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Fiscal policy, government size and EMU business cycle synchronization

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Abstract

We provide new evidence on the effects of fiscal policy and government size on pairwise business cycle synchronization in EMU. A novel time-varying framework is employed to estimate business cycle synchronization and subsequently a panel approach is used to establish the role of fiscal variables in determining the pairwise synchronization observations across time. The findings suggest similarities in the size of the public sector, yet divergence in fiscal policy stance, matter for the determination of business cycle synchronization. Hence, increased fiscal federalism in EMU will contribute to increased business cycle synchronization. Our results remain robust to different specifications and sub-periods.

KEYWORDS
business cycle synchronization, EU business cycles, fiscal policy, time-varying correlation

JEL CLASSIFICATION
C32; C33; E32; E62; O52; F44

1 | INTRODUCTION

The Global Financial Crisis of 2007–2009 and European Debt crisis since 2010 have revived the discussion of the suitability of the EMU as a common currency area. Business cycle synchronization is considered a pre-requisite for a well-functioning common currency area, according to the Optimum Currency Area theory (Alesina & Barro,

2002). Kappler and Sachs (2013) maintain that without a certain level 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 synchronization is a matter of importance to policymakers, particularly in a common currency zone. Moreover, business cycle synchronization enables a more effective coordination of fiscal and monetary policies (Mundell, 1961). Business cycle synchronization may also impact upon the long run viability of monetary union, particularly in the presence 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., 2018; Degiannakis, Duffy, & Filis, 2014).

A vast amount of research has focused on business cycle synchronization and its determinants. Belke, Domnick, and Gros (2017) provide an extensive review of the literature, along with the earlier research by Degiannakis et al. (2014), Papageorgiou, Michaelides, and Milios (2010), de Haan, Inklaar, and Jong-A-Pin (2008) and Altavilla (2004). The aim of the present study is not to present a thorough account of the existing findings, but rather to identify relevant gaps in the literature so to highlight the contribution made. In short, the literature related to the determinants of business cycle synchronization focuses mainly on bilateral trade, industrial specialization, 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 synchronization 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 synchronization 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 focusing on the potential impact of fiscal policy on business cycle synchronization (see, for instance, Gächter, Gruber, & Riedl, 2017; Inklaar, Jong-A-Pin, & Haan, 2008). Interestingly, there is no consensus among this limited number of studies as to whether fiscal policy can increase business cycle synchronization.

Overall, the current strand in this line of research has neglected several important aspects when considering the impact of fiscal policy on business cycle synchronization. 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 synchronization, with the only exception being the study by Camacho, Perez-Quiros, and Saiz (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 synchronization between an EU aggregate business cycle and the individual countries' business cycles. Rather, we consider bilateral synchronization 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, unlike Gächter et al. (2017) and Darvas et al. (2005), we employ a robust time-varying framework to estimate the pairwise business cycle synchronization, which overcomes issues related to the use of rolling-window correlations. For instance, results based on rolling-window approaches are influenced by the choice of the window length, whereas no such decision is required using the time-varying framework that we apply in this study. Even more, rolling-window correlation exhibits slow dynamics due its overlapping calculation (i.e. when one observation is dropped at the start of the window length, it is subsequently replaced by another observation at the end of this window period.). This latter point is also responsible for the observed autocorrelation between the rolling-window correlation figures at successive time points.

[1]See, *inter alia*, Montinari and Stracca, (2016); Kappler and Sachs (2013); Cerqueira and Martins, (2009, 2011, (2009, 2011); 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); Baxter and Kouparitsas (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).

Fourth, given that Degiannakis, Duffy, Filis, and Livada (2016) show the fiscal policy effects on business cycle synchronization are time varying, we also consider several sub-periods in our analysis. Changes in the determinants of business cycle synchronization during different phases of European integration can help in understanding why countries may have synchronous or asynchronous business cycles.[2]

In summary, the contributions of this paper are as follows. First, we investigate both the role of fiscal policy and government size on business cycle synchronization 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 synchronization is essential to capture the substantial changes in business cycle synchronization that occur over time, as discussed by Degiannakis et al. (2014), Degiannakis et al. (2016). Third, a broad range of explanatory variables are used, including, bilateral trade, sectorial specialization, the size of the 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 synchronization over different time periods, which are characterized by important institutional changes, in order to evaluate potential differences in the determinants of business cycle synchronization as these institutions change.

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

The remainder of the paper is structured as follows. Section 2 presents the channels by which fiscal policy might impact business cycle synchronization. Section 3 provides a description of the data and the methodological approach. Section 4 analyses business cycle synchronization in the EU, whereas Section 5 analyses the empirical findings on the effects of fiscal policy on the level of business cycle synchronization. Finally, Section 6 concludes the study and presents the policy implications.

