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Investigating the Effect of Trade on Business Cycle Synchronization: An Applied Case to the EU

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Abstract

An ingredient of a successful currency union is synchronized business cycles. A perceived benefit of a currency union is increased trade. Therefore, the relationship between trade and synchronized business cycles becomes important to ensuring the stability of the currency union. This study investigates whether trade promotes the synchronization of business cycles. Sectoral and financial linkages are included in to the model to account for endogeneity. The results strongly show that trade is significant in positively re-enforcing the synchronization of business cycles between countries. Sectoral linkages are also significant via a positive impact on trade. Finally, financial integration is insignificant when looking at how to promote business cycle synchronization.

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1 Introduction

"Countries that grow together, stay together"

Anon

An ingredient of a successful currency union is synchronized business cycles. A perceived benefit of a currency union is increased trade. Therefore, the relationship between trade and synchronized business cycles becomes important to ensuring the stability of the currency union. This study investigates whether trade promotes the synchronization of business cycles. Sectoral and financial linkages are included in to the model to account for endogeneity. Attention will be paid to the cycle extraction methods and it is shown that the UCM approach can improve the fit of the estimated business cycles. By improving on the estimation of business cycles, there is greater accuracy when measuring business cycle sychronisation and therefore a more accurate estimation of the determinants. The results of this study strongly show that trade is significant in positively re-enforcing the synchronization of business cycles between countries. Sector alignment is is significant via its positive impact on trade. Finally, financial integration is insignificant when looking at how to promote business cycle synchronization.

The estimation in this study investigates the effect of trade on cycle synchronisation. By using a system of equations, the simultaneous impact of endogenous factors such as sector alignment and financial integration are empirically quantified. The dataset is dyadic and contains observations for all unique country pairs in the EU, 377 in total. The system of equations is estimated using IV, two staged and three staged least squares approach.

The results show that trade has a positive effect on synchronizing business cycles. However, having similar industries concentration is a stronger determinant of synchronization than trade. Finally, financial integration appears to have no significant impact at all.

The framework adopted in this study allows us to incorporate for the endogeneity between the independent variables. When accounting for this endogeneity, the results show that similarities in sector concentration has a positive impact on the amount of bilateral trade that occurs. This could

suggest an important role of intra-industry trade if countries are trading within the same sector. Financial Integration has weakly significant impacts on trade and sector alignment. Exploit data richness by conducting in a EU only place.

One of the key contributions is to investigate the impact that the choice of cycle extraction method has played in influencing existing results in this field. The benchmark method of business cycle extraction is the Hodrick-Prescott filter. By using a cyclical extraction method based on the Kalman Filter, the argument is made that such a filter is much less presumptive about the behavioural properties of the underlying growth trend. As a result, previous studies might have overstated the impact of trade on the alignment of business cycles. The first contribution made, is that the UCM method proposed in this paper has a better fit to the data that the standard Hodrick-Prescott filter. This is based on the assumptions that are made by the bethod but also this is empirically proven with a lower AIC model fit. The benchmark estimation is re-run using the exact same data and model specification but this time the dependant variable is the correlation of business cycles extracted with Hodrick-Prescott filter. There are some modest observable changes in the results. Firstly the coefficient on trade is larger implying a slightly bigger magnitude of the effect of trade. Secondly, the financial integration becomes more significant and finally the rsqaured is lower from the estimation for the cycle equation. The use of the UCM has allowed modest improvements on the results previously achieved in the literature.

Entering a currency union has the very direct benefit of reduced costs associated with trade. Allowing neighbouring countries to share the same currency has certain advantages that can help to boost trade. 44 of the worlds 193 countries currently participate in a currency union, and there are many more engaging in proposals for future currency unions. The main benefit associated with currency unions are reduced costs with major trading partners. Further benefits can come in the form of currency stabilization , particularly for small open economies that could be subjected to speculative currency attacks. If a small open country, shares its currency with other countries, then it is less vulnerable to currency speculation , as movements in the currency reflect a wider group of countries. In order to successfully participate in a currency union, countries must forego their independent monetary policy. This is because the same interest rate needs to be offered by all

countries within the union, to avoid arbitrage and capital movements.

One of the downside risks of embarking on a shared currency is that , there is some degree to which synchronized output movements are required. This allows for cyclical policy to be conducted at a more centralized level, as one policy should be an adequate measure for all the countries in the group(Alesina, Barro & Tenreyro 2002). The Euro Convergence criteria (also known as the Maastricht criteria) sets out four main criteria for countries to meet before having the euro currency. The criteria have been set out to help ease transition in to the euro and so that the country can successfully transition to adopting the monetary policy of the ECB.

The business cycle of a country refers to the expansionary and recessionary episodes that occur around the long-run growth trend. The closer together in time, these expansionary and recessionary episodes are, the more synchronized two countries business cycles are. The causes of business cycle synchronization are of both academic and policy interest for a variety of reasons. This includes more accurate policy impact estimation and also it is of importance in deciding optimal currency areas (OCA). In order to maintain an optimal currency area, one key ingredient is the synchronization of business cycles. This is partly so that monetary policy can be conducted on a basis that is optimal for every state involved. Furthermore, this means that a floating value of the currency is a better representation of the economic and business environment within each state and therefore becomes a more accurate representation of the current economic events in that country.

If the main benefit of embarking in a currency union is trade and one the the inputs to a successful currency union is synchronized business cycles, the inevitable question becomes, what is the impact of trade on business cycle synchronization.

Two variables that measure institutional similarity are introduced to the empirical exercise. These variables are an index employment protection law that allows for a cross-comparison of employment protection laws between two countries. Secondly, an index of Product Market Regulation was included. This allows to cross compare Product Market Regulation. Another variable that is introduced is a discrete variable that measures the number of shared systemically important banking institution that are shared by two

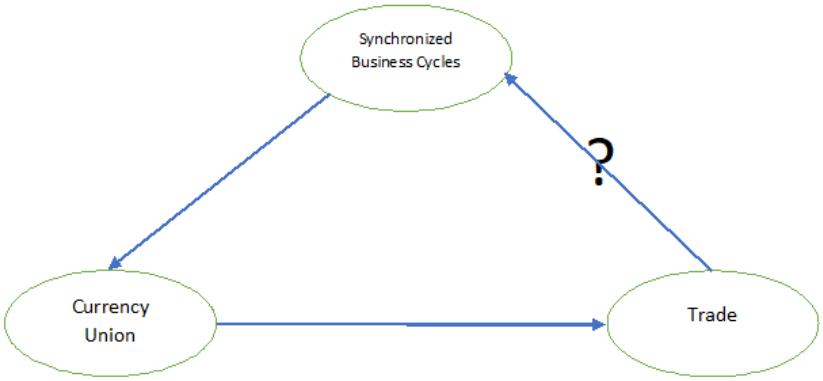

Figure 1: The Cycle of Currency Union Stability

countries. This is to show a similarity in banking institutions and therefore highlights possible ease of transferring assets and an existing degree of financial integration. If a country has a large bank whose parent bank is large in another country, then this country pair will adopt a dummy value of 1.

This study investigates how trade plays a role in determining synchronization whilst unpicking the effects of sector specialization and financial specialization. This study contributes to a handful of studies that investigate this relationship whilst accounting for simultaneity with tangential but related factors. One key area in which this study seeks to expand on existing studies is in the cycle extraction method itself. By using an UCM Decomposition as outlined by (Harvey 1990) and applied in other studies(Macchiarelli 2013). This is a contribution to this branch of literature . No other studies in this literature have used an structural time series method with a Fourier expansion to extract business cycles. By improving the accuracy with which business cycles can be estimated, there is greater accuracy in measuring synchronization and therefore empirically testing the determinants. This is the first study that is conducted including every member of the EU. This is important as it allows us to capture the dynamics of the newer member states who might display a different behaviour owing to their size or the increased volatility within their business cycles.

