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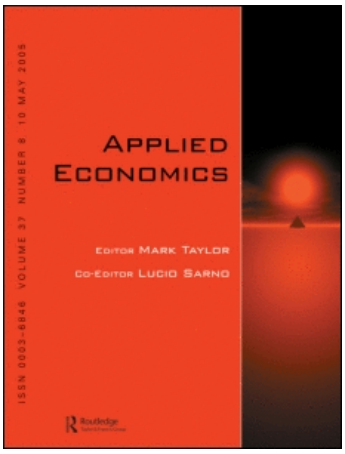

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Business-cycle synchronization in the EMU

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Business-cycle synchronization in the EMU

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This article asks whether the business cycles of the EU countries have become more or less synchronized after the introduction of the euro. Our findings show that *all* countries in our EU sample are better synchronized with the EMU-wide economy in the post-EMU period than they were before the euro. We also show that this increase in synchronization is present in all components of aggregate demand, as well as two supply-side variables, but it is more pronounced in the trade components (imports and, particularly, exports). It is also shown that the increase in trade within the EMU area is at least partly responsible for the increase in cyclical synchronization.

I. Introduction

The theory of Optimum Currency Areas (OCA) has long stressed the importance of the synchronization in cyclical economic activity for members of a monetary union.[1] In particular, the higher the correlation of business cycles, the lower the stabilization cost of giving up an independent monetary policy. Intuitively, if a member economy's business cycle is very highly correlated with the union-wide cyclical output, then monetary policy conducted by the common central bank will be a very close substitute for the country's own independent monetary policy. If, on the other hand, the economy's business cycle is weakly correlated (or, worse, negatively correlated) with the union's cyclical output, then the common monetary policy will be a poor substitute for that economy's own independent monetary policy, and may end up actually being destabilizing.

More recently, however, it has been suggested that business-cycle synchronization may be more than just an exogenous OCA criterion, its role in the process being more complicated. Beginning with Frankel and Rose (1998), it has been proposed that cyclical synchronization may be *endogenous*, in the sense that it is itself affected by membership in a monetary union. The effect of the creation of a monetary union on the cyclical synchronization could in theory be either positive or negative. In fact, it crucially depends on the nature of trade. If trade among the countries joining the monetary union is mostly intra-industry, then is more likely that demand and sectoral shocks will affect these countries in a similar way. Then, the removal of barriers with the completion of a single market and elimination of the exchange-rate risk will reinforce these tendencies. As a result, countries will become more synchronized. On the contrary, if trade is mostly inter-industry, it is more likely that the member countries will become

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[1] The theory was first developed by Mundell (1961) and extended by the contributions of McKinnon (1963) and Kenen (1969). For some recent contributions see Alesina and Barro (2002), Alesina *et al*. (2002) and Corsetti and Pesenti (2002).

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more specialized, and so end up being less synchronized and subject to more frequent asymmetric shocks.[2] Recent empirical research has found that the positive effect will dominate.[3]

In this article we first ask whether the business cycles of EU countries have actually become more or less synchronized after the birth of the EMU. Our findings imply that there has been a remarkably widespread increase in the degree of cyclical synchronization. We then ask why this may have been the case, and we show that an increase in trade is mainly responsible.

The article is organized as follows. In the next section we present a brief literature review of the importance of business-cycle synchronization, particularly for the EMU. In Section III we compute various measures of cyclical correlations with EMU-wide aggregates for 12 EU countries and compare their values for the pre-EMU and post-EMU periods. Section IV investigates the role of trade in the determination of these correlations, and Section V contains the main policy implications and conclusions.

II. Literature Review

The literature on business cycle synchronization in Europe (and how it compares to the United States) is vast. Bayoumi and Eichengreen (1993) found that demand and supply shocks are more correlated between states in the US than in Europe, and that the US states adjust more quickly to economic fluctuations than European countries. Using a different methodology, Wynne and Koo (2000) also found that business cycles are more aligned in the United States than in the Eurozone (of 11 members). Other authors, such as Clark and Shin (1998) and Clark and Van Wincoop (2001), focused on both within-country and cross-country synchronization. They found that average within-country cyclical output correlations are larger than cross-country correlations, for both the United States and European countries (and again that business cycles are more synchronized in the United States than in Europe). Recently, Peiró (2004), examining the existence of asymmetries in industrial production in seven European countries for the period 1957 to 1998, finds that several of these countries have aligned business cycles.