2 | TRANSMISSION CHANNELS FOR THE EFFECTS OF FISCAL POLICY ON BUSINESS CYCLE SYNCHRONIZATION

Ideas regarding the role of fiscal policy are never far from the centre of economic and policy debate. In the EU, the debate has revolved around the role of national fiscal policies, fiscal federalism and fiscal constraints, with issues regarding fiscal austerity to the fore most recently. The arguments have centred around the effectiveness and use of fiscal policy in smoothing business cycle fluctuations as well as issues associated with the role and scope of government activities. Moreover, in a monetary union, countries that face asymmetric shocks, or react

[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.

asymmetrically to common shocks, require fiscal authorities to use their fiscal policy to counterbalance the negative impacts of the common monetary policy in promotion of stability and synchronization. This paper seeks to fill a gap in the literature and establish empirically the joint role of discretionary fiscal policy and the size of the government as determinants of business cycle synchronization.

The role of discretionary fiscal policy on the business cycle is ambiguous. The ambiguity arises due to the potential for discretionary fiscal policy to impact either as a source of economic shock (Fatás & Mihov 2006), or as a discretionary countercyclical stabilization tool used in a Keynesian manner. Moreover, when considering the impact of fiscal policy on the level of synchronization across countries, differences in fiscal policy stance across countries may be due to a stabilizing reaction to idiosyncratic shocks, or a stabilizing reaction to a common shock with idiosyncratic impact.

As such fiscal deficits may be used to smooth cyclical fluctuations and differences in fiscal deficits across countries may contribute to cyclical synchronization in responding to economic shocks. However, budget deficits which contribute to destabilizing the business cycle, due, for example, to procyclical fiscal policy, may contribute to reducing synchronization across countries due to the idiosyncratic nature of such fiscal shocks. It is an empirical question as to the impact of fiscal differences across countries on business cycle synchronization. Gächter et al. (2017), Gächter and Riedl (2014), Inklaar et al. (2008) and Darvas et al. (2005), for example, maintain that fiscal convergence may lead to higher synchronization, whereas Furceri and Karras (2008) suggest that fiscal policy does not really explain the synchronization of business cycles at all. 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. However, Degiannakis et al. (2016) show that the effects of fiscal policy on business cycle synchronization are time-varying, and they are not always used to promote greater synchronization levels. These studies mainly use either the budget balance or the cyclically adjusted budget deficits to approximate national fiscal policies.

The size of the government can have an impact on how fiscal policy is conducted and the impact it has on the business cycle. Despite the impact of the size of the government sector on output volatility, there is little research on the role of the size of the government sector on business cycle synchronization, see for example Camacho et al. (2006) for an empirical approach.

In considering the size of the government sector in the economy, there are two channels through which government size may impact upon output volatility, that is the stabilization channel and the structural channel. Fatas and Mihov (2001) and Gali (1994) provide evidence of a strong negative correlation between government size and the volatility of GDP. The channel for this stabilization effect is that government size is associated with the size of automatic stabilizers. The automatic stabilizer component of government expenditure will operate in a direction counter to the business cycle. This counter cyclical element of public expenditure will dampen cyclical fluctuations. Hence, smaller government sectors, and smaller automatic stabilizers, react less to economic shocks.

Government sector size also determines the structure of the economy in terms of the mix of activity between the public and private sectors. Rodrik (1998) characterizes the government as a 'safe' sector, playing a risk reducing role, by reducing the volatility of output, particularly in more open economies. This safety characteristic of the public sector is confirmed by the results in Montinari and Stracca (2016), who show that countries with smaller public sectors are more vulnerable to spillover effects from foreign business cycles. By its nature, the government sector is not directly susceptible to the processes which drive the business cycle in the consumption, investment and international sectors of the private economy. Rather, the variation in the size of the government, both across countries and across time, is reflective of changing policies regarding the role and scope of the government in the economy during the period.

As a result of both automatic stabilizers and economic structure, countries with larger government sectors tend to have more stable business cycles. The smaller the government sector the more susceptible economies will be to spillover effects from foreign business cycles and, as such, to the transmission of economic shocks. Moreover, countries with smaller government sectors, and smaller automatic stabilizers, will react less to these

shocks. Due to spillover effects and a lack of automatic stabilization, countries with similarly small government sectors will be expected to have more similar business cycles and vice versa for countries with large governments. The relationship between government sector size, along with discretionary fiscal policy, and business cycle synchronization is investigated empirically in this paper.

3 | DATA AND METHODS DESCRIPTION

3.1 | 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 United Kingdom. The period of the study is 1981–2014. This group of countries are the members of the EU for the full sample period and 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 United Kingdom). Our choice to use annual data is motivated by Degiannakis et al. (2016) who maintain that when dealing with fiscal variables, annual data are 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 synchronization between each EU member country and an EU-wide business cycle, or core country business cycle, we focus on pairwise synchronization between countries. The 14 countries of our sample generate $N(N-1)/2$ unique pairs of synchronization, that is, 91. Thus, our sample has 3,094 country-pair-years. All variables are winsorized at the 1% level to reduce the influence of outliers, leaving 3,063 country-pair-years. The actual data series used in this study are shown in Table 1.

3.1.1 | Data construction

In this section, we describe how the variables that are used in Equation 3 (see Section 3.2) are constructed from the series shown in Table 1.