To signpost, the three main contributions of this study are:

- 1) To show that trade positively impacts business cycle synchronization in the applied case of the EU. This is the first study to assess this question using data from all 28 member states of the EU.
- 2) By using an UCM model, this paper shows that a better estimation of business cycles in the EU can be achieved. The results of the estimation using the UCM imply that previous studies may have understated the impact of trade on cycle synchronisation.
- 3) This will be the first study to take in to account the full range of the crisis and therefore the data will carry a greater range of dynamics in which to use in the estimation.

Section 2 will review the literature regarding the existing studies that look at determinants of business cycle synchronization . Key findings from the literature will be explained and analyzed. Section 3 will discuss and conduct the initial stage of the exercise which is the cycle extraction method. Section 4 will continue with the methodology discussing the second stage which involves the three stages least squares estimation of the system. Section 5 will outline the main tenets of the results and Section 6 will Conclude.

2 Determinants of Business Cycle synchronization

The evidence on the effect of trade on business cycle synchronization is inconclusive. In this literature review, I look at the existing studies on the effect of Trade, Sectoral-specialization and Financial integration on the synchronization of business cycles between countries. I look at papers that discuss the effects of each of these factors individually on output synchronization. I will then go on to explain the approach of papers that look at combinations of these factors simultaneously.

2.1 Trade

The initial relationships between trade and output were estimated using the gravity equation. The gravity equations tries to predict the amount of bilateral trade that will occur between two countries(Isard 1954). The gravity literature identifies that countries with similar gdps are more likely to trade with each. Frankel and Rose (1998) in 1998 based on pre-emu data conduct a study that shows that a shared currency can promote trade between in countries and that trade between countries promotes growth convergence. Frankel and Rose use the gravity frame work to look at how trade affects output. They find that the only channel through which currency unions promote growth is via their positive effect on trade. Their results no direct impact of currency unions on growth but only an indirect impact through trade.

Although Frankel and Rose look at the impact of currency unions on growth , the great recession showed that currency unions can have their vulnerabilities. A key factor to the success of a currency union is not just output convergence but real business cycle convergence and therefore synchronized business cycles. If the monetary policy cannot adequately address a countries business cycle situation then it is difficult to maintain domestic price stability. Although a currency union might be positive output, the stability of it relies can only be maintained if the prices can be stabilized via monetary policy.

There is an intuitive reason that the effect of trade on business cycle integration is positive. This positive relationship, comes in the form of contagion. Two countries that trade together have a direct economic link to each other. In a two country model with international trade, a negative domestic shock in country i will reduce the demand of exports for country j . This has a direct impact on GDP for Country j from pure accounting. However, this could have knock on impacts for various aspects of Country j's economy. Whether it be through supply side or the inability to buy. This reduction in demand for imports from country i will affect country i's major trading partners.

This fall in trade is could have re-percussive effects through the rest of the economy for country j. This somewhat intuitive results has been

proven to be correct many times in the literature. The literature regarding this issue is often grounded in OCA literature.

However, there are alternative forces at work. Ricardian theory suggests that trade occurs in industries where countries have a comparative advantage. As a result, trade encourages specialization of domestic production in industries where countries have a comparative advantage. If countries are specialized in different industries they have different technologies and supply inputs as well as output markets. As a result, they are less likely to react in the same-way to identical exogenous shocks. Furthermore, there is likely to be divergence in the exchange rate profiles owing to movements in input commodity prices. Papers that find empirical evidence for this are Bayoumi and Eichengreen who argue that output responses to identical supply-side shocks is the way to measure synchronization.

2.2 Sector Specialization

Sector specialization refers to the amount of production that occurs within the same industry within two countries. If two countries both have 90% of their output produced by the automotive industry, then they would be very close in Sector Specialization. If one country had 90% of their production in agriculture and the other country had 90% in the automotive industries, these countries would be further apart in sector specialization. There are two channels through which sector specialization can affect output synchronization. The first one is through the impact that sector specialization can have on the amount of international trade that two countries will do with each other. The second is through the symmetry of shock propagation when the production of two countries are heavily focused in the same industries.

If two countries have a high proportion of resources that are used to produce goods within the same industry , then this is presumed to have an impact on how much bilateral trade occurs between the two countries. The original theoretical justifications for the benefits of free trade provided by Ricardo and others came from the ideas that trade was driven by comparative advantage and production efficiency's. If countries have a comparative advantage in the production of a particular good then production in that

country was likely to be oriented around that particular good.

This means that countries with similar industries are less likely to trade with each other. If countries share the same sector, then their factor endowments and their technological capabilities are likely to also be similar. As a result, there would be very little to gain economically, from embarking on trade with each other. This is particularly true when looking at armington aggregator preferences (Dixit & Stiglitz 1993) whereby the consumer has a preference for consuming different items. If countries have similar industries, then they are likely to be producing similar goods in which case the likelihood of trade falls. As trade is lower, it is then assumed that business cycle synchronization is also less likely.

However, there is a large body of literature that for various reasons argues that countries that have similar industries are more likely to be synchronized(Davis 1995). This argument has two main sources. The first is that intra-industry trade is more significant than inter-industry trade. A study by Davis(1995) shows that intra-industry trade is prevalent and countries that specialize in the same industries are more likely to trade with each other. Davis (1995) creates a theoretical framework using the Heckser-Ohlin model to show how intra-industry trade can be explained via comparative advantage and the relative technological capabilities of countries. On the one hand, it depends on the strength of inter-industry trade versus intra-industry trade.

With regard to the final impact on synchronization without the interaction of trade, it is believed that similar industries with in countries should promote convergence. This argument comes from the fact that similar industries face similar exogenous shocks, and as a result are more likely to have similar output fluctuations to each other. Furthermore, the exchange rates and other monetary indicators are likely to react also in a similar way to these exogenous shocks. The synchronicity in these fluctuations increase the likelihood of output synchronization between two countries.

2.3 Financial Integration.

The impact of financial integration on business cycle synchronization is the least tangible of the relationships explored in this study. The literature is the most conflicted as to what the direction of the relationship should be. There are a group of studies that argue that the effect of financial integration on business cycle synchronization is negative(Backus, Kehoe & Kydland 1992)(Heathcote & Perri 2002)(Obstfeld 1992). (Kalemli-Ozcan, Sørensen & Yosha 2001) use a panel approach to find that banking integration is significantly negatively impacting the business cycle correlation. It seems that financial integration encourages different investment portfolios and specialization in different types of financial products. As a result, this leads to different business cycles. Some papers argue that the relationship is endogenous. that countries with different risk profiles are more likely to be financially linked leading to further output divergence.

There is a group of literature that proposes a positive link for the relationship (Kose & Yi 2006).Kose and Yi (2006) find that the international real business cycle can help promote the positive relationship between trade and output co-movement. The basis for the positive link is grounded in the existence of contagion. If countries are financially linked and one country experiences a financial shock, the propagation of this shock through the links with its country traders, is likely to impact the linked economy in a negative way too.

2.4 Simultaneity

An handful of existing studies have reconmized the important of accounting for simulatneity in multiple mechanisms when looking at the impact of trade on output synchronization. The approaches used by Frankel and Rose accounted for endogeneity in two stages through using an instrumental variable regression. This works on the assumption that the endogeneity between the dependant and independant variables do no occur simultaneously and that there is a time-lapse between the two channels. This assumption appears to be quite a strong one to make. There are factors that are likley to effect both the amount that a country trades with each other as well as the extent to

which their output is synchronised. Imbs (2004) argued it is possible for the effects of changes in sectoral production to affect trade volume and output levels instantaneously. Therefore an approach that accounts for simultaneity in the endogeneity . A system of equations allows for this simultaneity to be accounted for is estimated. Teh system of equations accounts for the effect of trade on output synchornisation and the effect of industry specialisation on both trade and output synchornisation. Imbs applies this approach at the state level in the USA and finds that trade is positive in promoting business cycle synchronization and that sectoral similarities help in promoting both trade and output synchronization. One limitation of Imbs study is that it takes place on an intra-national scale within the US. There is a degree of similarity that takes place on federal level. There is some control that the centralised government has on all of the states. This is a further source of endogenity between the dependant and independant variables. There is no control for similarity in output fluctuations that might be caused by synchronization in fiscal policy. There could be some positive bias in the result owing to this universal fiscal policy.