More closely related to the approach of the present study, other researchers have looked at changes in correlation patterns over time. Angeloni and Dedola (1998) found that the output correlation between Germany and other European countries has clearly increased during 1993–1997. Fatás (1997), using annual employment growth rates for regions of France, Germany, Italy and United Kingdom, found that the average correlation with aggregate EU-12 employment growth has increased from 1966–1979 to 1979–1992. Furceri and Karras (2006), analysing cyclical output for the EU-15 countries found that business-cycle synchronization has also increased for many countries from 1980–1991 to 1992–2003.

The literature has also considered the implications of the EMU for fiscal policy. In fact, unlike other monetary unions, the EMU does not have a central fiscal authority, and stabilization of asymmetric shocks is left to the responsibility of the domestic fiscal policies of the EMU members. However, the literature has shown that the ability of the EMU members' national fiscal policies to smooth asymmetric shocks is very modest.[4] One implication of this is that business-cycle synchronization is extremely important in the EMU not only because it reduces the probability of asymmetric shocks, but also because it makes it plausible to expect the European Central Bank (ECB) to respond to aggregate shocks and to implement stabilizing interventions with greater ease.

The literature is much thinner on whether the single currency has actually made the EU countries more or less similar, at least in business-cycle terms. Undoubtedly, one reason for this scarcity is that the euro has existed for a relatively short time – too short to answer the question decisively. The obvious importance of the issue, however, has attracted the attention of the press, but with contributions that are not always the most pertinent. On 30 September 2004, for example, the Economist in the article 'Europe: Growing Apart' reported that 'euro countries seem to be out of sync with each other. The divergence in the growth rates of euro members conceals much larger, and widening, differences in the components of economic growth: changes in consumption, investment, government, spending and net exports' (emphasis added). But this

[2] Krugman (1991) suggests that trade integration will lead to regional concentration of industrial activities, implying that the kind of trade that will prevail in the monetary union will be at the inter-industry level.
[3] See Artis and Zhang (1995), Frankel and Rose (1998), Rose and Engel (2002) and Rose (2004).
[4] See, e.g., Galì and Perotti (2003), Furceri (2005).

Table 1. GDP business-cycle syncronization

		Pre-EMU			Post-EMU			
		Differencing	HP	BP	Differencing	HP	BP	Change
EMU	Austria	0.541	0.672	0.741	0.584	0.886	0.719	+++
	Belgium	0.608	0.683	0.699	0.739	0.848	0.808	+++
	Finland	0.237	0.258	0.437	0.447	0.716	0.493	+++
	France	0.496	0.831	0.868	0.799	0.983	0.945	+++
	Germany	0.730	0.764	0.796	0.800	0.963	0.944	+++
	Greece	−0.183	−0.061	−0.345	0.040	0.205	0.190	+++
	Italy	0.454	0.743	0.713	0.707	0.925	0.898	+++
	Netherlands	0.569	0.614	0.773	0.747	0.927	0.824	+++
	Spain	0.254	0.476	0.579	0.641	0.849	0.631	+++
NonEMU	Denmark	0.134	0.575	0.445	0.501	0.831	0.482	+++
	Sweden	−0.043	−0.011	−0.050	−0.136	0.071	0.072	−++
	UK	0.187	0.551	0.228	0.576	0.948	0.823	+++

Notes: (+) Means increase, (−) means decrease. Pre-EMU: From April 1993 to April 1998. Post-EMU: From January 1999 to January 2004.

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conclusion was based on a study that simply compared the standard deviations of quarterly growth rates for some of the EMU countries, and didn't even examine the correlations with EMU wide income, or how these have changed since the introduction of the euro. Here we show that the answer is quite different if the question is asked in the right way.