Dependent variable: Business cycle synchronization 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 synchronization 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 synchronization relative to country *j*'s cyclical component is estimated using the Diag-BEKK multivariate GARCH model. Dynamic business cycle synchronization ($BCS_{ij,t}$) 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 synchronization, as this is approximated by the dynamic correlations (see, Degiannakis et al., 2014; Degiannakis et al., 2016). 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]

[3]For brevity 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 $(N(N+1)/2)$.

TABLE 1 Variables' description

Variable's name	Acronym	Description and Source
Gross domestic product	*GDP*	GDP at constant prices of 2000. Obtained from European Commission AMECO database.
Cyclically adjusted net lending	*CANL*	This is the measure of net lending or net borrowing of central government expressed as a % of GDP. Obtained from European Commission AMECO database and European Economy.
Government expenditure	*GEXP*	Total expenditure of general government expressed as a % of GDP. Obtained from European Commission AMECO database and European Economy.
Gross exports	*EXP*	Gross exports of country *i* to country *j*. IMF Direction of Trade Statistics obtained from UK Data Service.
Total factor productivity	*TFP*	The growth rate of TFP of the total economy. Obtained from European Commission AMECO database.
Labour productivity	*LP*	The growth rate of the labour share of total factor productivity of the total economy. Obtained from European Commission AMECO database.
Capital productivity	*KP*	The growth rate of the capital share of total factor productivity of the total economy. Obtained from European Commission AMECO database.
Consumer price index	*CPI*	National Consumer Price indices (all items). Obtained from European Commission AMECO database.
Size of agricultural sector	*AGRI*	Agriculture, forestry and fishing gross value added (GVA) at constant prices. Obtained from European Commission AMECO database.
Size of services sector	*SERV*	Services gross value added (GVA) at constant prices. Obtained from European Commission AMECO database.
Size of industrial sector	*IND*	Industry (excluding building and construction) gross value added (GVA) at constant prices. Obtained from European Commission AMECO database.
Size of construction sector	*CONS*	Building and construction gross value added (GVA) at constant prices. Obtained from European Commission AMECO database.
Private savings	*PRSAV*	Private savings as a percentage of GDP. Obtained from European Commission AMECO database and European Economy.
National savings	*NATSAV*	National savings as a percentage of GDP. Obtained from European Commission AMECO database.

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

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

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 **A**, **A**', **B** and **B**' are diagonal.

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

$$\rho_{ij,t} = \mathrm{BCS}_{ij,t} = \frac{\mathbf{h}_{ij,t}}{\sqrt{\mathbf{h}_{ii,t}}\sqrt{\mathbf{h}_{jj,t}}}, \tag{2}$$

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).

3.1.2 | 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., $CANL\_DIFF_{ij,t} = \left|CANL_{i,t} - CANL_{j,t}\right|$).

The size of the public sector captures the mix of public and private sector activities 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 as a share of GDP (*GEXP*), that is, $PS\_DIFF_{ij,t} = \left|GEXP_{i,t} - GEXP_{j,t}\right|$.[5]

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

Differences in sectorial specialization are captured by taking the absolute differences between sectors' GVA as a percentage of GDP of country *i* and country *j*, that is, $SECT\_DIFF^{(s)}_{ij,t} = \left|SECT^{(s)}_{i,t} - SECT^{(s)}_{j,t}\right|$, 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 are measured as $PRSAV\_DIFF_{ij,t}$ = \vert $PRSAV_{i,t}$–$PRSAV_{j,t}$|.

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 GDP of both country *i* and country *j* at time *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 productivity growth 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.

3.2 | Method

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

$$\begin{aligned} BCS_{ij,t} = {} & a_0 + b_1 BCS_{ij,t-i} + b_2 CANL\_DIFF_{ij,t-i} + b_3 PS\_DIFF_{ij,t-i} \\ & + \boldsymbol{b_k F'}_{ij,t-i} + \mu_{ij} + \lambda_t + \nu_{ij,t}, \end{aligned} \tag{3}$$

where BCS_{ij} is the bilateral correlation index of business synchronization between countries *i* and *j*, $CANL\_DIFF_{ij}$ denotes their fiscal policy differentials and PS_DIFF_{ij} captures differences in the size of their public sectors. $\boldsymbol{F'}_{ij}$ is the

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

vector of ***k*** potential determinants of business synchronization, which are included in the model as control variables, including, bilateral trade, productivity differentials, inflation differentials, sectorial specialization and differences in savings rates. We have included as many variables as have been suggested by the existing literature, with the restriction that data are 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, $v_{ij,t}$ represents the error term. $\beta_{1,2,3}$ are coefficients for the lagged values of BCS_{ij}, $CANL\_DIFF_{ij}$ and PS_DIFF_{ij}, respectively, whereas $\boldsymbol{\beta_k}$ is the vector of coefficient estimates for the ***k*** control variables. The key hypothesis tested by this model is to establish if and how discretionary fiscal policy and government size jointly determine business cycle synchronization. If discretionary fiscal policy responds to idiosyncratic shocks in a manner supportive of business cycle synchronization then a positive coefficient will be found on this variable. If similarities in government size determine synchronization then a negative coefficient will be expected on this variable.

