t})$ can be approximated by the time-varying correlation level between two countries' cyclical components. Recent studies in this strand of the literature have shown that multivariate GARCH models, such as the Baba, Engle, Kraft and Kroner (BEKK) model of Engle and Kroner (1995) are successful in capturing the time-varying synchronisation, as this is approximated by the dynamic correlations (see, Degiannakis *et al*., 2016; Degiannakis *et al*, 2014). Given the low frequency of our data, and the relatively small time-period, we use a more parsimonious version of the BEKK model, namely the Diagonal BEKK (Diag-BEKK) model, as used by Degiannakis *et al*. (2014)[4].

The Diag-BEKK with standard normal distribution is defined as follows:

$$\begin{aligned} \mathbf{Y}_t &= \boldsymbol{\mu}_t + \boldsymbol{\varepsilon}_t \\ \boldsymbol{\varepsilon}_t &= \mathbf{H}_t^{1/2}\mathbf{z}_t \\ \mathbf{z}_t &\sim N(\mathbf{z}_t;\mathbf{0},\mathbf{I}) \\ \mathbf{H}_t &= \mathbf{C}\mathbf{C}^{'} + \mathbf{A}\boldsymbol{\varepsilon}_{t-1}\boldsymbol{\varepsilon}'_{t-1}\mathbf{A}^{'} + \mathbf{B}\mathbf{H}_{t-1}\mathbf{B}^{'}, \end{aligned} \tag{1}$$

where, $\mathbf{Y}_t$ is a vector containing the business cycles of country *i* and *j*, and $\boldsymbol{\mu}_t$ represents their mean values. The $\boldsymbol{\varepsilon}_t$ is the innovation process and $\mathbf{z}_t$ denotes the bivariate standard normal density function. The conditional covariance matrix $\mathbf{H}_t$, is positive definite, whereas matrices $\mathbf{A}$, $\mathbf{A}^{'}$, $\mathbf{B}$ and $\mathbf{B}^{'}$ are diagonal.

The time-varying correlation (i.e. synchronisation) between the business cycles of country *i* and *j*, denoted as $\rho_{ij,t}$, are estimated as follows:

[3]The results are not shown here but they are available upon request.

[4] The BEKK model requires $(N\,(N+1)/2) + 2N^2$ parameters to be estimated, whereas the Diag-BEKK only $(N\,(N+1)/2)$.

$$\rho_{ij,t} = BCS_{ij,t} = \frac{\mathbf{h}_{ij,t}}{\sqrt{\mathbf{h}_{ii,t}}\sqrt{\mathbf{h}_{jj,t}}}, \quad (2)$$

where, $\mathbf{h}_{ij,t}$ denotes the covariance between the i^{th} and j^{th} countries' business cycles and $\mathbf{h}_{ii,t}$, $\mathbf{h}_{jj,t}$ are the variances of the two countries' business cycles.

The technical details of the Diag-BEKK model can be found in Degiannakis *et al.* (2016) and Xekalaki and Degiannakis (2010).

Explanatory variables

The pairwise fiscal policy differentials between countries *i* and *j* are captured by the absolute differences in the cyclically adjusted net lending (i.e., $CANL\_DIFF_{ij,t} = |CANL_{i,t} - CANL_{j,t}|$).

The size of the public sector captures the mix of public and private sector activity in the economy. To capture differences in the size of the public sector ($PS\_DIFF_{ij,t}$) we use the absolute differences in government expenditure ($GEXP$), i.e. $PS\_DIFF_{ij,t} = |GEXP_{i,t} - GEXP_{j,t}|$[5].

Furthermore, we use variables that capture differences in the structure of the economy across country-pairs. These include the sectorial specialisation measures and the private savings rate.

Differences in sectorial specialisation are captured by taking the absolute differences between sectors' GVA as a percentage of GDP of country *i* and country *j*, i.e., $SECT\_DIFF_{ij,t}^{(s)} = \left|SECT_{i,t}^{(s)} - SECT_{j,t}^{(s)}\right|$, where $s = agri, ind, cons, serv$ for the agricultural, industrial, construction and services sectors, respectively.

The private savings ratio ($PRSAV$) is used to capture the consumer side of the economy and thus differences in this ratio is measured as $PRSAV\_DIFF_{ij,t} = |PRSAV_{i,t} - PRSAV_{j,t}|$.

The bilateral trade intensity variable is calculated as $BTI_{ij,t} = \left(\frac{EXP_{ij,t} + EXP_{ji,t}}{GDP_{i,t} + GDP_{j,t}}\right)$, where, $EXP_{ij,t}$ denotes the exports from country *i* to *j* at time *t*, $EXP_{ji,t}$measures the exports from country *j* to country *i* at time *t*, while the denominator is the sum of both country *i* and

[5] We have also used the absolute differences in government revenues and the results, which are available upon request, are qualitatively similar.

country *j* GDP at *t*. Imports are omitted to avoid double counting as exports from country *i* to *j* are imports of country *j* from *i*.

On the production side, total factor productivity growth rates (TFP), as well as, both labour (LP) and capital (KP) productivity growth rates are used to capture the productivity of the factors of production in the economy. Hence, differences in productivity are measured as $TFP\_DIFF_{ij,t} = \left|TFP_{i,t} - TFP_{j,t}\right|$, $LP\_DIFF_{ij,t} = \left|LP_{i,t} - LP_{j,t}\right|$ and $KP\_DIFF_{ij,t} = \left|KP_{i,t} - KP_{j,t}\right|$, respectively.

Finally, differences in monetary developments across country-pairs are measured by differences in inflation rates, as $INF_{DIFF}{}_{ij,t} = \left|log\left(CPI_{i,t}/CPI_{i,t-1}\right) - log\left(CPI_{j,t}/CPI_{j,t-1}\right)\right|$.

We should highlight that all differentials are converted into their absolute values so that our results are not impacted by the choice of which country enters first or second in the calculations.

2.2 Method

To test the impact of fiscal policy and government size on business cycle synchronisation, we use a dynamic panel model. Our specification is specified as follows:

$$BCS_{ij,t} = a_0 + b_1 BCS_{ij,t-i} + b_2 CANL\_DIFF_{ij,t-i} + b_3 PS\_DIFF_{ij,t-i} + \boldsymbol{b_k F'}_{ij,t-i} + \mu_{ij} + \lambda_t + \nu_{ij,t}, \quad (3)$$

where BCS_{ij} is the bilateral correlation index of business synchronisation between countries i and j, FP_DIFF_{ij} denotes their fiscal policy differentials and PS_DIFF_{ij} captures differences in the size of their public sectors (either from the revenue or expenditure side). $\boldsymbol{F'}_{ij}$ is the vector of $\boldsymbol{k}$ potential determinants of business synchronisation, which are included in the model as control variables, including, bilateral trade, productivity differentials, inflation differentials, sectorial specialisation and differences in savings rates. We have included as many variables as have been suggested by the existing literature, with the restriction that data is available for all countries for the full period.