We are aware that the euro's youth limits our ability to claim that the question is settled once and for all, but we think it is important to start exploring the answer, even if for now it may be only provisional.

III. Synchronization Before and After the Euro

We use quarterly data of real GDP from the Organization for Economic Cooperation and Development (OECD's) Main Economic Indicators for 12 European countries: Austria, Belgium, Denmark, Finland, French, Germany, Greece, Italy, the Netherlands, Spain, Sweden and United Kingdom. We rely on three different detrending methods in order to compute the cyclical component of economic activity: simple differencing, the Hodrick–Prescott filter, and the Band–Pass filter.[5]

Unlike some other works in the literature, we do not compute average cross-country business-cycle correlations, but the correlation between the cyclical output of each individual country with the EMU-wide cyclical output. Since the monetary policy of the ECB is targeted to aggregate euro-area shocks, we believe that this is a more appropriate measure.

Table 1 reports the estimated correlations of each country's cyclical (detrended) GDP with EMU-wide cyclical GDP for the three detrending methods and two different time periods: pre-EMU (from April 1993 to April 1998) and post-EMU (from January 1999 to January 2004). Looking at the pre-EMU estimates first, the correlations range from highly positive (in Germany, France, Italy) to weakly positive (in Denmark, United Kingdom) to negative (in Sweden, Greece). Note that, while the three detrending methods give generally different correlation estimates, the relative magnitudes of synchronization implied by the three techniques are quite similar. We also note that in the period 1993 to 1998, Denmark, Sweden and United Kingdom had consistently and significantly lower correlations than the other countries (except Greece – see footnote 5) which explains their decision stay out of the monetary union: they correctly calculated that the stabilization costs of adopting the common currency would be too high.[6] Looking at the post-EMU panel of Table 1, the 1999–2004 correlations also exhibit sizable variability, but perhaps less so than the pre-EMU estimates. More specifically, correlations now range from very high (in Germany, France, Italy and the Netherlands) to virtually zero (in Greece and Sweden). However, the most striking

[5] Appendix A provides a more detailed discussion about these three methods.
[6] Greece was also facing high stabilization costs, as implied by the negative correlation estimates, but its decision (indeed, eagerness) to adopt the euro can be explained by the common currency's larger anticipated benefit of reducing the country's stubborn inflation bias.

Table 2. Business-cycle syncronization (GDP-components, HP)

		Pre-EMU					Post-EMU					
		C	*I*	*G*	IMP	EXP	*C*	*I*	*G*	IMP	EXP	Change
EMU	Austria	0.266	0.477	0.108	0.066	0.677	0.743	0.613	−0.636	0.268	0.867	++−++
	Belgium	0.323	0.130	0.066	0.855	0.672	0.836	0.796	−0.246	0.894	0.884	++−++
	Finland	0.190	0.237	−0.243	0.810	0.626	0.680	0.789	0.432	0.795	0.816	+++−+
	France	0.842	0.644	0.523	0.891	0.941	0.762	0.961	0.771	0.913	0.977	−++++
	Germany	0.548	0.733	0.763	0.911	0.797	0.908	0.957	0.661	0.949	0.954	++−++
	Greece	0.212	0.099	−0.450	0.064	0.072	0.042	0.255	0.109	0.665	0.673	−++++
	Italy	0.150	0.383	0.514	0.944	0.693	0.886	0.706	0.693	0.852	0.879	+++−+
	Netherlands	0.229	0.486	−0.133	0.871	0.646	0.771	0.752	0.730	0.938	0.960	+++++
	Spain	0.444	0.725	0.072	0.789	0.620	0.799	0.919	−0.209	0.812	0.754	++−++
NonEMU	Denmark	−0.063	0.626	0.273	0.790	−0.055	0.379	0.186	0.580	0.641	0.837	+−+−+
	Sweden	−0.030	0.438	0.021	0.492	0.381	0.296	0.307	0.061	0.690	0.444	+−+++
	UK	−0.354	0.245	−0.043	0.078	0.308	0.587	0.455	−0.131	0.803	0.842	++−++

Notes: (+) Means increase; (−) means decrease. Pre-EMU: from April 1993 to April 1998. Post-EMU: From January 1999 to January 2004.