By applying this approach to an international context , this error is somewhat reduced as different political entities such as countries, have different fiscal regimes and can be treated as random. These fiscal regimes will be have the sole purpose of maintain the economic output of that particular entity rather than the whole area. Therefore, this error of fiscal policy driving synchronization is removed. This shortcoming is overcome in IMBS paper with a re-estimation on EU sample that confirms the result found on a state level leading to the conclusion that this works on an intra-national and inter-national level.

In a panel study Dees et al adds to the existing apporaches by adding a third endogenous variables which is financial integration. Failing to pay attention to the importance of cyclical extraction methods. This study will look at how cyclical extraction methods can determine the outcome of the results. On top of which I make small additions to the existing framework in order to improve upon the existing results.

This study follows the approach of a group of studies that use a system of simultaneous equations to assess the question. There are a number of benefits of insight that a simultaneous approach can give us. The linear ap-

proaches used in gravity equations to assess the determinants of trade often fail to account for the endogeneity between the regressors and the regressors and the regressors and the dependant variable. This issue is particularly pertinent in the Frankel and Rose 2002 paper whereby the dependant variable is divided by the sum of GDP, and the product of GDP is used as an explanatory variable. These approaches will be applied to the case of the EU. The focus will be on the full EU28 countries. There are a few reasons the focus is on a eu28. One of the main policy areas that looks at business cycle synchronization is that of Optimal Currency Areas and in particular whether countries are sufficiently synchronized to share the same currency.

3 Cycle Extraction Methods

One of the main contributions of the this study is to introduce alternative ways of extracting the cyclical elements of real output. Understanding business cycles and how they fluctuate has long been an important step in helping conduct economic policy. In order to be accurate in extracting the cyclical component , an assumption must be made about what the underlying data generating process for structural growth is. This referto the assumption of whether underlying growth follows a linear , stochastic or is simply represented by a random walk. The benchmark method used to measure business cycles is the Hodrick-Prescott filter. The typical method used in studies of this kind are applying an Hodrick-Prescott filter to a gdp series and using the cyclical component. (Baxter & King 1999) found that linear de-trending or first differencing as a method of removing trends was not desirable for business cycle extraction. As a result , band-pass filters are presumed to be a stronger method.

The current benchmark in the literature is the Hodrick-Precott filter. The Hodrick-Precott is an econometric smoothing technique that works by penalising the cyclical component of a time series and then assuming that everything that remains is the trend component of a time series.

$$\min_{\tau}(\sum_{t=1}^{T}(y_t-\tau_t)^2+\lambda\sum_{t=2}^{T-1}[(\tau_{t+1}-\tau_t)-(\tau_t-\tau_{t-1})]^2) \tag{1}$$

The first term of the equation is the sum of the squared deviations $d_t = y_t - \tau_t$ which penalizes the cyclical component. Let y_t, for $t = 1, 2, ..., T$, denote the logarithms of a time series variable. The series y_t, is made up of a trend component τ_t, a cyclical component c_t, and an error component $\epsilon_t \epsilon_t suchthat$ $y_t = \tau_t + c_t + \epsilon_t$ Given an adequately chosen, positive value of λ , there is a trend component that will solve The second term is a multiple λ of the sum of the squares of the trend component's second differences. This second term penalizes variations in the growth rate of the trend component. The larger the value of λ, the higher is the penalty(Kim 2004).

Whilst a useful technique in econometrics time-series, it has some limitations. One is that the Hodrick-Prescott filter is that it does not adequately account for shocks in the time-series and these shocks are often interpreted as part of the underlying trend component.

Limitations of the Hodrick-Prescott Filter have been outlined by (King & Rebelo 1993) the main one being that the filter has a poor performance in series with low frequency spectral density. Hamilton(2017) outlined a few reasons why the Hodrick-Prescott Filter was inadequate. Three of the reasons, "(1) HP introduces spurious dynamic relations that have no basis in the underlying data-generating process. (2) Filtered values at the end of the sample are very different from those in the middle, and are also characterized by spurious dynamics. (3) A statistical formalization of the problem typically produces values for the smoothing parameter vastly at odds with common practice. ".(Hamilton 2017)

In this section, I advance on previous studies by applying various forms of an unobserved components model to extract business cycles. To overcome the problems as outlined by (Guay & St.-Amant 2005) , this study will propose an alternative way in which to extract cycles. The main basis of this approach is to adopt a unobserved components model (UCM), which uses a structural approach in which to extract the cyclical components of the business cycle. Later sections will measure the impact that this approach has against the HPFilter which is the benchmark.[1]

UCM models decompose a time series in to three components. A trend component, a seasonal component and an irregular component: Let y_t

[1]AIC allows for multi-model comparison.

be the raw time-series that is being decomposed. It is assumed to contain a trend component ,μ_t , a seasonal component ,γ_t, and an irregular component, ε_t . The trend component is locally estimated by the following equation:

$$y_t = \mu_t + \gamma_t + \varepsilon_t \tag{2}$$

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t \tag{3}$$

$$\beta_t = \beta_{t-1} + \zeta_t \tag{4}$$

$$t = 1.....T$$

η_t and ζ are assumed to be serially and mutually uncorrelated with zero mean and variance σ^2 $(\eta_t, \zeta_t \sim NID(0, \sigma^2_{\eta\zeta}))$

The seasonal component is determined as follows:

$$\gamma_t = \sum_{s-1}^{j=1} \gamma_{t-1} + \omega_t \tag{5}$$

The cyclical component is estimated with a series of sinusoidal functions :

$$\begin{bmatrix} \varphi_t \\ \varphi_t^* \end{bmatrix} = \begin{bmatrix} cos\lambda_c & sin\lambda_c \\ -sin\lambda_c & cos\lambda_c \end{bmatrix} \begin{bmatrix} \varphi_{t-1} \\ \varphi^*_{t-1} \end{bmatrix} + \begin{bmatrix} \kappa_t \\ \kappa_t^* \end{bmatrix} \tag{6}$$

Nine variants of the kalman filter are run on the GDP time series.I follow the model structure as outlined in Macchiarelli (2013). In this study UCM models are run on GDP and inflation time series of CEE countries to see if the dynamics are related. The AIC is then used to select the best model, based on model fit. The first three models start with the basic form of a trend cycle decomposition and then various restrictions on the variance of the level and slope component are added to see if they provide a better model fit. The models are estimated using an arma 2 process.

- Model 1 is the structural decomposition with the variance on the level fixed at zero but the variance on the slope remains determined by the model.

- Model 2 is the structural decomposition with the variance on the slope fixed at zero but the variance on the level remains determined by the model.

- Model 3 is the structural decomposition with the variance on the level and slope both fixed at zero.

  I continue to follow the specification as outlined in (Macchiarelli,2013) The next group of models work by replacing the stochastic equation for a trend with a data generating process that is based on the assumption of a finite number of minima and maxima within the series. The stochastic trend in the earlier model is replaced with a more general specification that includes a fourier transform.This is the fourier approximation allows us to represent a cycle as a series of sinusoidal functions. This means that a non-linear assumption can be placed on the underlying structural growth. I run three further models on the raw data but this time I incorporate a first order fourier expansion. The fourier expansion allows for time-series to be split into composite waves and the assumption is that the trend may also follow a non-linear and there might exists cyclicality in structural growth. By incorporating this flexible functional for to determine the trend, we allow for the possibility that there are multiple peaks and troughs in the time series. This is a more realistic determination of the real business cycle.

$$x_{i,j} = \sum_{h=0}^{2} \delta_{i,h} t^h + \sum_{k=1}^{n} \alpha_{i,k} sin(\frac{2\pi kt}{T}) + \sum_{k=1}^{n} \beta_{i,k} cos(\frac{2\pi kt}{T}) \qquad (7)$$

  Where k is the order of the expansion. Where $n < \frac{T}{2}$ and n refers to the number of frequencies contained in the approximation and t = 1, ..., T is a linear trend

- Model 4 is a first order fourier approximation

- Model 5 is a first order fourier approximation with a time trend

- Model 6 is is a first order fourier approximation with a quadtratic time trend The final three models that are run on the raw data are a pure second order fourier expansion.