In the model, we control for country-pair fixed effects (μ_{ij}) to control for unobservable heterogeneity. λ_t controls for idiosyncratic shocks and α_0 is the constant. Finally, $\nu_{ij,t}$ represents the error term. $\beta_{1,2,3}$ are coefficients for the lagged values of BCS_{ij},

FP_DIFF_{ij}, and PS_DIFF_{ij}, respectively, whereas $\boldsymbol{\beta_k}$ is the vector of coefficient estimates for the $\boldsymbol{k}$ control variables.

The above dynamic panel model presents a number of econometric issues when used to estimate the matrix of potential determinants of business cycle synchronisation. First, the OLS estimation method is likely to produce biased estimation in the presence of the unobserved country-specific-effects. This can be attributed to the correlation between the unobserved country-specific-effects and the lagged dependent variable. Although taking first-differences could likely eliminate the country-specific-effects problem, on the other hand, the first-difference transformation will produce a correlation between $\Delta BCS_{ij,t-1}$ and $\Delta v_{ij,t}$ through the terms $BCS_{ij,t}$ to $v_{ij,t}$, leading to inconsistent OLS estimates being produced. Second, the model faces several endogeneity problems given that some of the explanatory variables are not strictly exogenous. For instance, trade integration and *BCS* are strictly not exogenous. Frankel and Rose (1998) contend that countries with similar output patterns and stronger trade integration are likely to join a currency union, which inevitably in return increases their trade integration and business cycle synchronisation.

To address the latter issue, we follow Cerqueira and Martins (2009) and employ the system GMM dynamic panel estimator (Arellano & Bover 1995; Blundell & Bond 1998), which offers several advantages. First, it allows us to draw from the data, a large number of instruments by instrumenting all the exogenous variables with their own lagged values as long as they are not correlated with the error term. Second, the system GMM addresses any potential endogeneity issues of all the variables by estimating the equations jointly in differences and in levels. Additionally, it also corrects any additional biases due to the correlation between the fixed-specific-effects and the lagged dependent variable (Cerqueira and Martins 2009; Guney *et al.*, 2017).

In our estimation, we report the findings of the Sargan test of over-identifying restrictions J as a test for instrument validity, although Blundell et al. (2000) report Monte-Carlo evidence that this test tends to over-reject, especially when the data are persistent and the number of time-series observations are large. Equation 3 is also estimated for different sub-periods. Based on the evidence of the AR2 and the Sargan test, we adopt different sets of lagged instruments across these different sub-periods, ranging from t-2 for the ERM period and the common currency period up to t-6 for the Maastricht treaty period. The differences in Hansen's J-test of overriding restrictions and the AR2 confirm the validity of the instruments. In the dynamic model, we expect to have a first order serial correlation (i.e., AR1) and no

second order serial correlation (i.e., AR2). Results of these tests are presented in each of the regression output tables.

3. Time-varying bilateral business cycle synchronisations

Before we analyse how fiscal policy and the size of the government might play a role in determining the pairwise business cycles synchronisations in the EU, it is useful to get a sense of how synchronisation levels have fluctuated over our sample period. Figure 1 shows the average levels of synchronisation, annually, for the period 1981-2014, along with their dispersion (i.e. minimum, maximum, and standard deviation).

[FIGURE 1 HERE]

Our findings suggest that the average pairwise business cycle synchronisation levels (across the 91 country-pairs) is moderately high, fluctuating between 0.5 and almost 0.8, where 1 indicates perfect synchronisation, 0 indicates no synchronisation and a negative value indicates business cycles are moving in different directions (i.e. de-synchronised). Throughout the observation window there are periods of increasing and decreasing levels of synchronisation; nevertheless, synchronisation levels are on average higher in the latter part of the study period. Although, the average value might not reveal the full story and may mask what is happening at an individual country level. A closer inspection, focusing on the minimum and maximum values at each time point, shows that there are periods when the pairwise synchronisations exhibit higher or lower dispersion. This picture is also confirmed from an examination of the standard deviations of the synchronisation levels.

With respect to the dispersion of synchronisation measures, we show that during our sample period, there are four reasonably distinct episodes (1980-1993, 1994-2001, 2002-2009 and 2010-2014), which correspond with various institutional changes and the European debt crisis. These changes in synchronisation levels and dispersions, in relation to the institutional changes, are also found and discussed extensively in Degiannakis *et al.* (2014). The first episode (1980-1993) corresponds with the period of the Exchange Rate Mechanism (ERM), which was eventually suspended in 1993 following the European currency crisis of 1992/93. This period began with a high average level of synchronisation, a low level of dispersion in synchronisation, and positively correlated cycles across all country-pairs. As the period progressed, synchronisation levels declined, and several country-pairs were experiencing

very high negative correlation levels (i.e. de-synchronisation). Moreover, the dispersion of synchronisation across country-pairs increased substantially.

The period after the ERM collapse corresponds with the implementation of the Maastricht Treaty and a move towards convergence in monetary and fiscal policies in the run up to Monetary Union (i.e. 1994-2001). This period seems to have promoted EU business cycle synchronisation, which exhibits high average values with materially decreasing dispersion across country-pairs.

The period between the introduction of the common currency and the start of the European Debt crisis (2002-2009) is generally associated with increasingly high synchronisation levels between country-pairs. The average measure of synchronisation reached a peak in 2009 of around 0.8. This peak in synchronisation is due to the impact of the Great Recession, which drove a common cyclical downturn, and thus an increase in synchronisation levels. However, even though for much of this sub-period the country pairwise correlation levels were increasing, the divergence in synchronisation measures across countries also increased. This was primarily driven by lower synchronisation levels for the UK and Greece, and to a lesser extent, Portugal, as shown in Figure 2.

Figure 2 presents the synchronisation measures, by country average, across the full sample period. The UK was not on course to becoming a member of EMU and the lack of synchronisation for the Greek economy was well evidenced with the unfolding of the European Debt crisis.

[FIGURE 2 HERE]

The decoupling effects of the European Debt crisis, during the period 2010-2014, are clearly shown in Figures 1 and 2, where there is a sharp and pronounced decline in the average synchronisation measure. This sharp decline in synchronisation is evident across all country-pairs. Nevertheless, an upward trend is observed towards the end of the sample period. It is also noted that this period is associated with an increase in the dispersion of synchronisation levels across country-pairs. This increase in dispersion occurs as the synchronisation measure falls substantially more in some countries, than in others. This is expected given that during this period, countries, such as, Ireland, Italy, Portugal and Greece experienced significant declines in their GDP figures, whereas this was not observed for other EMU countries, such as, Germany. This might also explain the rather interesting finding that

is revealed in Figure 2, which is the fact that Germany exhibits the lowest levels of synchronisation among all core EMU members and it declines sharply in 2011.

Overall, the dynamics of the synchronisation measures over time show evidence of periods of desynchronisation, which are associated with the ERM and the European Debt Crisis periods. The Maastricht period and the common currency period are associated with higher and increasing synchronisation levels. The dispersion of synchronisation levels also varies across country-pairs during the sample period indicating that not all countries follow the general pattern and that different countries experience different business cycle dynamics.