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finding of Table 1 is that the estimated correlations have increased in every single country: *all* countries in the sample were better synchronized with the EMU-wide economy in the period 1999 to 2004 than during 1993 to 1998. Moreover this result is very robust with respect to the different detrending methods.

It is worth being explicit about what this finding implies and what it does not. It clearly implies that all these economies, in terms of business cycle synchronization, have been more similar after the euro than they were before the euro. However, remarkable as it is, this finding does not (necessarily) imply that the euro has caused the greater synchronization. Indeed, and somewhat surprisingly, the countries that seem to experience the highest increase in synchronization with EMU-wide income are two that are not part of the EMU: Denmark and especially, United Kingdom.

It is also interesting to ask whether a similar pattern can be detected for some of the broader components of aggregate income. In Table 2 we present the correlations of cyclical components for Consumption (*C*), Investment (*I*), Government expenditure (*G*), Imports (IMP) and Exports (EXP).[7]

Overall, the results of Table 2 are qualitatively very similar to those reported by Table 1. Once again, the components of the three noneuro countries (and Greece) have some of the lowest estimated correlations during 1993–1998, which is consistent with our earlier observation. More important for our purposes, however, is that the overwhelming majority of estimated correlations are higher for the post-EMU period: most (48 out of 60) of these components of aggregate demand are better synchronized with the corresponding EMU-wide values after the euro, than before.

It is also instructive to compare the changes in correlations for the different components of aggregate demand (Table 3). Then, a clear distinction emerges between Exports, for which correlations increase in all countries, and Government purchases, for which correlations are higher in 7 of the 12 economies (the smallest number than any of the components). The evidence is clearly suggesting that the remarkable increase in overall synchronization is more due to trade factors and less (if at all) to fiscal policy coordination.[8]

Higher synchronization in EMU is also confirmed by data on unemployment. Table 4 looks at the correlations between each country's unemployment rate and the EMU-wide unemployment rate. It is again evident that for all countries unemployment rates are more synchronized in the period post-EMU

[7] This table shows only the results obtained with the HP (1600) filter. In Appendix B we report the results obtained with the other two detrending methods.

[8] It may even suggest that a common monetary policy has necessitated a divergence of fiscal policies in order to deal with the surviving asymmetric shocks. It is important to note, however, that although government expenditure is not very synchronized among the EMU (and more generally the EU) countries, several works in the literature such as Esteve *et al.* (2005), find convergence in the government expenditure level and its components in the EU.

Table 3. Correlation syncronization

	GDP	*C*	*I*	*G*	IMP	EXP
GDP	1					
C	0.6646515	1				
I	0.6086646	0.7164073	1			
G	0.4348434	0.2900566	0.3870265	1		
IMP	0.4445615	0.4833662	0.4774698	0.5252234	1	
EXP	0.7284791	0.7855529	0.5069462	0.396772	0.4938395	1

Note: *C* = consumption, *I* = investments, *G* = government expenditure, IMP = imports, EXP = exports.

Table 4. Unemployment rate correlation

		Pre-EMU	Post-EMU	Change
EMU	Austria	−0.071	0.506	+
	Belgium	0.046	0.932	+
	Finland	0.402	0.668	+
	France	0.840	0.985	+
	Germany	0.233	0.541	+
	Greece	−0.585	0.356	+
	Italy	−0.284	0.508	+
	Netherlands	0.531	0.690	+
	Spain	0.560	0.925	+
NonEMU	Denmark	0.264	0.474	+
	Sweden	0.823	0.857	+
	UK	0.350	0.695	+

Notes: (+) Means increase; (−) means decrease. Pre-EMU: From April 1993 to April 1998. Post-EMU: From January 1999 to January 2004.

(from January 1999 to January 2004) than in the pre-EMU period (from April 1993 to April 1998). In particular, the highest increase in synchronization has occurred for countries such as Italy and Greece, which are characterized by chronically high and persistent unemployment rates.