- Model 7 is a second order fourier approximation

- Model 8 is a second order fourier approximation with a time trend
- Model 9 is is a second order fourier approximation with a quadtratic time trend.

The nine models are run on quarterly pre-seasonally adjusted logged gdp for all 28 countries. The data runs from 2000q1-2017q4.

Although the model specification allows for a seasonal component to be extracted, I use pre-seasonally adjusted data as seasonal holidays and working day adjustments are made by the respective statistical agencies of the member states.Once I run all the models, I extract the cyclical components of each model. The best model is selected based on the Akaike information criterion. Table 3 in the appendix shows the results for all nine models across all 28 countries.

The first order fourier expansion without a time trend seems to be the best fit for most of the countries in the sample (fourth model). However, this difference is marginal as the AIC remains around the same level for both model 3 and model 4. This is different to previous papers(Macchiarelli 2013) who finds that a variety of models fits best for the 10 countries in the sample.This could be because of the time sample that I have used which includes the crisis and post crisis periods. There is also the possibility that the filtering methods might be sensitive to the frequency of data and therefore the use of quarterly data may change what is the best model selected. The second order fourier expansions do not perform as well as the rest of the models and the model with the weakest is the second order fourier expansion with a quadratic time trend. This is probably intuitive because business cycles do not display quite as erratic behaviour, although we might have expected some countries that had a double dip recession to be explained by the second order.

Figure 2 shows the extracted cycles for all 28 member states. The graph shows that there is increased synchronicity that is attained during the

downturn of the cycle. There seems to be a lot more variance in the post-crisis period than the pre-crisis period. Ireland stands out in this graphs as having a better than average post-crisis recovery. Once I have chosen the correct cycles for each of the countries, I then obtain a correlation for the cycles on a bilateral basis for all the country pairs.

The majority of the country pairs exhibit pro-cyclical business cycle synchronization. However, unlike with the use of the Hodrick-Prescott filter the correlations of the cycles extracted using the UCM show counter-cyclical business cycle relationships. This is the case for ten of the 377 country pairs. They are listed in the table below.

Country I	Country J	Cycle Correlation
CYPRUS	UK	-0.23606
CYPRUS	ESTONIA	-0.19899
CYPRUS	LITHUANIA	-0.1963
CYPRUS	LATVIA	-0.17553
ESTONIA	GREECE	-0.12043
ESTONIA	PORTUGAL	-0.10516
CYPRUS	HUNGARY	-0.09379
LITHUANIA	PORTUGAL	-0.06551
LATVIA	PORTUGAL	-0.05293
PORTUGAL	UK	-0.00071

Table 1: Countries that move counter-cyclically

The median value for the correlation of business cycles in 0.59. Countries within the EU appear to already have some synchronicity(Dées & Zorell 2012). When looking at an EU only sample, the variation in the dependant variable is much more limited compared to when observing a global data-set. Factors of geography are likely to promote synchronicity in the kind of exogenous shocks that these countries face. However, the positive side is that purely EU dynamics are captured which reduces the risk of outliers affecting the result. The harmonised practices of national data reporting across the EU, means that there is more consistency when cross-comparing data compared to using data on a global scale.