Figure 3 shows the average level of synchronisation for each country over the full period. It is evident that countries which are not members of EMU (e.g. Denmark and the UK) exhibit among the lowest levels of synchronisations over the sample period. This could explain their decision to remain outside the EU or perhaps to the endogeneity effects of EMU later in the post-2001 period. Nevertheless, the most interesting observation is the fact that Germany and Greece are shown to be the least synchronised EMU countries (this was also demonstrated in Figure 2). It is often argued that EMU is not suited to Greece and the low level of observed cyclical synchronisation supports this argument. The finding for Germany is contrary to previous studies, such as Degiannakis *et al.*, (2014, 2016), which found relatively high levels of synchronisation between Germany and a common EU business cycle. It is likely that the large weight of Germany in determining EU GDP drove the high levels of synchronisation when calculated vis-à-vis an EU cycle. Here, the size of Germany's economy is not considered, and indeed it's cycle lacks synchronisation in a similar manner to Greece. This may be troubling for the operation of EMU policy, as Germany's size allows great influence; however, despite Germany's size, it is not highly influential in synchronising with the cycle of other European countries, provoking the idea that is not only Greece that is not suitable for the common currency, but Germany also. Ahlborn and Wortmann (2018) also found evidence of a lack of synchronisation between Germany and other countries business cycles. They suggest that France would be a better candidate an exemplar of a core EMU business cycle. France is shown here to have the highest level of synchronisation with other countries over the period confirming its more appropriate position as a proxy for a core European Business cycle.

[FIGURE 3 HERE]

Having briefly examined the patterns of the pairwise synchronisation levels over time, it is important to identify whether individual fiscal policies and the size of governments acted as promoters of synchronisation, as Optical Currency Area (OCA) theory suggests they ought.

4. The determinants of time-varying business cycle synchronisation

4.1. Full-sample estimation

In this section we present the findings from Eq. 3. As aforementioned, in order to establish the effects of fiscal policy and government size on the pairwise business cycle synchronisation across the sample of 14 EU countries, we also consider 10 additional determining factors, which have been included as control variables. The data has been analysed for the full sample period 1981 to 2014.

The results from the full-sample estimation, shown in Table 2, find that the two fiscal variables matter for business cycle synchronisation[6]. Differences in the size of the public sector (PS_DIFF) across countries exercises a statistically significantly negative effect, whereas statistically significant positive effects are evident for the differences in fiscal policy across countries (as captured by $CANL\_DIFF$).

These findings reveal that the greater divergence in public sector size, across country-pairs, results in lower levels of synchronisation. In other words, countries with similar sized public sectors have more synchronised business cycles, affirming the finding in Camacho *et al.* (2006). The rationale for this relationship is that since the public expenditure component of GDP does not fluctuate with the business cycle, unlike the cyclical fluctuations of the investment and consumption components, similarly sized public sectors are driving greater synchronisation levels. Moreover, the automatic stabiliser component of the public sector will operate in a direction counter to the business cycle. This counter cyclical element of public expenditure will dampen cyclical fluctuations (see, Fatas and Mihov 2001). This dampening effect is also ensuring that countries with similarly sized public sectors, tend to have more synchronised business cycles. In related research, Montinari and Stracca (2016) found that countries with large public sectors are less vulnerable to spill-over effects from foreign business cycles. The findings here go further, indicating that countries with similarly sized public sectors will have more synchronised business cycles, presumably through the

[6] We have further disaggregated the private savings rate variable into household and corporate savings rates; nevertheless, we did not find evidence that these variables exercise any effect on BCS. For robustness purposes we have estimated the models using only the EMU countries. The results are qualitatively similar.

lack of cyclicality in the non-cyclical component of government expenditure, and the dampening effects of automatic stabilisers on individual cycles.

The second fiscal variable, cyclically adjusted net lending (*CANL*), removes the cyclical component and captures discretionary changes in fiscal policy stance. Differences in these discretionary policies are found to promote synchronisation, indicating that country-specific discretionary fiscal policy promotes synchronisation. This finding is in line with OCA theory, which suggests that independent fiscal policies in a monetary union should be used to align the business cycles of member countries. As such, an idiosyncratic fiscal policy response, to an idiosyncratic economic shock, will ensure that business cycles remain more synchronised across countries. It is noted however, that the co-efficient on the fiscal variable is small and the fiscal variable is only statistically significant in the second specification of the model.

With regards to the control variables, trade intensity and inflation differentials are found to promote cyclical synchronisation, while differences in factor productivity growth tend to result in less synchronisation. Sectorial specialisation and private savings do not exercise any significant influence on the time-varying synchronisation measure.

[TABLE 2 HERE]

More specifically, this study shows that trade, is by far, the most important determinant of business cycle synchronisation across the country-pairs. The positive effects of bilateral trade intensity on business cycles synchronisation confirms a long list of previous studies, which find trade to be important in explaining business cycle synchronisation (see, for instance, Gächter *et al.*, 2017; Montinari and Stracca 2016; Cerqueira and Martins, 2009; Inklaar *et al.* 2008; Baxter and Kouparitsas, 2005; Babestkii, 2005; Imbs, 2004; de Haan *et al.*, 2002; Frankel and Rose, 1998). This is expected given that when a country experiences an increase in its productivity, this will lead to higher output and income, which, in turn, will lead to higher imports for intermediate goods (productivity effects), as well as, finished goods (income effects) from its trading partner. Eventually, this should lead to the increase in the trading partner's output and income. Montinari and Stracca (2006) and Imbs (2004) also suggest that trade integration is found to foster these spillover effects on countries' business cycles.

As for the inflation differentials, their positive effect is next in importance to trade intensity. This contrasts with previous studies, such as Camacho *et al.* (2006) who find no

evidence to suggest that monetary variables can explain business cycle synchronisation. Inflation differentials across countries are shown to promote business cycle synchronisation. There may be two channels for this effect. Firstly, differences in inflation rates across countries indicate that prices and wages are adjusting at different rates. In the New Keynesian model of macroeconomic fluctuations it is the adjustment of wages and prices that allows an economy to move towards its trend growth rate following an economic shock. For example, following a positive demand shock, wages and prices will adjust upwards moving an economy back towards its trend growth rate. It is shown here that, inflation differentials across countries, indicate that the adjustment mechanism is operating to promote cyclical synchronisation across countries. Secondly, inflation differentials across countries provides a mechanism for real exchange rate adjustments, and thus may address potential competitiveness gaps among members of a monetary union. The real exchange rate adjustments will result in trade balances moving in a direction in support of greater business cycle synchronisation.

This result is particularly important for the Eurozone countries as inflation differentials are shown to have not only a direct effect on monetary policy (i.e. challenging the notion of "one size fits all" monetary policy as being suitable across member countries), but also an indirect effect, as inflation differentials are shown to increase business cycle synchronisation. As such, the findings here show that divergence in inflation rates are expected to lead to more synchronised business cycles, Hence, we notice here that inflation convergence, which was one of the Maastricht criteria for joining the Eurozone, does not contribute positively to business cycle synchronisation, but rather the reverse holds true.