The above dynamic panel model presents a number of econometric issues when used to estimate the matrix of potential determinants of business cycle synchronization. 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, 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 strong trade integration are likely to join a currency union, which, in turn, further increases their trade integration and business cycle synchronization.

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 for all 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 & Martins, 2009; Guney, Karpuz, & Ozkan, 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, Bond, and Windmeijer (2001) report Monte Carlo evidence that this test tends to over-reject, especially when the data are persistent and the number of time-series observations is 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.

4 | TIME-VARYING BILATERAL BUSINESS CYCLE SYNCHRONIZATIONS

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

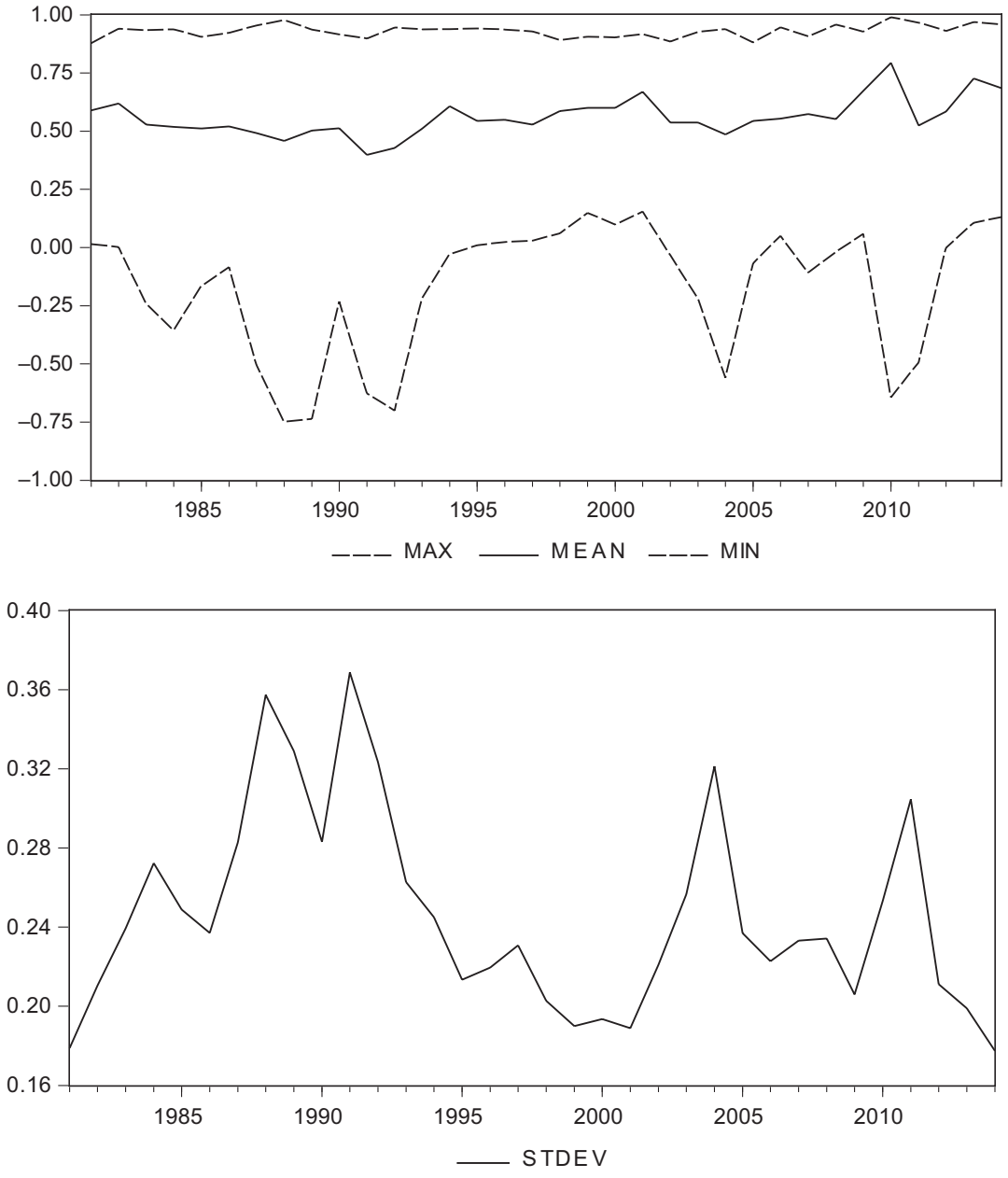

FIGURE 1 Average, minimum, maximum and standard deviation of all pairwise business cycle synchronizations over the 14 countries per year. Sample period 1980–2014. In the top panel, the figure depicts the average, minimum and maximum business cycle synchronization level of all 14 countries for each year during the sample period 1980–2014. The bottom panel shows the standard deviation of all business cycle synchronizations for each year over the sample period