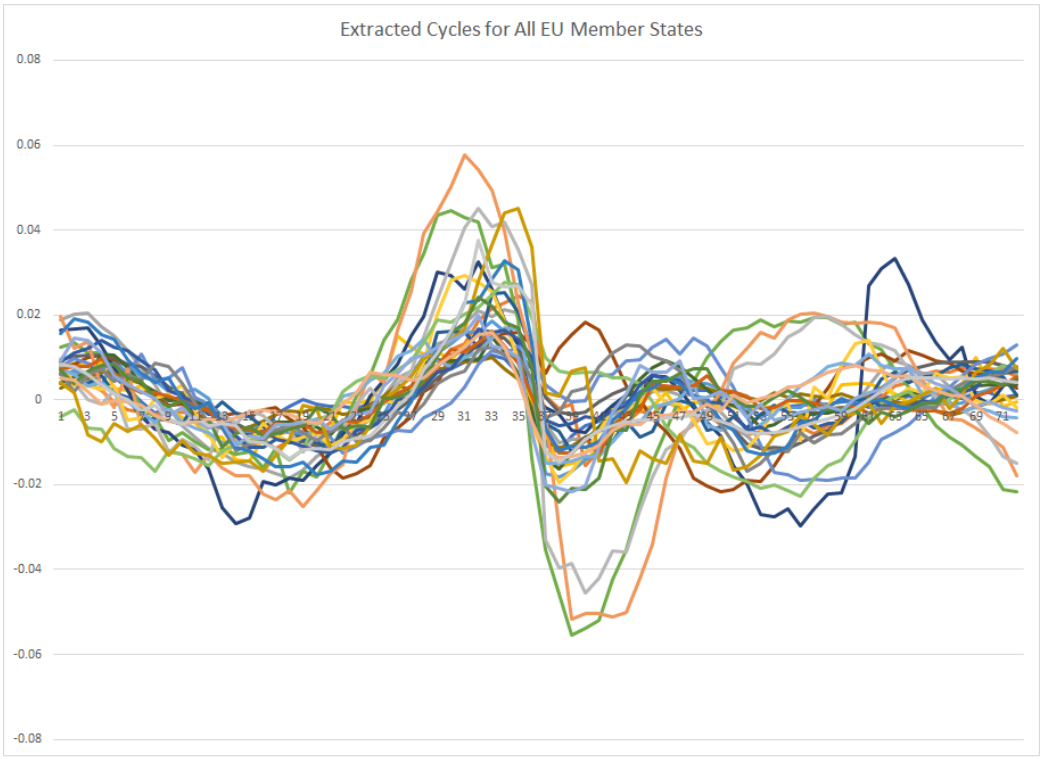

Figure 2: Extracted Cycles for all 28 EU Member states 2000q1-2017q4

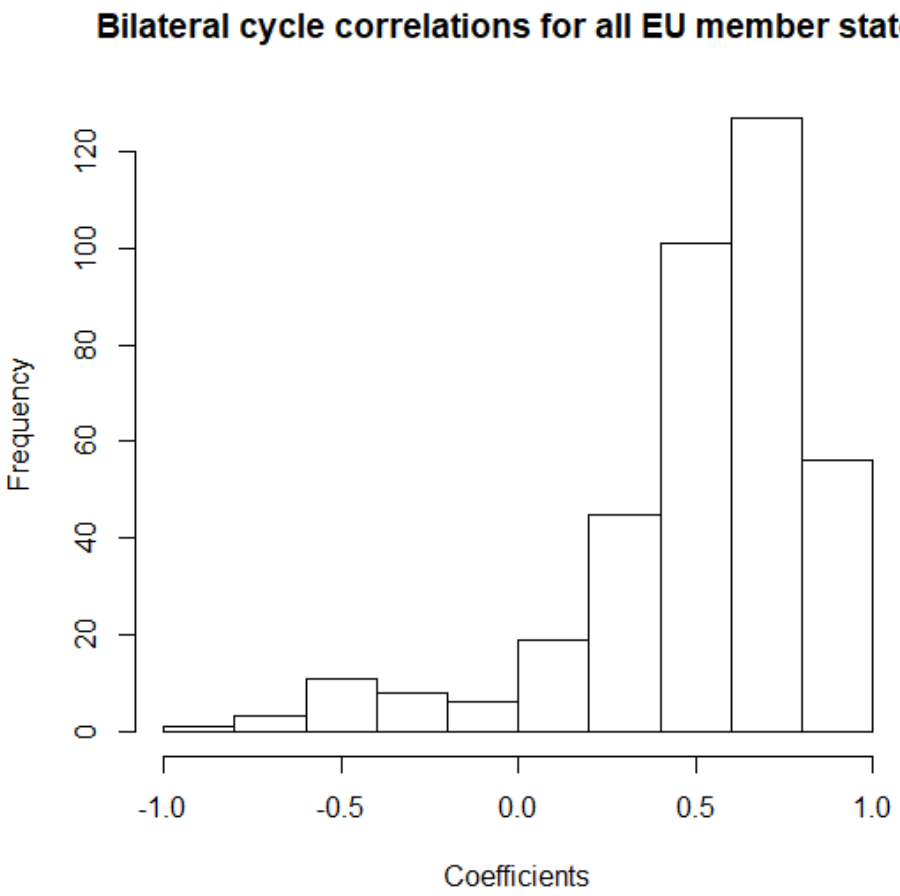

Figure 3: Correlations of UCM filtered Real Business Cycles

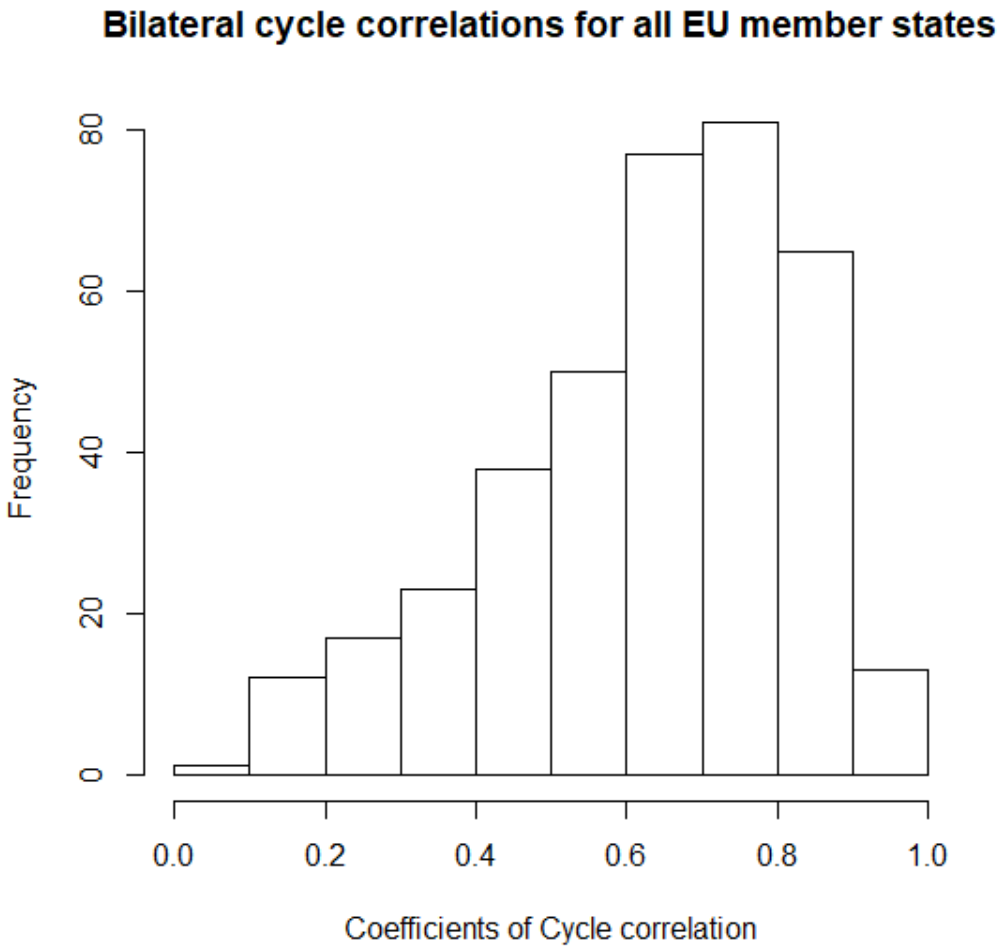

Figure 4: Correlations of Hodrick Prescott filtered Real Business Cycles

4 Data

The analysis will be conducted using dyadic data which is the bilateral observations between all unique country pairs within the EU. The main dependant variable is the business cycle correlation index which is depicted by ρ_{ij}. It is the correlation between the business cycles of two countries as outlined in the previous section. There are three other endogenous variables : Trade intensity, Sector Specialization and Financial integration and 11 exogenous variables.

The times series that most of the data was collected for is 18 years from 2000-2017. Although the series are averaged over the time-frame and reduced in to one figure to represent the whole period, the benefit is that given that we are looking at cycles that typically occur over a 6 year period [2] , definition by NBER, collecting data over a longer time frame means that we are collective averages over a few cycles as oppose to either the upturn or downturn period of a cycle. This helps to reduce bias occurring from looking at a limited part of the cycle.

Trade intensity is the first endogenous variable in the estimation. Bilateral Trade intensity is measured by

$$TradeIntensity_{ij} = \frac{(\sum X_{ij} + \sum M_{ij}) * Y_{EU}}{Y_i + Y_j} \tag{8}$$

This is the sum of total imports and exports divided by the sum of GDP in both countries and the number of units in the time frame. This a standard measure of trade intensity that is used in the literature (Dées & Zorell 2012)(Frankel & Rose 1998)(Imbs 2004). It is also often the measure of the dependant variables in gravity model style equations. The source of the trade data is the EUComext data base which is a comprehensive dataset of all goods that cross all EU borders. One limitation is that I only look at goods which may affect the result. Service data tend not to be available with such detail and also often with less accuracy.

Geography plays a role in determining trade flows via it's impact on the cost of transporting goods. The first exogenous variable is bilateral

[2]The NBER's Business Cycle Dating Procedure: Frequently Asked Questions

distance between the two countries capital.[3]. Next I include a dummy variable which signifies if two countries share a land border. This is thought to be a trade determinant as it implies a combination of geographical closeness along with other kinds of cultural ties. These cultural ties could include shared language that make trade more likley. These two geographic variables fixed throughout the whole sample.

Finally, I include a variable for the same currency. Countries with the same currency are thought to have an increased incidence of trade due to reduced associated risk with transactions. If both countries have the euro then the currency dummy is at 1, and is 0 in all other cases.

The currency dummy is weighted by the number of years the country has had the euro. For any countries that adopted the euro in the group that were the first adopters (i.e. January 1st 1999), the value will be one. For any countries that joined later, the value is weighted by the number of years in the time frame that the country had the euro. This is so that the effects can be weighted by the proportion of the time series that the country had the euro. The last member to join was in 2015 and therefore has only had the euro for three years in the sample. Next, I multiply the dummy by the sum of the proportion of euro area GDP that the two countries share. This is so that the larger number of smaller countries do not bias the results. So the currency is dummy is essentially weighted by country size.

$$Currencydummy = \frac{t_n}{T} * \frac{Y_i + Y_j}{\sum_{i=1} Y_i} \tag{9}$$

The sectoral-specialization index is given by:

$$SectoralSpecializaionindex = 1/N \sum_{n}^{N} |s_{in} - s_{jn}| \tag{10}$$

Where n is number of industries and N is the sum across all industries. s is the sector in which the gap is being measured. i and j refers to the two different countries.

[3]Obtained from CEPII : $http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp$

The data to compute the sectoral-specialization is obtained from Eurostat. It is annual data from 2001-2016 and it is the breakdown of gross value added (GVA) across eight industries for each country.[4]. The difference in shares between the two countries is summated and then divided by the number of industries and the number of years. The data is annual from 2000-2016. This index was first developed by Imbs. As this study is an EU only study, there is the added benefit of having such a detailed measure. This is because this GVA series is available for such a long time series for all 28 countries.

The exogenous variables are: the multiple of log gdp and also the log difference of GDP. The log difference of GDP is used because it is thought that countries with different levels of output are less likely to have similar sectors.