Total factor productivity growth is the final variable found to have a significant impact upon business cycle synchronisation, suggesting that differences in total factor productivity growth reduce business cycle synchronisation across countries. These results hold true even when we disentangle the total factor productivity into labour and capital productivity growth rates (see, specifications 2 of Table 2). The findings show that it is mainly capital and not labour productivity that matters for business cycle synchronisation. Previous findings by Camacho (2006) also found productivity to be important, but it was labour rather than capital productivity that was shown to matter for business cycle synchronisation. The fact that total factor productivity and capital productivity play a significant role in business cycles synchronisation is related to the argument put forward by Kydland and Prescott (1982), who argue that *TFP* is a primary cause of the business cycle.

Finally, we observe that differences in the structure of the economy, as well as, in private savings do not contribute to the synchronisation of business cycles. The finding that differences in sectoral specialisation are not found to be determinants of business cycle synchronisation is contrary to Krugman's (1993) argument that sectorial specialisation should lead to the decoupling of business cycles. The theory is that differences in sectoral specialisation will result in countries being more susceptible to asymmetric shocks and hence less synchronised. This is not shown to be the case here. For robustness purposes the estimations have been carried out using national savings rather that private savings to capture the savings and consumption side of the economy over the full sample period. These results are presented in Table 3 and they are qualitatively similar to those in Table 2.

[TABLE 3 HERE]

Overall, the evidence from the full-sample estimations shows that fiscal policy variables can be used to promote business cycle synchronisation across countries when controlling for other determining factors. However, it is the size of the government sector rather than the use of discretionary fiscal policy that determines business cycle synchronisation. Hence, similar roles for the public sector across EU countries will promote business cycle synchronisation and the sustainability of the monetary union.

4.2. Sub-period analysis

It is rather important to examine whether the full period findings still hold at different sub-periods, or if differences in determinants exist across sub-periods. Recall that we split our full-sample period into four sub-periods, which are characterised by important institutional changes in the EU (i.e. 1981-1993, 1994-2001, 2002-2009 and 2010-2014). The dynamics of business cycle synchronisation differed across these time periods, as discussed in Section 3 and in previous literature such as Degiannakis *et al.* (2014). Moreover, Böwer and Guillemineau (2006) find that the set of determinants of business cycle synchronisation varies across the different phases of European integration. These phases of integration are characterised by changes in the institutional framework over time.

Joining European Monetary Union for our sample countries in 2001 could promote greater synchronisation given the common monetary and exchange rate policy adopted, or it could in fact be a source of macroeconomic instability as individual countries can no longer use monetary and exchange rate policy in response to asymmetric shocks (Kappler and Sachs,

2013). Entering a monetary union is likely to alter, quite substantially, the behaviour of business cycles, not only through the adoption of a common monetary and exchange rate policy but also due to increased trade linkages (Frankel and Rose, 1998). On the other hand, increased economic integration may cause business cycle divergence if that integration promotes specialisation in trade, in line with a country's comparative advantage, ultimately leaving the economy more susceptible to asymmetric shocks (Kose and Yi, 2001; Krugman, 1993).

The results for each of the four sub-periods are shown in specifications 5 to 12 in Table 4[7]. Specifications 5 to 8 are based on labour and capital productivity individually, whereas 9 to 12 are based on *TFP*. The sub-period analysis suggests that partly the results are time-varying, yet some consistent effects are also evident throughout the periods.

[TABLE 4 HERE]

We start our analysis once again focusing on the key variables of interest, namely, differences in the size of the public sector and in fiscal policies.

It is interesting that the results reveal a rather different picture from the full-sample estimation, which further validates our approach to examine the aforementioned effects in a time-varying approach. Overall, it is clear that $CANL\_DIFF$ is a statistically significant determinant of the level of synchronisation, rather than PS_DIFF. More specifically, differences in the size of the public sector seem to matter only during the European debt crisis period, whereas fiscal policy is significant for all sub-periods.

Put simply, these findings suggest that deviations in country specific fiscal policy stances tend to promote higher synchronisation, which is in line with the policy prescription associated with OCA theory, as mentioned previously. Similar findings have been also shown by Degiannakis *et al.* (2016). In contrast, Böwer and Guillemineau (2006) find that fiscal policy differentials have driven differences between countries business cycles only prior to the establishment of the Stability and Growth Pact. We argue here that our framework, where we utilise a robust time-varying synchronisation measure, as well as, the use of bilateral business cycles synchronisations, allows us to reveal new insights in this line of research.

On the other hand, the fact that differences in the size of the public sector matter only during the European debt crisis periods may suggest that during this crisis period, when fiscal

[7] For robustness purposes, the sub-period analysis has been also performed for the EMU countries only. The results remain qualitatively similar.

policy was more constrained (i.e. by the EMU institutional rules, sovereign bond market conditions and fiscal austerity policies), it is government size that matters for synchronisation rather than differences in fiscal policy stance. As such, of the two fiscal variables, fiscal policy stance was doing less to promote synchronisation during this period.

Turning to the control variables, we note that TFP_DIFF, KP_DIFF, INF_DIFF and BTI maintain their significance and direction of effect in all sub-period. Once again trade is the most important determinant of synchronisation across the sub periods, as is also shown in the full-sample estimation. The consistency in the role played by these variables across all sub-periods adds robustness to the earlier findings that they matter for synchronisation and that their importance does not change due to institutional changes. This is different to the findings of Böwer and Guillemineau (2006) and Kappler and Sachs (2013), who maintain that since the inception of the common currency there is a decline in the importance of trade integration on the business cycle synchronisation among EU members. No such decline is evident here. However, there are differences in some of the other control variables across the sub-periods.

The notable differences in the sub-period analysis, compared to the full-sample estimation, are related to the effects of differences in the structure of the economy, labour productivity and the role played by private savings.

Focusing on sectorial specialisation, it is found that differences in the size of the agricultural sector, and the construction sector matter for synchronisation during the common currency period and also during the Maastricht Treaty period. The positive coefficients in the construction and agricultural sectors support the view that higher divergence in these sectors promotes cyclical synchronisation. This is because divergence in sectoral specialisation across countries can emerge as countries increase their trade volumes and increasingly specialise production in the sector in which they enjoy a comparative advantage. This is the rationale for intra industry trade. The positive coefficient on these sectoral specialisation variables is indicative of this process of increasing synchronisation. This finding runs contrary to Krugman (2003), who predicted that sectoral specialisation would leave countries susceptible to asymmetric shocks which would lead to business cycle decoupling. It is also noteworthy that differences in specialisation matter most during periods of increasing synchronisation across countries and increasing integration pre and post the introduction of the common currency, hence sectoral differences can promote synchronisation during the process of integration.