Our findings suggest that the average pairwise business cycle synchronization levels (across the 91 country-pairs) are moderately high, fluctuating between 0.5 and almost 0.8, where 1 indicates perfect synchronization, 0 indicates no synchronization and a negative value indicates business cycles are moving in different directions (i.e. de-synchronized). Throughout the observation window there are periods of increasing and decreasing levels

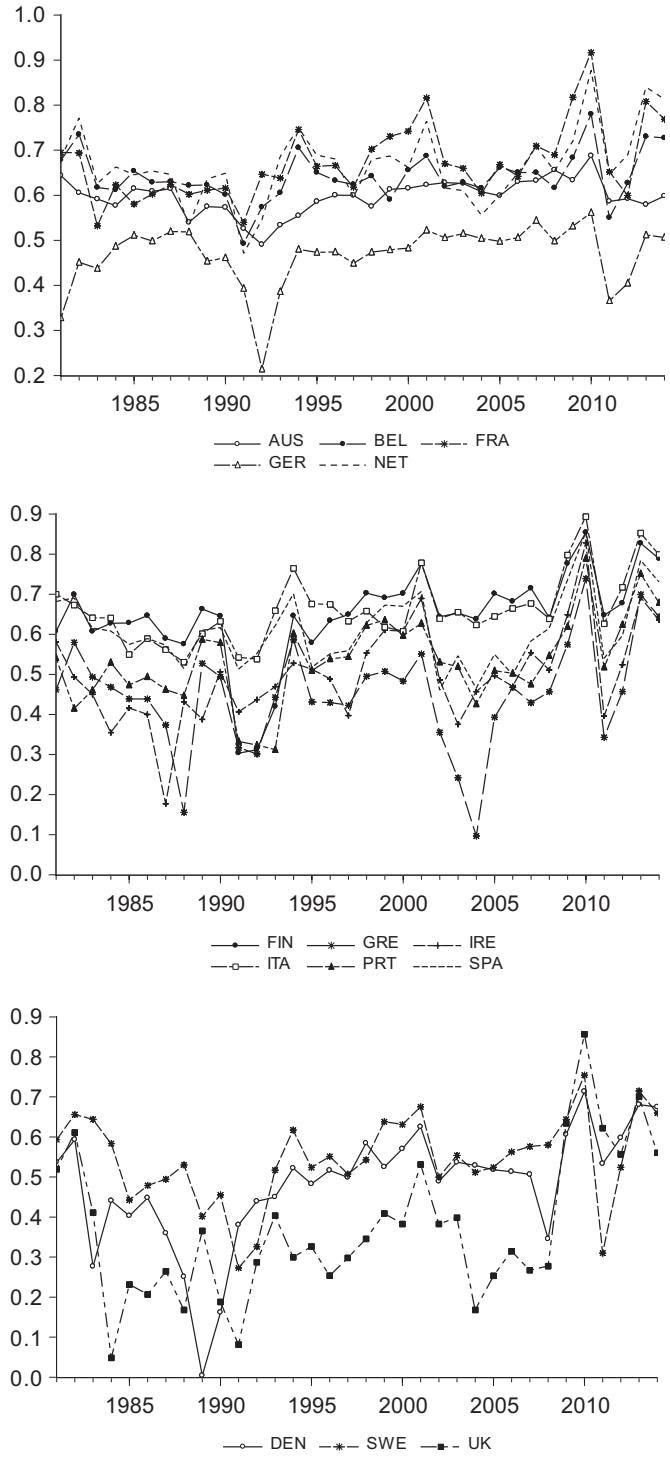

FIGURE 2 Average country-level business cycle synchronizations per year. Sample period 1980–2014. The three panels show the core, periphery and non-EMU countries respectively. AUS = Austria, BEL = Belgium, DEN = Denmark, FIN = Finland, FRA = France, GER = Germany, GRE = Greece, IRE = Ireland, ITA = Italy, NET = Netherlands, PRT = Portugal, SPA = Spain, SWE = Sweden, UK = United Kingdom. The figure presents the average country-level business cycle synchronization vis-à-vis all other countries, per year over the sample period