Financial integration is the variable whose data varies the most in the literature. FDI is the most commonly used however, concerns about sensitivity of the results depending on the financial instrument used, means that various other measure have been used. These include IMF's capital restrictions database (Binici, Hutchison & Schindler 2010) created a database of capital restrictions. In this study, I will stick to the benchmark measure of FDI. The first reason is that it is the only measure that can act as a measure of a financial relationship between two countries and is does not work on estimating the similarity between two indicators and assuming integration[5]. Secondly, the data availability for FDI for all the countries is the sample and going back as far as 2001 is the most complete. There are however, some limitations to FDI data. The first being that it is not the most comprehensively measured indicator and therefore is subject to measurement error. For financial integration, I use FDI data to act as a measure of the financial links

[4](1.Agriculture, forestry and fishing 2.Industry (except construction) 3.Manufacturing 4.Construction 5.Wholesale and retail trade, transport, accomodation and food service activities 6.Information and communication Financial and insurance activities Real estate activities Professional, scientific and technical activities; administrative and support service activities 7. Public administration, defence, education, human health and social work activities 8.Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organizations and bodies)

[5]If measures of correlation are used rather than exact causation then the incidence of mis-specification error occurs as correlation could be caused by third part. Bilateral FDI overcomes this problem

between two countries. The series is formed by a pure summation of all the FDI that has taken place between the two countries over a 16 year period. The data is from Eurostat [6] For FDI, I introduce some exogenous variables that are new to this branch of literature. They are a group of variables that seek to capture the ease of business in goods and financial markets.

The first variable that I include is called a systemically important cross-border bank. This is an indicator that shows if the banking institutions deemed as systemically important to a country are linked. For example if a country has deemed an institution as systemically important and another country has deemed an institution as systemically important and these two institutions which are in two different countries are part of the same banking group, then the value for this country pair would be 1. The designation of banks as being systemically important is formal EU requirement as per the ESRB. These banks are deemed as systemically important to the country and is held by a bank that is systemically important to the other country.

EPL Employment Protection Law [7] The difference between the indicators for both countries is used as the variable. Employment protection law is an index of labour market flexibility in a country. The flexibility or the labour market is thought to increase the ease of conducting business in a foregin country as it is linked to the risk attached with the initial investment. Product Market Regulation (PMR) [8] is an index that is created by the OECD and reflects the ease of doing business. This index includes aspects such as administration involved with product creation. It captures the ease of doing business in a country. The ease at which a foreign country can conduct business located in another a country is a big determinant of the incidence of foreign investment.

[6] [Include footnote and metadata].

[7] This database includes data on strictness of employment protection legislation for overall, regular and temporary employment.

[8] The economy-wide indicators of policy regimes in OECD countries have been estimated for 1998, 2003, around 2008 and 2013.

These indicators summarise a wide array of different regulatory provisions across countries.

4.1 Estimation

The estimation is a system of four equations in total. There is one equation to estimate each of the endogenous equations. There are three methods used to apprach the system of equations. The instrumental variable, two staged least squares and three staged least squares with a brief description of each outlined below.

Outlined below are the four equations that are used in the system:

Business Cycle Integration Equation:

$$\rho_{ij} = \alpha_0 + \alpha_1 \text{Trade Intensity} + \alpha_2 \text{Sectoral Specialization} + \alpha_3 FDI + \varepsilon_1 \quad (11)$$

Trade Integration:

$$\begin{aligned} \text{Trade Int}_{ij} = \beta_0 + \beta_1 SectorIndex + \beta_2 FDI \\ + \beta_3 \text{Distance} + \beta_4 \text{Currency Dummy} + \beta_5 \text{Border Dummy} \\ + \beta_6 \text{EPL} + \beta_7 \text{PMR} + \varepsilon_2 \end{aligned} \quad (12)$$

Sectoral Integration Equation:

$$\begin{aligned} \text{Sectoral Specialization} = \gamma_0 + \gamma_1 FDI \\ + \gamma_2 (GDP_i - GDP_j) + \varepsilon_3 \end{aligned} \quad (13)$$

Financial Integration:

$$FDI = \delta_0 + \delta_1 (GDP_i + GDP_j) + \delta_2 CrossBorder + \varepsilon_4 \quad (14)$$

There are three approaches used to estimate the main model. These are the two staged least squares, three staged least squares and seeming unrelated regressions. The two staged least squares approach works by regressing an endogenous variable on the main dependant variable .Then, by using the residuals of this equation as the main dependant in the final estimation.

The three staged least squares approach estimates the endogenous variables first and then uses the residuals to estimate the main equation

(much like the 2sls). However the error terms from the initial regressions are used to adjust the error term in the main equation. The three staged least squares approach often provides a better model fit than the two staged least square approach and thus is often preferred. SUR approach estimates the all the equations in one go and uses the error matrix to adjust the estimated residuals.

The three approaches are similar in structure and often tend to produce similar results however it is often thought that the 3SLS is more efficient.

5 Results

Table 1 presents the coefficients of main endogenous variables in the benchmark estimation carried out in section 4. The endogenous variables are along the leftside column and the dependant variables along the header column. The effect of trade on business cycle synchronization is 7% with a pvalue of 0.01. Trade has a positive relationship on business cycle synchronization. The positive and significant result that trade has on business cycle synchronization is inline with previous studies(Frankel & Rose 1998)(Imbs 2004)(Dées & Zorell 2012).

	Cycle	Trade	Sector
Trade	0.10***		
Sector	-0.02	-0.89***	
Financial Integration	0.01	0.22***	0.04***

Table 2: Estimated Coefficients from Benchmark Estimation

The results are steady across all three specifications of the model. The coefficient remains around the 10% mark. The results is significant across all the estimations at p=0.01. The scale of the trade coefficient is strongly in line with (De Grauwe & Mongelli 2004) who also estimate a coefficient of 7%. These results contradict studies that argue that increased trade may lead to a divergence of business cycles due to trade being a sign of efficiency differences.

The strongest determinant of business cycle correlation is industry specialization which is the coefficient of the Sector variable. The sectoral differences index has a significantly negative coefficient on output correlation. This means that closer industry alignment has a positive effect on business cycle correlations. The coefficient value is negative at 20% over the all three estimations. These results are significant at 99.9% and remains constant throughout all three specifications of the model.

The second channel through which sectoral integration can promote business cycle convergence is indirectly through it's effect on trade. The coefficient of sector differences on Trade is significant and negative. This means that countries that have greater differences in industry have a lower amount of trade. This means that the relationship between sectoral integration and trade is positive. This result implies that the positive effect of intra-instrusty trade outweighs the ricardian effect. If countries that have aligned sectors are more likely to trade with each other then this implies that intra-industry trade occurs. It disproves studies that suggest that increased trade leads to divergence of industries [cite]. Furthermore, the existence of an armington aggregator is somewhat challenged in so far as that intra-industry as oppose to inter-industry trade seems to be playing such a big role.

The currency dummy is significant and positive. This result is interesting in the context of OCA. It confirms the consensus that a shared currency promotes trade. However a recent study by Frankel and Rose proved that these results with post EMU data are insignificant. This study proves that not to be the case however, the significance from these results is somewhat limited.

When looking at the importance of geography, the results are unsurprising. Closer distance is a significant and positive determinant of Trade intensity. A shared border is also positive and significant as a determinant of trade but to a smaller degree than distance. This might make sense in so far as that there is such variance in the land size of countries that the distance between three countries could be smaller than the distance between larger countries capital and its neighbour.

Finally , the results of the direct impact of financial integration on business cycle synchronization is insignificant. Financial integration is the

weakest of the endogenous variables and is the only variable that does not have a significant result to output correlation. However , there are two mechanisms that FDI has a significant impact on $_{ij}$. The impact of FDI on both sectoral-specialization and trade is significant at 99.9%. The ambiguity surrounding the final impact of financial integration is justified by the results in this study. First, is that Financial integration has the most about of variance in the data used in the literature, so the result is often sensitive to the choice of instrument as pointed out by (Dées & Zorell 2012). However, FDI is the most commonly used as a measure of financial integration. Altough intuition would suggest that if a country has embarked on FDI , then the income streams of both countries are linked and therefore likely to be correlated.

The weakness in the FDI regress and could come from the fact that returns on FDI are very temperamental and even if they do occur, in most cases, it occurs years after the initial investment was made.