Finally, higher synchronization also emerges with respect to labour costs. As Table 5 reports, for the majority of countries the unit labour cost has become more synchronized in the post-EMU period. We conclude that our result is valid for both demand-side and supply-side variables.[9]

IV. Trade and Business-Cycle Synchronization in the EMU

This section examines the extent to which the remarkable increase in business-cycle synchronization documented here can be attributed to increased trade among the countries in the sample.

There is a significant and growing interest in the determinants of business-cycle comovements. One of the most analysed candidates is bilateral trade. In fact, current account transactions have long been recognized as a channel for the transmission of economic fluctuations across countries. Frankel and Rose (1988) and Canova and Dellas (1993) provided empirical evidence that bilateral trade is responsible for business-cycles synchronization.[10] Although the size of this effect has been questioned (Gruben *et al*., 2002; Inklaar *et al*., 2005), its existence has become part of the conventional wisdom.

As another possible determinant of synchronization, recent research has focused on the similarity in industrial sectors (Imbs, 1998, 1999, 2004). In another contribution, Stockman (1998) distinguished between sectoral and aggregate shocks. A third approach considers currency union as determinant of synchronization (Rose and Engel, 2002). All these determinants have been studied together by Baxter and Kouparitsas (2004). Using the Extreme–Bounds Analysis proposed by Leamer (1983) and applied in an influential growth study by Levine and Renelt (1992), Baxter and Kouparitsas (2004) examined these three determinants and concluded that bilateral trade is extremely robust.

More recently, Inklaar *et al*. (2005), estimating a multivariate model including variables capturing specialization, financial integration, and similarity of economic policies, confirm that trade intensity significantly affects business-cycle synchronization, even if the effect is much smaller than previously reported by Frankel and Rose (1988).

On the contrary, industrial similarity and currency-union membership are not generally found to be robust to different model specifications. As a result, we elect here to focus on trade as the most promising determinant of the increase in synchronization established above.

[9] We are grateful to an anonymous referee for raising this issue.
[10] This empirical evidence has been confirmed by more recent studies. See, for example, Sharma and Chua (2000), Otto *et al*. (2001), Calderón *et al*. (2002), Inklaar *et al*. (2005), De Grauwe and Mongelli (2005).

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Table 5. Unit labour cost business-cycle syncronization

		Pre-EMU			Post-EMU			
		Differencing	HP	BP	Differencing	HP	BP	Change
EMU	Austria	0.364	0.443	0.569	0.021	0.787	0.636	−++
	Belgium	0.545	0.581	0.655	0.603	0.717	0.734	+++
	Finland	0.211	0.474	0.422	0.134	0.465	0.479	−−+
	France	0.361	0.618	0.647	0.619	0.935	0.850	+++
	Germany	0.811	0.884	0.911	0.849	0.717	0.817	+−−
	Greece	−0.105	0.032	0.099	−0.250	−0.350	0.286	−−+
	Italy	0.554	0.583	0.634	0.662	0.808	0.831	+++
	Netherlands	0.388	−0.224	0.308	0.816	0.925	0.872	+++
	Spain	0.110	0.144	0.135	0.124	0.746	0.660	+++
NonEMU	Denmark	0.489	0.327	0.583	0.257	0.116	0.063	−−−
	Sweden	−0.076	0.119	−0.170	0.231	0.398	0.247	−++
	UK	0.095	−0.381	−0.124	0.131	0.042	0.572	+++

Notes: (+) Means increase; (−) means decrease. Pre-EMU: From April 1993 to April 1998. Post-EMU: From January 1999 to January 2004.

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Empirical methodology

Our purpose is to estimate the effect of within-EMU trade on business-cycle synchronization. The model that we estimate is the following:

$$\mathrm{Corr}\left(c_t^{\mathrm{EMU}}, c_t^i\right) = \alpha + \beta\,\mathrm{Trade}_{i,\,\mathrm{EMU}} + \varepsilon_{i,\,t} \qquad (1)$$

where $\mathrm{Corr}(c_t^{\mathrm{EMU}}, c_t^i)$ denotes the correlation between EMU-wide and country i's cyclical output over time span t. The variable *Trade* is measured by the natural logarithm of trade intensity between the country and the EMU as a whole.