A related finding with regards to sectoral differences is the role played by private savings during the sub periods. Private savings is found to be statistically significant during the common currency period. Countries with similar savings rates are found to have greater levels business cycle synchronisation. To explain this finding, we should note that private savings capture not only the savings rate, but also the consumption side, and the investment side of the economy. Given that private saving is disposable income less consumption, and that in equilibrium savings equal investment, then differences in savings rates could reflect differences in consumption patterns (e.g. lower consumption leading to higher savings rates) or differences in investments rates (e.g. higher savings rates leading to higher investments). Our findings reveal that the more aligned the private savings rates (consumption and investment) between countries, the higher the level of synchronisation. Both consumption and investment, after all, tend to move is a procyclical manner and are regarded as leading indicators for the business cycle (Kharroubi and Kohlscheen, 2017; Parigi and Schlitzer, 1995). Such evidence does not offer support to the Backus–Kehoe–Kydland consumption-correlation puzzle (Backus *et al.*, 1992), which suggests that consumption levels among OECD countries are less correlated compared to the respective outputs' correlation levels. In essence, this is capturing the structure of the economy, which along with the construction and agricultural sectors is found to matter during the common currency period.

Finally, there is evidence that labour productivity and capital productivity are significant during the first three sub-periods. However, the coefficient on the labour productivity variable is positive, indicating that similarity in labour productivity growth rates across countries, results in less synchronised business cycles, whereas the opposite is true for capital productivity growth rates.

5. Conclusions and Policy Implications

This study has sought to understand the role played by fiscal variables in the determination of pairwise business cycle synchronisation across a sample of EU countries. A novelty of the methodological approach applied here is to estimate time-varying pairwise synchronisation measures using a multivariate GARCH model, specifically the Diagonal BEKK model. Moreover, apart from the fiscal variables, a set of control variables are also used, which have been found in the literature to impact upon business cycle synchronisation. These include trade intensity, factor productivity, inflation, savings and sectoral specialisation. The aim has been to establish if differences in the fiscal variables, along, with

differences in the control variables are found to impact upon the level of synchronisation across country-pairs, which is measured using a time-varying indicator of synchronisation.

Synchronisation of business cycles across country-pairs is shown to increase over the 1981-2014 sample period; however, the dispersion of synchronisation across country-pairs shows substantial changes over certain sub-periods. There are periods with a low degree of dispersion of synchronisation across country-pairs, such as during the Maastricht period, and periods when the dispersion increased, such as during the recent European Debt crisis. These changes in the dispersion of synchronisation indicates that, even though, the overall synchronisation measures are high and exhibit an increasing pattern, there are periods when decoupling effects are evident among countries. We highlight that these changes in business cycle synchronisation are themselves associated with institutional changes in the process of European integration.

Among the least synchronised business cycles over the sample period are those of UK, Greece, and Germany. With respect to the UK, this is partly due to the endogeneity effects of their decisions to remain outside of EMU, and partly an indication that their cycles were less suited to EMU. The findings for Greece and Germany make it all the more pertinent that policy makers understand the determinants of business cycle synchronisation in EMU and the potential role that policy variables can play in ensuring synchronisation is supported.

The main findings of the study show that both the size of the public sector and fiscal policy matter for the determination of business cycle synchronisation. Countries with similarly sized public sectors and greater fiscal divergence have more synchronised business cycles. Hence, convergence in the size and scope of the public sector across countries will help to ensure greater business cycle synchronisation. As such increased fiscal federalism in EMU will contribute to increased business cycle synchronisation. As the EU considers the question as to how much fiscal federalism is desirable, the finding here suggest business cycle synchronisation ought to feature in this evaluation. Coupled with the aforementioned finding is the evidence that that fiscal divergence can also promote business cycle synchronisation. Although this may seem a contradictory finding, it is in fact evidence that country specific fiscal policy has been responsive in a divergent manner to stabilise EU business cycles in response to idiosyncratic shocks in a manner that has ensured increased synchronisation. This is in accordance with how optimal currency area theory suggests that fiscal policy ought to be used in a monetary union. From an institutional design perspective, any move to increased fiscal federalism, or constraints that are placed on national fiscal

policies, ought to be flexible to the role that can be played by fiscal policy in ensuring synchronisation. The decoupling of several countries business cycles during the European debt crisis is indicative of the policy relevance of this finding.

With respect to the control variables, we show that trade intensity, inflation differentials and differences in capital productivity growth rates matter for synchronisation. Country-pairs that trade more intensely and have similar capital productivity growth rates have more synchronised business cycles, while differences in inflation rates across country-pairs leads to increased business cycle synchronisation. Policies to support trade integration will increase synchronisation, as will policies to ensure similar productivity growth rates across economies. Countries with particularly high, or low, productivity growth rates will be at risk of decoupling. Finally, inflation differentials are found to be supportive of synchronisation and are indicative of differing wage and price dynamics across countries as business cycles revert to trend growth rates. This contrasts somewhat with the traditional view that inflation convergence is vital in a monetary union to ensure that a single, 'one size fits all', monetary policy is not a destabilising force across the currency zone.

Taken together the findings in this research show that in general economic and institutional convergence is supportive of business cycle synchronisation, but policy tools and policy makers need to be flexible to divergence particularly with regards to fiscal policy.

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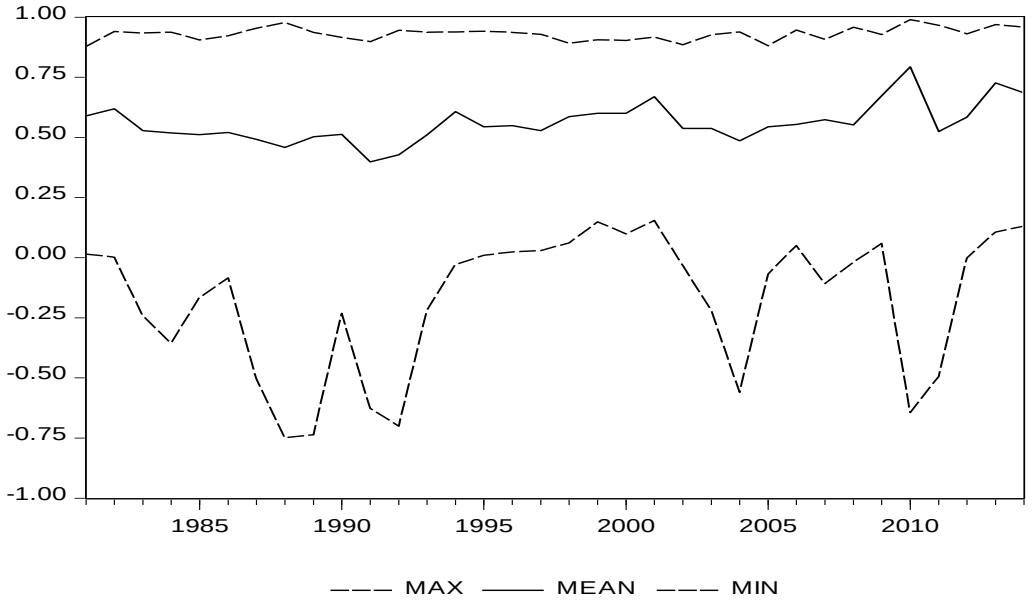
Figures

Figure 1: Average, Minimum, Maximum and standard deviation of the pairwise business cycle synchronisations over the 14 countries, period 1980-2014.