The last results to comment on are the group of exogenous variables that used in the FDI The Cross border banking index count seems to play some role in determining the FDI. This is probably quite intuitive as the banks would be able to easier facilitate funds in the host country. The EPL and PMR regulations are not showing up as significant. It might be the case that given a relatively overarching EU framework, the relative differences might between the laws of member states is not enough to sway FDI from one direction to another. It would seem that institutional ease of financing is a stringer determinant that the institutional ease of business conditions. Further research would be needed to confirm this result.

The log ratio tests are listed in full in the appendix. The three staged least squares estimation has the lowest log likelihood ratio test and performs the best. The inclusion of the EPL and PMR increases the model fit .

5.1 Sensitivity of Cycle Extraction Method

To investigate the impact that cycle sensitivity has on the estimation the model is re-run with the dependant variable that uses the Hodrick-Prescott filter to extract the real business cycles from GDP. The first step is to apply

the filter to log seasonally adjusted GDP series. For the lambda which is the cyclical penalizing parameter, I use the value of 1600 which is the standard in the literature for quarterly data (Ravn & Uhlig 2002). Once I have extracted the cycles, I compute the pairwise correlation over the 17 year period for all the unique country pairs of the EU.

The figure above shows the density of pairwise correlations between zero and one.

The results of the Hodrick-Prescott filter are presented in the table below.

	Cycle	Trade	Sector
Trade	0.06***		
Sector	-0.03	-0.89***	
Financial Integration	-0.01**	0.22***	0.04***

Table 3: Estimated Coefficients from Estimation using the dependant variable of HP Filtered Cycles

The first point to make is that the coefficient on the trade variable remains at a similar value as it does for the estimation with the UCM. Furthermore, the result remains significant at p=0.01. The main tenets of the results do remain broadly unchanged with results of trade remaining significant and remaining in its scale.

Other results that remain unchanged are all the components of the trade equation (2). The currency result remains significant at p=0.1. The value of the coefficients also remain at around the same value.

The use of the HP filter causes some changes to the results previously obtained. The first is that the coefficient of sectoral-specialization remains significant and negative, however there is a sharp drop in the value of the coefficient. It falls from 0.18 to 0.06. The coefficient scales remain the same for the effect of trade on cycles.

The most significant of the changes to the results in the baseline estimation is that FDI now becomes significant in the estimation and furthermore the value of the coefficient increases from 0.01 to 0.03. The lack of robustness with the financial integration variable might not be the most surprising.

The coefficient of FDI appears to be very significant when using the HPFilter cycle correlation as the dependant variable at p=0.01 but yet with the UCM show a reduced level of significance at p=0.1. This movement in the significance is somewhat surprising and there are two takeaways from it. First is that it shows the lack stability in the results achieved for the effect of FDI. Secondly, it shows that care must be taken for cycle extraction methods as it shows that they can play a part in effecting the final result.

6 Conclusion

Understanding the determinants of output synchronisation is important to help deliver stable currency unions. One factor that is thought to increase synchronisation is trade. This study investigates the relationship between trade and output synchronisation. By using a system of endogenous equations, the effects of trade on output synchronization are empirically estimated. The system of equations allows for the simultaneous estimation of the impact of Sectoral integration and financial integration both on trade and output synchronisation. The results show a significant and positive relationship between trade and correlation of business cycles. The existence of intra-industry trade as a mechanism for promotion of trade is confirmed.

The addition of the different cyclical extraction method has not had a significant impact on the main tenets of the result however it understates the mechanism of intra-industry trade as a mechanism of output convergence as the coefficient is much lower when using the benchmark HP Filter. The second thing of importance that the cyclical extraction method uncovers is to continue to the scale of the ambiguity surrounding the impact of financial integration on business cycle synchronization.

The results of the benchmark estimation showed that the effect of financial integration on output convergence to be insignificant, however when replacing the dependant variables with the correlation between cycles extracted using the Hodrick-Prescott filter, the impact of financial integration becomes significant at 99.9% and furthermore the coefficient is positive at 3%. This study shows that previous literature using the hodrick prescott filter to estimate business cycles have overstated the positive impact that financial

integration has on business cycle synchronization. Further research will be needed to provide a conclusive answer to the role of financial integration in determining business synchronization.

The implications of this research on further integration of the EU suggest that the aligning of industries across the member states is the most direct way in which to achieve convergence both through promoting trade between member states and promoting synchronization directly.

(Gallant & Golub 1984) (Baxter & King 1999) (Glick & Rose 2015) (Davis 1995) (De Grauwe & Macchiarelli 2015) (Harvey 1990) (Zellner & Theil 1962)

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A Appendix

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Cycle: (Intercept)	0.17	0.00	0.12	0.01	−0.20	0.05
	(0.10)	(0.10)	(0.09)	(0.12)	(0.11)	(0.09)
Cycle: Tradeint	0.04***	0.05***	0.05***	0.06***	0.08***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Cycle: Sector	−0.06**	−0.05*	−0.06**	−0.04	−0.01	−0.04
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Trade: (Intercept)	21.58***	22.09***	22.06***	18.67***	19.03***	19.03***
	(0.74)	(0.73)	(0.73)	(0.70)	(0.68)	(0.69)
Trade: Sector	−0.42**	−0.61***	−0.61***	−0.68***	−0.90***	−0.89***
	(0.14)	(0.14)	(0.14)	(0.12)	(0.12)	(0.12)
Trade: Distance	−1.20***	−1.25***	−1.24***	−0.96***	−1.01***	−1.01***
	(0.10)	(0.10)	(0.10)	(0.09)	(0.09)	(0.09)
Trade: Currency	5.61***	5.70***	5.69***	2.03*	1.91*	1.81
	(1.00)	(0.98)	(0.99)	(0.94)	(0.91)	(0.93)
Trade: BorderShared	0.58*	0.46	0.50*	0.42*	0.33	0.38
	(0.24)	(0.24)	(0.24)	(0.21)	(0.20)	(0.20)
Sector: (Intercept)	3.69**	4.87***	4.87***	6.44***	8.10***	8.11***
	(1.18)	(1.18)	(1.18)	(1.39)	(1.38)	(1.38)
Sector: Diffgdp	0.02	0.03	0.03	0.02	0.04*	0.04*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Sector: Multgdp	−0.86*	−1.26**	−1.26**	−1.76***	−2.35***	−2.35***
	(0.40)	(0.40)	(0.40)	(0.46)	(0.46)	(0.46)
Cycle: FDI				−0.01**	−0.02***	−0.01*
				(0.00)	(0.00)	(0.00)
Trade: FDI				0.20***	0.22***	0.22***
				(0.02)	(0.02)	(0.02)
Trade: EPL				−0.10*	−0.09*	−0.10*
				(0.05)	(0.04)	(0.04)
Trade: PMR				0.03	0.06	0.05
				(0.05)	(0.04)	(0.04)
Sector: FDI				0.03***	0.04***	0.04***
				(0.01)	(0.01)	(0.01)
Financial: (Intercept)				−15.11***	−15.30***	−15.29***
				(1.68)	(1.68)	(1.68)
Financial: BankShared				1.13*	1.15*	1.15*
				(0.51)	(0.50)	(0.50)
Financial: Sumgdp				1.45***	1.46***	1.46***
				(0.11)	(0.11)	(0.11)
Cycle: R^2	0.13	0.11	0.13	0.13	0.09	0.14
Trade: R^2	0.50	0.50	0.50	0.64	0.63	0.63
Sector: R^2	0.01	0.01	0.01	0.05	0.04	0.04
Cycle: Adj. R^2	0.13	0.11	0.12	0.12	0.09	0.13
Trade: Adj. R^2	0.50	0.50	0.50	0.63	0.62	0.62
Sector: Adj. R^2	0.01	0.01	0.01	0.04	0.04	0.03
Num. obs. (total)	1131	1131	1131	1508	1508	1508
Financial: R^2				0.35	0.35	0.35
Financial: Adj. R^2				0.35	0.35	0.35