We use two different measures of trade intensity. The first one captures the relative importance of the EMU countries relative to the Rest of the World (RoW).

$$\mathrm{Trade}^{*}_{i,\,\mathrm{EMU}} = \frac{\left(X_{i,\,\mathrm{EMU}} + M_{i,\,\mathrm{EMU}}\right)}{\left(X_{i,\,\mathrm{RW}} + M_{i,\,\mathrm{RW}}\right)} \qquad (2)$$

where $X_{i,\mathrm{EMU}}$ and $M_{i,\mathrm{EMU}}$ denote, respectively, exports and imports between country i and the EMU; $X_{i,\mathrm{RW}}$ and $M_{i,\mathrm{RW}}$ indicate, respectively, exports and imports between country i and the RoW.

The second measure is total trade with the EMU as a fraction of the country's GDP (a usual measure of trade openness):

$$\mathrm{Trade}^{**}_{i,\,\mathrm{EMU}} = \frac{\left(X_{i,\,\mathrm{EMU}} + M_{i,\,\mathrm{EMU}}\right)}{\mathrm{GDP}_i} \qquad (3)$$

These two ratios are obtained by aggregating bilateral trade data from the OECD's *Monthly Foreign Trade Statistics* (for annual trade data from 1993 to 2003) and from the OECD's *Main Economic Indicators* (for \GDP data).

As has been pointed out by Frankel and Rose (1998), Ordinary Least Square (OLS) estimation is inappropriate for Equation 1, since trade could also depend on the degree of synchronization and integration with the EMU. Thus, to identify the effect of within-EMU trade on business-cycle synchronization, we need to instrument Trade. It is widely recognized that 'gravity' variables provide satisfactory instruments for bilateral trade. However, in our analysis we are concerned with trade within the EMU. Since in this context the dummy variables for linguistic distance and borders are not so meaningful, we will consider just distance as instruments. In particular, we use two different measures of distance. The first is the average distance between a single country and the EMU countries; the second one is the maximum distance between the single country and the EMU countries.

Results

We start analysing the results concerning the first stage estimation. Table 6 shows that average and maximum distances are both highly significant and strongly negatively correlated with trade in the EMU. This first-stage estimation fits relatively well both when EMU trade is normalized by total trade and when is normalized by nominal GDP. In particular, EMU trade normalized by total trade is better instrumented by maximum distance, and EMU trade normalized by GDP is better instrumented by average distance. The *F*-statistics (for these two estimates) suggest that the bias of the IV

Table 6. First stage estimates (instrument for trade with EMU)

	Trade with the EMU			
	Normalized by total trade		Normalized by GDP	
Log of average distance	−0.404	(−3.01)	−1.15378	(−3.57)
R^2	0.26		0.37	
F-Statistics	9.03		12.73	
Log of maximum distance	−0.781	(−3.98)	−1.61946	(−2.91)
R^2	0.42		0.24	
F-Statistics	15.82		8.45	

Notes: *t*-Statistics in parenthesis. Intercepts not reported. Annual trade data for 12 European countries, from 1992 to 2003 split into two subsamples periods. Sample size = 24.

Table 7. IV Estimates (effect of trade on cyclical income correlation)

Detrending	Normalized by total trade		Normalized by GDP	
HP	1.5219	(2.37)	0.7580	(2.53)
BP	1.5739	(2.29)	0.8139	(2.56)
Differencing	1.4530	(2.32)	0.7264	(2.66)

Notes: Instrumental variable for trade normalized by total trade is log of maximum distance; Instrumental variable for trade normalized by GDP is log of average distance; *t*-statistics in parenthesis, all significant at 5%. Intercepts not reported.

Table 8. IV Estimates for different periods (effect of trade on cyclical income correlation (HP))

Detrending	Normalized by total trade		Normalized by GDP	
Pre-EMU	1.7111	(1.85)*	0.8605	(1.75)
Post-EMU	1.3351	(1.70)	0.6662	(1.73)

Notes: Instrumental variable for trade normalized by total trade is log of maximum distance; Instrumental variable for trade normalized by GDP is log of average distance; *t*-statistics in parenthesis, * significant at 10%. Intercepts not reported.