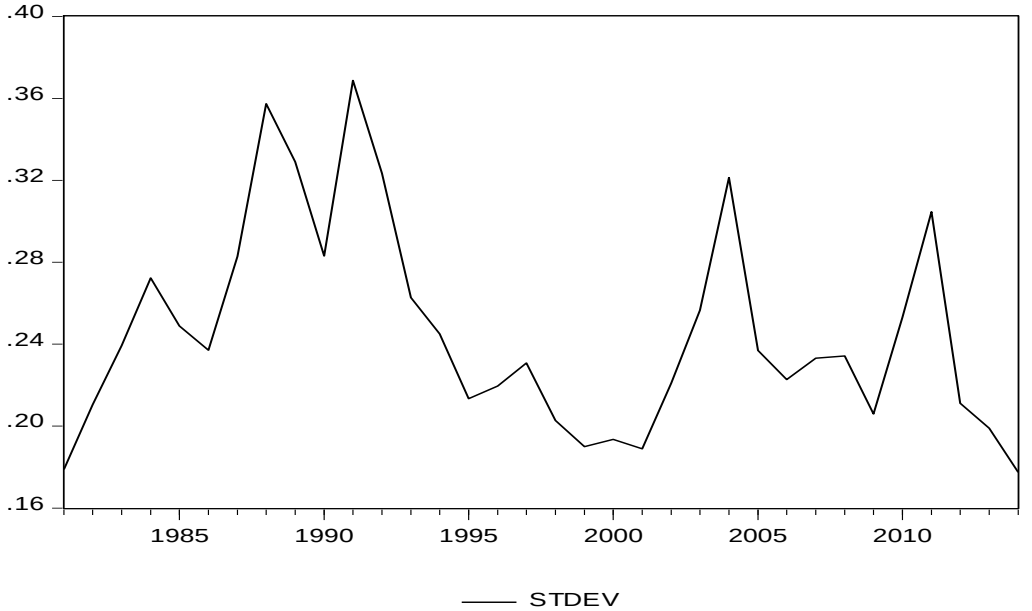
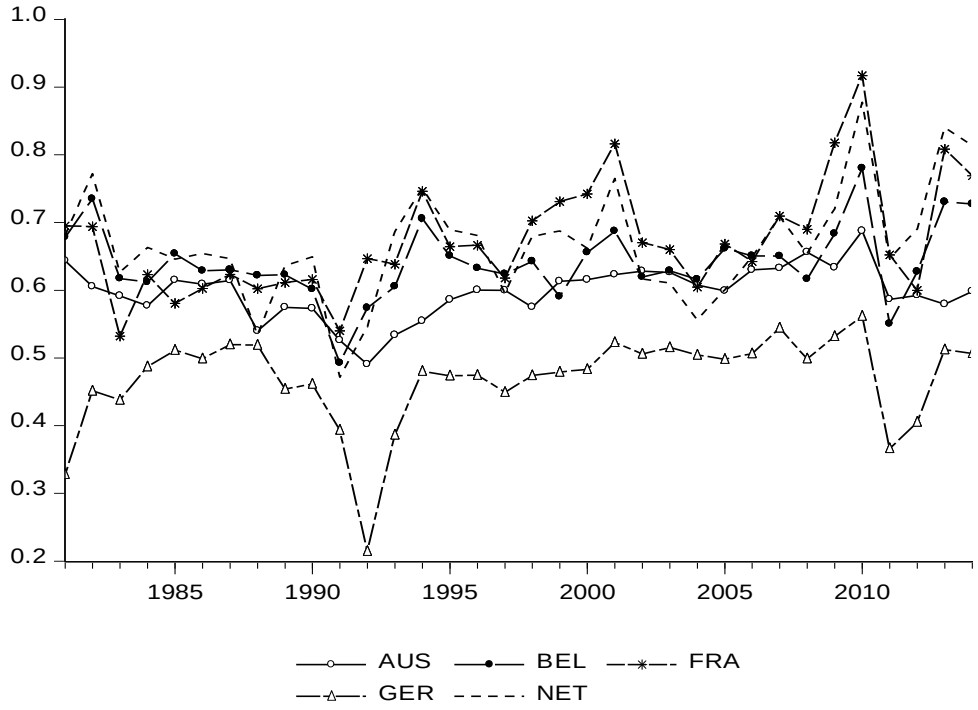
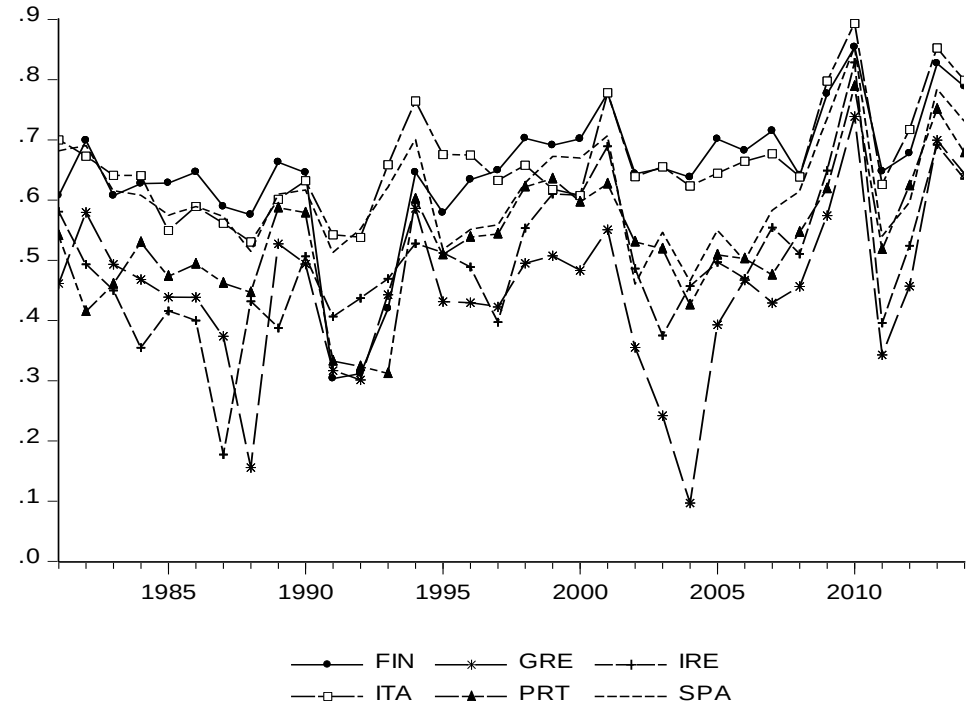
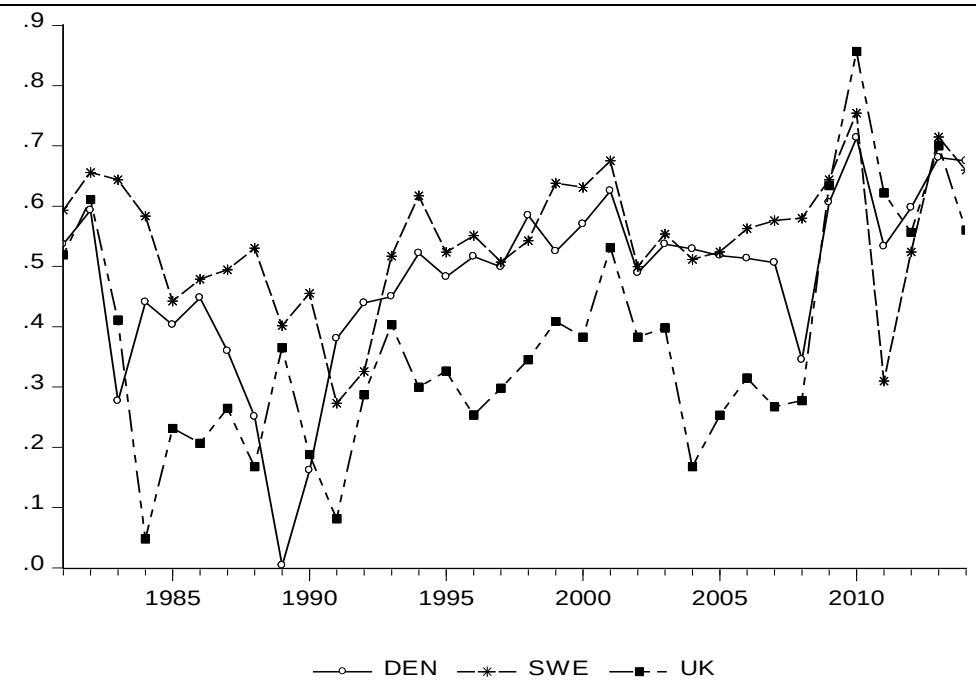