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 5: Results from Estimation using HP filtered cycles

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Cycle: (Intercept)	-0.35^{**}	-0.63^{***}	-0.36^{**}	-0.51^{***}	-0.87^{***}	-0.39^{**}
	(0.13)	(0.13)	(0.11)	(0.15)	(0.15)	(0.12)
Cycle: Tradeint	0.08^{***}	0.10^{***}	0.08^{***}	0.09^{***}	0.12^{***}	0.08^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Cycle: Sector	-0.03	-0.00	-0.03	-0.00	0.04	-0.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Trade: (Intercept)	21.58^{***}	22.25^{***}	22.22^{***}	18.67^{***}	19.15^{***}	19.17^{***}
	(0.74)	(0.72)	(0.73)	(0.70)	(0.68)	(0.69)
Trade: Sector	-0.42^{**}	-0.62^{***}	-0.61^{***}	-0.68^{***}	-0.91^{***}	-0.89^{***}
	(0.14)	(0.14)	(0.14)	(0.12)	(0.12)	(0.12)
Trade: Distance	-1.20^{***}	-1.27^{***}	-1.26^{***}	-0.96^{***}	-1.03^{***}	-1.03^{***}
	(0.10)	(0.10)	(0.10)	(0.09)	(0.09)	(0.09)
Trade: Currency	5.61^{***}	5.89^{***}	5.86^{***}	2.03^{*}	2.08^{*}	1.91^{*}
	(1.00)	(0.97)	(0.99)	(0.94)	(0.90)	(0.92)
Trade: BorderShared	0.58^{*}	0.36	0.44	0.42^{*}	0.23	0.34
	(0.24)	(0.23)	(0.24)	(0.21)	(0.20)	(0.20)
Sector: (Intercept)	3.69^{**}	4.87^{***}	4.88^{***}	6.44^{***}	8.12^{***}	8.13^{***}
	(1.18)	(1.18)	(1.18)	(1.39)	(1.38)	(1.38)
Sector: Diffgdp	0.02	0.03	0.03	0.02	0.04^{*}	0.04^{*}
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Sector: Multgdp	-0.86^{*}	-1.26^{**}	-1.26^{**}	-1.76^{***}	-2.35^{***}	-2.35^{***}
	(0.40)	(0.40)	(0.40)	(0.46)	(0.46)	(0.46)
Cycle: FDI				-0.01^{*}	-0.02^{***}	-0.01
				(0.01)	(0.01)	(0.00)
Trade: FDI				0.20^{***}	0.22^{***}	0.22^{***}
				(0.02)	(0.02)	(0.02)
Trade: EPL				-0.10^{*}	-0.09^{*}	-0.10^{*}
				(0.05)	(0.04)	(0.04)
Trade: PMR				0.03	0.07	0.06
				(0.05)	(0.04)	(0.04)
Sector: FDI				0.03^{***}	0.04^{***}	0.04^{***}
				(0.01)	(0.01)	(0.01)
Financial: (Intercept)				-15.11^{***}	-15.34^{***}	-15.32^{***}
				(1.68)	(1.68)	(1.68)
Financial: BankShared				1.13^{*}	1.14^{*}	1.16^{*}
				(0.51)	(0.50)	(0.50)
Financial: Sumgdp				1.45^{***}	1.46^{***}	1.46^{***}
				(0.11)	(0.11)	(0.11)
Cycle: R^2	0.16	0.12	0.15	0.14	0.08	0.16
Trade: R^2	0.50	0.50	0.50	0.64	0.63	0.63
Sector: R^2	0.01	0.01	0.01	0.05	0.04	0.04
Cycle: Adj. R^2	0.15	0.11	0.15	0.14	0.07	0.15
Trade: Adj. R^2	0.50	0.49	0.50	0.63	0.62	0.62
Sector: Adj. R^2	0.01	0.01	0.01	0.04	0.03	0.03
Num. obs. (total)	1131	1131	1131	1508	1508	1508
Financial: R^2				0.35	0.35	0.35
Financial: Adj. R^2				0.35	0.35	0.35

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 4: Results from Benchmark Estimation

Country	Selected Model	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
AUSTRIA	4	-12.05	-12.028	-12.039	-12.262	-12.249	-11.829	-11.819	-11.806	-9.0845
BELGIUM	4	-12.397	-12.299	-12.231	-12.551	-12.073	-12.071	-12.058	-9.0851	
BULGARIA	4	-11.072	-11.149	-11.149	-11.234	-11.221	-11.067	-11.08	-11.067	-9.3501
CROATIA	5	-11.345	-11.345	-11.395	-11.518	-11.505	-11.348	-11.356	-11.344	-9.5486
CYPRUS	4	-10.825	-10.946	-10.946	-11.071	-11.058	-10.871	-10.879	-10.866	-9.2508
CZECH	4	-11.575	-11.459	-11.459	-11.68	-11.667	-11.363	-11.377	-11.364	-9.1949
DENMARK	4	-11.131	-11.131	-11.131	-11.167	-11.154	-10.951	-10.963	-10.95	-9.0698
ESTONIA	4	-9.5149	-9.4966	-9.4981	-9.7549	-9.7419	-9.3284	-9.362	-9.3495	-8.9033
FINLAND	4	-10.487	-10.493	-10.507	-10.731	-10.718	-10.386	-10.375	-10.362	-8.9569
FRANCE	4	-12.702	-12.594	-12.572	-12.959	-12.946	-12.389	-12.377	-8.8043	
GERMANY	4	-11.428	-11.444	-11.499	-11.508	-11.495	-11.072	-11.061	-11.048	-8.6999
GREECE	4	-10.26	-10.373	-10.373	-10.545	-10.532	-10.267	-10.303	-10.291	-8.7556
HUNGARY	4	-11.113	-11.182	-11.182	-11.31	-11.297	-11.07	-11.102	-11.09	-9.1095
IRELAND	4	-8.7293	-8.7706	-8.8085	-8.8708	-8.6324	-8.6347	-8.6223	-8.0944	
ITALY	4	-11.948	-11.737	-11.734	-12.195	-12.182	-11.595	-11.603	-11.591	-8.8031
LATVIA	4	-9.9028	-9.8452	-9.8452	-10.147	-10.134	-9.6394	-9.725	-9.7125	-9.0468
LITHUANIA	4	-9.3973	-9.4595	-9.4595	-9.6021	-9.5891	-9.3259	-9.3466	-8.7602	
LUXEMBOURG	3	-9.9041	-9.9852	-10.035	-10.034	-9.7863	-9.7867	-9.7742	-8.895	
MALTA	4	-10.021	-10.098	-10.098	-10.121	-10.108	-9.9174	-9.9255	-9.896	-9.2813
NETHERLANDS	4	-11.765	-11.823	-11.823	-11.936	-11.923	-9.3877	-11.678	-11.666	-8.9615
POLAND	1	-11.248	-11.216	-11.221	-11.047	-11.034	-11.022	-11.012	-10.999	-9.0316
PORTUGAL	4	-11.529	-11.573	-11.573	-11.628	-11.615	-11.453	-11.475	-11.463	-9.0515
ROMANIA	3	-9.881	-9.988	-10.027	-10.018	-10.005	-9.9089	-9.9176	-9.9051	-8.808
SLOVAKIA	4	-9.8675	-9.9329	-9.9704	-10.039	-10.027	-9.8426	-9.8438	-9.8313	-8.9095
SLOVENIA	4	-11.074	-10.898	-10.898	-11.15	-11.137	-10.788	-10.801	-10.788	-9.2785
SPAIN	4	-13.471	-12.656	-12.656	-13.218	-13.205	-12.772	-12.773	-12.761	-8.8757
SWEDEN	4	-11.076	-11.085	-11.092	-11.303	-11.29	-10.858	-10.861	-10.848	-9.0268
UK	4	-12.486	-12.246	-12.246	-12.419	-12.407	-9.7892	-12.097	-12.084	-8.7807

Table 6: Akaike Information Criterion for nine models estimated for the decomposition (N:B Missing numbers need re-esetimation)