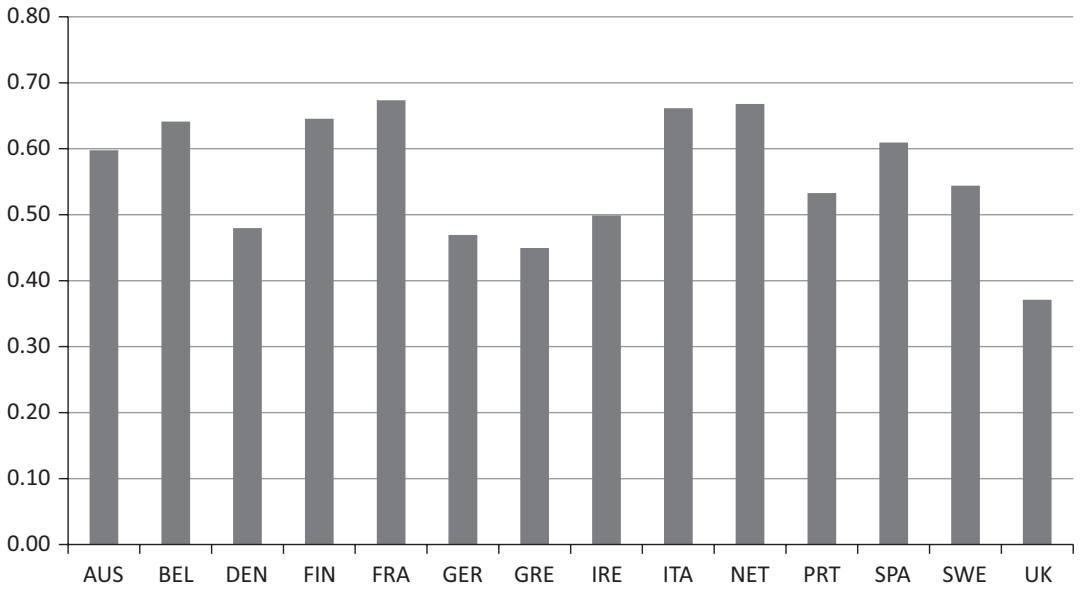

FIGURE 3 Average country business cycle synchronizations over the period 1980–2014. AUS = Austria, BEL = Belgium, DEN = Denmark, FIN = Finland, FRA = France, GER = Germany, GRE = Greece, IRE = Ireland, ITA = Italy, NET = Netherlands, PRT = Portugal, SPA = Spain, SWE = Sweden, UK = United Kingdom. The figure presents the average country-level business cycle synchronization vis-à-vis all other countries during the whole sample period

of synchronization; nevertheless, synchronization 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 synchronizations exhibit higher or lower dispersion. This observation is also confirmed from an examination of the standard deviations of the synchronization levels, shown in the lower panel of Figure 1.

With respect to the dispersion of synchronization 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 synchronization levels and changes in dispersion, correspond with those found in Degiannakis et al. (2014), where they are discussed extensively. 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 1992–1993. This period began with a high average level of synchronization, a low level of dispersion in synchronization and positively correlated cycles across all country-pairs. As the period progressed, synchronization levels declined, and several country-pairs were experiencing very high negative correlation levels (i.e. de-synchronization). Moreover, the dispersion of synchronization 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 synchronization, 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 levels of synchronization between country-pairs. The average measure of synchronization reached a peak in 2009 of around 0.8. This peak in

synchronization is due to the impact of the Great Recession, which drove a common cyclical downturn, and thus, an increase in synchronization levels. However, even though there was a general increase in synchronization during this period, this was associated with an increase in the divergence of synchronization across countries.

Figure 2, which presents the synchronization measures, by country average, across the full sample period, illustrates that this increase in divergence of synchronization across countries, during the 2002–2009 period, was primarily driven by lower synchronization levels for the United Kingdom and Greece, and to a lesser extent, Portugal. The United Kingdom did not become a member of EMU and the lack of synchronization for the Greek economy was well evidenced with the unfolding of the European Debt crisis.

The decoupling effects of the European Debt crisis, during the period 2010–2014, are clearly shown in both Figures 1 and 2, where there is a sharp and pronounced decline observed in the average synchronization measure. This sharp decline in synchronization is evident across all country-pairs. Nevertheless, an upward trend is noted towards the end of the sample period. It is also noted that this period is associated with an increase in the dispersion of synchronization levels across country-pairs. This increase in dispersion occurs as the synchronization 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 Germany exhibits the lowest levels of synchronization among all core EMU members and it declines sharply in 2011.

Overall, the dynamics of the synchronization measures over time show evidence of periods of desynchronization, 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 synchronization levels. The dispersion of synchronization levels also varies across country-pairs 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 synchronization for each country, vis-à-vis all other countries, 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 synchronizations over the sample period. This could explain their decision to remain outside the EU or perhaps 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 synchronized 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 synchronization supports this argument. The finding for Germany is contrary to previous studies, such as Degiannakis et al., (2014), Degiannakis et al., (2016), which found relatively high levels of synchronization 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 synchronization when calculated vis-à-vis an EU cycle. Here, the size of Germany's economy is not considered, and indeed its cycle lacks synchronization 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 synchronizing 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 synchronization between Germany and other countries' business cycles. They suggest that France would be a better candidate as an exemplar of a core EMU business cycle. France is shown here to have the highest level of synchronization with other countries over the period confirming its more appropriate position as a proxy for a core European business cycle.

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

5 | THE DETERMINANTS OF TIME-VARYING BUSINESS CYCLE SYNCHRONIZATION

5.1 | Full-sample estimation

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

The results from the full-sample estimation, shown in Table 2, find that the two fiscal variables are determinants of business cycle synchronization.[6] As theory suggests, differences in the size of the public sector (*PS_DIFF*) across countries exercise 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 synchronization. In other words, countries with similar sized public sectors have more synchronized business cycles, affirming the finding in Camacho et al. (2006). The impact of government sector size on synchronization is operating through the 'safety' and automatic stabilization channels.