Figure 2: Average country business cycle synchronisations per year, period 1980-2014.

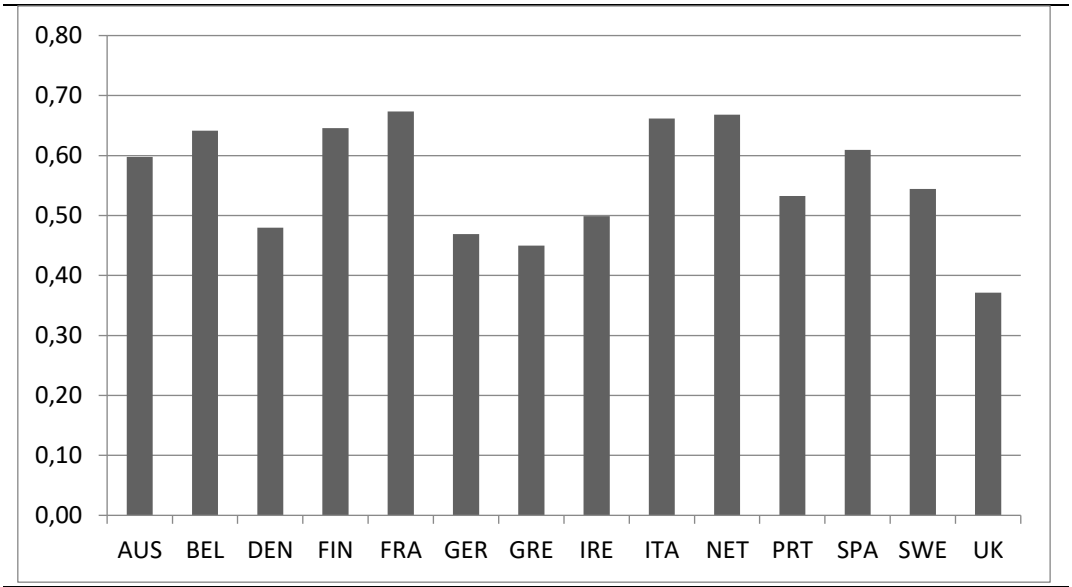






Note: AUS=Austria, BEL=Belgium, DEN=Denmark, FIN=Finland, FRA=France, GER=Germany, GRE=Greece, IRE=Ireland, ITA=Italy, NET=Netherlands, PRT=Portugal, SPA=Spain, SWE=Sweden, UK=United Kingdom.

Figure 3: Average country business cycle synchronisations over the period 1980-2014.



Note: AUS=Austria, BEL=Belgium, DEN=Denmark, FIN=Finland, FRA=France, GER=Germany, GRE=Greece, IRE=Ireland, ITA=Italy, NET=Netherlands, PRT=Portugal, SPA=Spain, SWE=Sweden, UK=United Kingdom.

Tables

Table 1: Variables' description

Variable's name	Acronym	Description
Gross Domestic Product	*GDP*	GDP at constant prices of 2000.
Cyclically adjusted net lending	*CANL*	This is the measure of net lending or net borrowing of central government expressed as a % of GDP.
Government expenditure	*GEXP*	Total expenditure of general government expressed as a % of GDP.
Gross exports	*EXP*	Gross exports of country *i* to country *j*.
Total Factor Productivity	*TFP*	The growth rate of TFP of the total economy.
Labour productivity	*LP*	The growth rate of the labour share of total factor productivity of the total economy.
Capital productivity	*KP*	The growth rate of the capital share of total factor productivity of the total economy.
Consumer price index	*CPI*	National Consumer Price indices (all items).
Size of agricultural sector	*AGRI*	Agriculture, Forestry and Fishing gross value added (GVA) at constant prices.
Size of services sector	*SERV*	Services gross value added (GVA) at constant prices.
Size of industrial sector	*IND*	Industry (excluding building and construction) gross value added (GVA) at constant prices.
Size of construction sector	*CONS*	Building and construction gross value added (GVA) at constant prices
Private savings	*PRSAV*	Private savings as a percentage of GDP.
National savings	*NATSAV*	National savings as a percentage of GDP

Table 2: Determinants of BCS, Full sample estimations.		
	(1)	(2)
	1981-2014	1981-2014
$BCS_{ij,t-1}$	0.402***	0.367***
$CANL\_DIFF_{ij}$	0.001	0.004**
PS_DIFF_{ij}	-0.019*	-0.012**
TFP_DIFF_{ij}	-3.946**	
LP_DIFF_{ij}		0.573
KP_DIFF_{ij}		-6.839***
BTI_{ij}	51.091***	31.370***
INF_DIFF_{ij}	3.153*	1.874***
$SECT\_DIFF_{ij}^{(agri)}$	0.052	0.011
$SECT\_DIFF_{ij}^{(ind)}$	0.015	-0.004
$SECT\_DIFF_{ij}^{(cons)}$	0.017	0.005
$SECT\_DIFF_{ij}^{(serv)}$	0.002	0.014**
$PRSAV\_DIFF_{ij}$	-0.010	-0.004
Country fixed effects	YES	YES
Time fixed effects	YES	YES
Hansen-J (statistic)	173.50	167.43
Hansen-J (degrees of freedom)	[173]	[181]
Hansen-J (p-value)	0.471	0.757
Arellano-Bond test for AR(1) in first difference	-6.163***	-6.425***
Arellano-Bond test for AR(2) in first difference	0.102	0.107
No. of observations	2972	2972