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 synchronization, indicating that country-specific discretionary fiscal policy promotes synchronization. This finding is in accordance 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 synchronized across countries. It is noted however, that the coefficient on the fiscal variable is only statistically significant in the second specification of the model.

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

More specifically, this study shows that trade exercises a highly significant effect on business cycle synchronization across the country-pairs. The positive effects of bilateral trade intensity on business cycle synchronization confirm a long list of previous studies, which find trade to be important in explaining business cycle synchronization (see for example Gächter et al., 2017). 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 & Stracca (2016) 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 effects contrast the evidence provided by previous studies, such as Camacho et al. (2006), who find no evidence to suggest that monetary variables can explain business cycle synchronization. Nevertheless, our finding can be explained by two possible channels. First, 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

[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 also estimated the models using only the EMU countries. The results are qualitatively similar.

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	2,972	2,972

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.
Abbreviations: *BTI*, bilateral trade intensity; *CANL_DIFF*, differences in the cyclically adjusted net lending; *INF_DIFF*, inflation rate differentials; *KP_DIFF*, differences in capital productivity; *LP_DIFF*, differences in labour productivity; *PRSAV_DIFF*, differences in private savings; *TFP_DIFF*, differences in total factor productivity; *PS_DIFF*, differences in public sector; *SECT_DIFF*, differences in economic sectors contribution to countries' *i* and *j* GDP.
*,** and *** denotes significance at 10%, 5% and 1% respectively.

differentials across countries indicate that the adjustment mechanism is operating to promote cyclical synchronization across countries. Second, inflation differentials across countries provide 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 synchronization.

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 synchronization. As such, the findings here show that divergence in inflation rates is expected to lead to more synchronized business cycles. Hence, we find here that inflation convergence, which was one of the Maastricht criteria for joining the Eurozone, does not contribute positively to business cycle synchronization, but rather the reverse holds true.

Total factor productivity growth is the final variable found to have a significant impact upon business cycle synchronization, indicating that differences in total factor productivity growth reduce business cycle synchronization across countries. These results hold true even when we consider only the labour and capital productivity growth rates (see specifications 2 of Table 2). Thus, overall, the findings show that it is mainly capital and total factor productivity that matters for business cycle synchronization. Previous findings by Camacho et al. (2006) also found productivity to be important, but it was labour rather than capital productivity that was shown to matter for business cycle synchronization. The fact that total factor productivity and capital productivity play a significant role in business cycles synchronization 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 synchronization of business cycles. The finding that differences in sectoral specialization are not found to be determinants of business cycle synchronization is contrary to Krugman's (1993) argument that sectorial specialization should lead to the decoupling of business cycles. The theory is that differences in sectoral specialization will result in countries being more susceptible to asymmetric shocks and hence less synchronized. 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.[7] These results are qualitatively similar to those in Table 2.

Overall, the evidence from the full-sample estimations shows that fiscal policy variables can be used to promote business cycle synchronization across countries when controlling for other determining factors. It is both the size of the government sector as well as discretionary fiscal policy that determines business cycle synchronization. Hence, greater similarity in the size of the public sector, accompanied by flexible and responsive fiscal policy, across EU countries will promote business cycle synchronization and the sustainability of the monetary union.

5.2 | 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 characterized by important institutional changes in the EU (i.e. 1981–1993, 1994–2001, 2002–2009 and 2010–2014). The dynamics of business cycle synchronization differed across these time periods, as discussed in Section 4 and in previous literature such as Degiannakis et al. (2014). Moreover, Böwer and Guillemineau (2006) find that the set of determinants of business cycle synchronization varies across the different phases of European integration. These phases of integration are characterized by changes in the institutional framework of the EU over time.

Joining European Monetary Union for our sample countries in 2001 could promote greater synchronization 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 & Rose, 1998). However, increased economic integration may cause business cycle divergence if that integration promotes specialization in trade, in line with a country's comparative advantage, ultimately leaving the economy more susceptible to asymmetric shocks (Krugman, 1993).

The results for each of the four sub-periods are shown in specifications 3–10 in Table 3.[8] Specifications 3–6 include labour and capital productivity individually, whereas specifications 7–10 include the *TFP* variable. The

[7]The results are available upon request.

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

TABLE 3 Determinants of BCS, sub-period results

	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	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]

(Continues)

TABLE 3 (Continued)

	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	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
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	1,082	720	720	542	1,082	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.

Abbreviations: *BTI*, bilateral trade intensity; *CANL_DIFF*, differences in the cyclically adjusted net lending; *INF_DIFF*, inflation rate differentials; *KP_DIFF*, differences in capital productivity; *LP_DIFF*, differences in labour productivity; *PRSAV_DIFF*, differences in private savings; *PS_DIFF*, differences in public sector; *SECT_DIFF*, differences in economic sectors contribution to countries' *i* and *j* GDP; *TFP_DIFF*, differences in total factor productivity.