Note: Estimates are derived from two-step system GMM with finite sample correction (Windmeijer, 2005). AR(1) and AR(2) are tests of the null hypothesis of no first- and second-order serial correlation, respectively. The Hansen-J is a test of the validity of the over-identifying restrictions based on the efficient two-step GMM estimator. $CANL\_DIFF$= differences in the cyclically adjusted net lending, PS_DIFF= differences in public sector, TFP_DIFF=differences in total factor productivity, LP_DIFF=differences in labour productivity, KP_DIFF=differences in capital productivity, BTI=bilateral trade intensity, INF_DIFF=inflation rate differentials, $SECT\_DIFF$=differences in economic sectors contribution to countries' i and j GDP. $PRSAV\_DIFF$=differences in private savings. *,**,*** denotes significance at 10%, 5% and 1%, respectively.

Table 3: Determinants of BCS, Full sample estimations based on national savings.

	(3)	(4)
	1981-2014	1981-2014
$BCS_{ij,t-1}$	0.385***	0.371***
$CANL\_DIFF_{ij}$	0.001	0.004**
PS_DIFF_{ij}	-0.026**	-0.010*
TFP_DIFF_{ij}	-4.044**	
LP_DIFF_{ij}		0.003
KP_DIFF_{ij}		-7.585***
BTI_{ij}	46.130***	29.781***
INF_DIFF_{ij}	2.462*	2.006***
$SEC\_DIFF_{ij}^{(agri)}$	0.012	0.015
$SECT\_DIFF_{ij}^{(ind)}$	0.013	-0.006
$SECT\_DIFF_{ij}^{(cons)}$	0.017	0.010
$SECT\_DIFF_{ij}^{(serv)}$	0.010	0.018***
$NATSAV\_DIFF_{ij}$	-0.003	-0.003
Country fixed effects	YES	YES
Time fixed effects	YES	YES
Hansen-J (statistic)	170.71	157.63
Hansen-J (degrees of freedom)	185	172
Hansen-J (p-value)	0.7263	0.7611
Arellano-Bond test for AR(1) in first difference	−5.141***	−4.9121***
Arellano-Bond test for AR(2) in first difference	0.302	0.104
No. of observations	2972	2972

Note: Estimates are derived from two-step system GMM with finite sample correction (Windmeijer, 2005). AR(1) and AR(2) are tests of the null hypothesis of no first- and second-order serial correlation, respectively. The Hansen-J is a test of the validity of the over-identifying restrictions based on the efficient two-step GMM estimator. PS_DIFF= differences in public sector, TFP_DIFF=differences in total factor productivity, LP_DIFF=differences in labour productivity, KP_DIFF=differences in capital productivity, BTI=bilateral trade intensity, INF_DIFF=inflation rate differentials, $SECT\_DIFF$=differences in economic sectors contribution to countries' i and j GDP. NATSAV_DIFF=differences in national savings. *,**,*** denotes significance at 10%, 5% and 1%, respectively.

Table 4: Determinants of BCS, Sub-period results.

	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	1981-1993	1994-2001	2002-2009	2010-2014	1981-1993	1994-2001	2002-2009	2010-2014
	ERM period	Maastricht Treaty	Common currency period	European Debt crisis	ERM period	Maastricht Treaty	Common currency period	European Debt crisis
$BCS_{ij,t-1}$	0.394***	0.408***	0.398***	0.381***	0.366***	0.425***	0.404***	0.404***
$CANL\_DIFF_{ij}$	0.007***	0.010***	0.011***	0.002**	0.009***	0.011***	0.010***	0.005***
PS_DIFF_{ij}	-0.007	-0.001	-0.004	-0.012***	-0.006*	-0.002	-0.001	-0.012***
TFP_DIFF_{ij}					-2.942***	-3.088***	-3.570***	-4.184***
LP_DIFF_{ij}	2.219**	4.246***	2.126**	1.002				
KP_DIFF_{ij}	-5.736***	-5.483***	-7.693***	-7.662***				
BTI_{ij}	26.190***	14.542***	20.121***	27.633***	19.051***	12.884**	20.103***	29.133***
INF_DIFF_{ij}	4.109***	2.231***	1.890***	1.316***	3.694***	2.536***	2.298***	1.023***
$SECT\_DIFF_{ij}^{(agri)}$	0.029	0.047*	0.071***	0.008	0.027	0.075***	0.046***	0.008
$SECT\_DIFF_{ij}^{(ind)}$	0.007	-0.006	-0.001	0.002	0.005	0.007	0.004	0.003
$SECT\_DIFF_{ij}^{(cons)}$	0.014	0.027*	0.045***	0.018*	0.021**	0.028**	0.056***	0.013
$SECT\_DIFF_{ij}^{(serv)}$	0.009	0.004	-0.001	0.012**	0.003	0.005	0.008*	0.008
$PRSAV\_DIFF_{ij}$	-0.009*	-0.006*	-0.009***	-0.005	-0.009***	-0.013***	-0.014***	-0.005**
Country fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Hansen-J (statistic)	150.34	143.81	138.61	48.93	167.94	144.1	138.80	53.46
Hansen-J (degrees of freedom)	[151]	(136)	(138)	[50]	[151]	(137)	(135)	[50]
Hansen-J (p-value)	0.108	0.130	0.128	0.1201	0.3131	0.138	0.125	0.1420
Arellano-Bond test for AR(1) in first difference	-5.567***	-6.68***	-6.71***	-1.02***	-5.713***	-6.67***	-6.56***	-0.171***

Arellano-Bond test for AR(2) in first difference	0.301	0.224	0.101	0.474	0.192	0.216	0.114	0.446
No. of observations	1082	720	720	542	1082	720	720	542

Note: Estimates are derived from two-step system GMM with finite sample correction (Windmeijer, 2005). AR(1) and AR(2) are tests of the null hypothesis of no first- and second-order serial correlation, respectively. The Hansen-J is a test of the validity of the over-identifying restrictions based on the efficient two-step GMM estimator. $CANL\_DIFF$= differences in the cyclically adjusted net lending, PS_DIFF= differences in public sector, TFP_DIFF=differences in total factor productivity, LP_DIFF=differences in labour productivity, KP_DIFF=differences in capital productivity, BTI=bilateral trade intensity, INF_DIFF=inflation rate differentials, $SECT\_DIFF$=differences in economic sectors contribution to countries' i and j GDP. $PRSAV\_DIFF$=differences in private savings. . *,**,*** denotes significance at 10%, 5% and 1%, respectively.