*,**,*** denotes significance at 10%, 5% and 1%, respectively.

sub-period analysis indicates that there is some change in the determinants of synchronization across time, but there is also a high degree of consistency in determinants across the sub-periods.

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 synchronization, 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 synchronization, which is in line with the policy prescription associated with OCA theory. Similar findings have also been 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 that our framework, where we utilize a robust time-varying synchronization measure, as well as the use of bilateral business cycle synchronizations, allows us to reveal new insights in this line of research.

However, the fact that differences in the size of the public sector matter only during the European debt crisis period may suggest that during this crisis period, when fiscal policy was more constrained (i.e. by the EMU institutional rules, sovereign bond market conditions and fiscal austerity policies), government size can also be supportive of increased synchronization.

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-periods. Once again trade exercises a highly significant effect on business cycle synchronization 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 synchronization 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 synchronization 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 sectoral specialization, it is found that differences in the size of the agricultural sector and the construction sector matter for synchronization during the common currency period and also during the Maastricht Treaty period. The positive coefficients in the construction and agricultural sectors indicate that differences in the size of these sectors across countries promote cyclical synchronization. This is because divergence in sectoral specialization across countries can emerge as countries increase their trade volumes and increasingly specialize 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 specialization variables is indicative of this process of increasing synchronization. This finding runs contrary to Krugman (1993) who predicted that sectoral specialization would leave countries susceptible to asymmetric shocks which would lead to business cycle decoupling. It is also noteworthy that differences in specialization matter during periods of increasing synchronization across countries and increasing integration pre and post the introduction of the common currency, hence sectoral differences can promote synchronization during the process of integration.

A related finding with regard 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 of business cycle synchronization. To explain this finding, we should note that private savings capture not only the savings rate but also the consumption and the investment

sides of the economy. Given that private saving is disposable income minus 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 synchronization. Both consumption and investment, after all, tend to move in a procyclical manner and are regarded as leading indicators for the business cycle (Kharroubi & Kohlscheen, 2017). Such evidence does not offer support to the Backus–Kehoe–Kydland consumption correlation puzzle (Backus, Kehoe, & Kydland, 1992), which suggests that consumption levels among OECD countries are less correlated compared to the output correlations. In essence, this is capturing the structure of the economy, which along with the construction and agricultural sectors is found to determine synchronization 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 synchronized business cycles, whereas the opposite is true for capital productivity growth rates.

6 | CONCLUSIONS AND POLICY IMPLICATIONS

This study has sought to understand the role played by fiscal variables in the determination of pairwise business cycle synchronization across a sample of EU countries. A novelty of the methodological approach applied here is to estimate time-varying pairwise synchronization measures using a multivariate GARCH model, specifically the Diagonal BEKK model. Moreover, apart from the fiscal variables, a set of control variables are also included, which have been found in the literature to impact upon business cycle synchronization. These include trade intensity, productivity, inflation, savings and sectoral specialization. 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 synchronization across country-pairs, which is measured using a time-varying indicator of synchronization.

Synchronization of business cycles across country-pairs is shown to increase over the 1981–2014 sample period; however, the dispersion of synchronization across country-pairs shows substantial changes over certain sub-periods. There are periods with a low degree of dispersion of synchronization 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 synchronization indicate that even though the overall synchronization 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 synchronization are themselves associated with institutional changes in the process of European integration.

Among the least synchronized business cycles over the sample period are those of the United Kingdom, Greece and Germany. With respect to the United Kingdom, this may be assumed to be partly due to the endogeneity effects of their decisions to remain outside of EMU, and partly an indication that their cycles are less suited to EMU. The findings for Greece and Germany make it all the more pertinent that policymakers understand the determinants of business cycle synchronization in EMU and the potential role that policy variables can play in ensuring synchronization 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 synchronization. Countries with similarly sized public sectors and greater fiscal divergence have more synchronized business cycles. Hence, convergence in the size of the public sector across countries will help to ensure greater business cycle synchronization, presumably through the 'safety' and automatic stabilization channels. As such increased fiscal federalism in EMU will contribute to increased business cycle synchronization. As the EU considers the question as to how much fiscal federalism is desirable, the finding here

suggests business cycle synchronization ought to feature in this evaluation. Coupled with the aforementioned finding is the evidence that that fiscal divergence can also promote business cycle synchronization. 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 stabilize EU business cycles in response to idiosyncratic shocks in a manner that has ensured increased synchronization. This is in accordance with how optimal currency area theory suggests that fiscal policy ought to respond in a monetary union. From an institutional design perspective, any move to increase 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 synchronization. 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 synchronization. Country-pairs that trade more intensely and have similar capital productivity growth rates have more synchronized business cycles, while differences in inflation rates across country-pairs lead to increased business cycle synchronization. Policies to support trade integration will increase synchronization, 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 synchronization 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 destabilizing 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 synchronization, but policy tools and policymakers need to be flexible to divergence particularly with regard to fiscal policy.

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