(Instrumental Variable Estimation) is substantially lower than the bias of the OLS.[11]

IV estimates of β are reported in Table 7. We use maximum distance as an instrument for trade intensity normalized by total trade, and average distance as an instrument for trade intensity normalized by nominal GDP.[12] The effect of trade intensity on business-cycles synchronization with the EMU is strongly positive and significant. In particular, the estimates point out that an increase in trade with the EMU countries increases significantly the cyclical correlation between the country in question (even if it is a nonEMU country) and EMU as a whole. Moreover, this impact is much larger than previously found in the literature.[13] In particular, our estimates imply that an increase in the regressor (EMU trade normalized by GDP) by one standard deviation starting form the mean of the data implies that business-cycle synchronization (computed using the HP filter) would rise from 0.63 to 0.70. Note that the estimates are very robust to the different detrending methods used.

We also investigate whether the trade effect on business-cycles synchronization is higher or lower before the birth of the EMU. We report the results for the two different periods in Table 8. Given the robustness of the results with respect to the different detrending methods, we report here just those obtained with the HP filter for the two different periods. While the estimates are not strongly statistically significant (which is not surprising, because of the limited number of observations), we believe it is worthwhile to report that the coefficient measuring the trade effect is consistently lower (by about 20%) in the post-EMU period than in pre-EMU. However, this difference is statistically significant only when we consider the trade intensity proxy obtained by normalizing with respect to total trade.

Overall, our results are very reasonable and may suggest that the creation of the European common market had a greater *trade effect* than the creation of the euro itself.

V. Policy Implications and Conclusions

Countries that join a monetary union lose some of their ability to stabilize cyclical fluctuations because they give up independent monetary policy. As the literature has pointed out repeatedly, this

[11] See Staiger and Stock (1997).
[12] In Appendix C, we report the result obtained by flipping the two instruments. They confirm the positive effect of trade intensity on business cycles synchronization.
[13] See Frankel and Rose (1998).

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stabilization cost is a decreasing function of the correlation between the cyclical output of the member country and that of the union as a whole.

The results of this article show that, for our sample of 12 EU countries, the stabilization cost of the euro has been remarkably reduced over time. In particular, we show that all countries in our sample were better synchronized with the EMU-wide economy in the post-EMU period 1999 to 2004 than they were during 1993 to 1998. This result is very robust to a number of different detrending methods, and applies not only to GDP, but also the unemployment rate and unit labour cost.

We also show that this increase in synchronization does not apply equally to each of the different components of aggregate demand. In particular, we find that the trade components (imports and particularly, exports) are more highly correlated after 1999 in virtually every case, whereas government purchases are better synchronized in just seven of the 12 economies. It is difficult to escape the conclusion that the remarkable increase in overall synchronization is more due to trade factors and less (if at all) to fiscal policy coordination.

We explored this further by investigating the relationship between within-EMU trade and the cyclical correlations. Considering two different measures of trade intensity with the EMU, we show that the effects of trade on cyclical synchronization are sizable and statistically significant.

Our results have interesting policy implications both for the old (pre-2004) and the new EU members. For the old, non-EMU members, they suggest that the weaker cyclical correlations of the 1990s overestimate the stabilization costs of joining the euro now. Similarly, the new and prospective members' current situation of very low or negative correlations with the EMU should be taken only to mean that the current stabilization cost of adopting the euro would be very high.[14] If the trade creation effects of joining the EMU follow a pattern similar with that of the older members, correlation endogeneity will result in higher synchronization and thus a lower stabilization cost for these countries.

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[14] See Furceri and Karras (2006) who show that the stabilization cost of adopting the euro for some of the new EU members (such as the Czech Republic, Estonia, Latvia, Lithuania and the Slovak Republic) and for other EU candidate countries (such as Bulgaria, Croatia, the Former Yugoslav Republic of Macedonia, Romania and Turkey) would be very high.

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Appendix A

Three different methods are used to detrend the output series and obtain a measure of the cyclical fluctuation of each series. The first is simple differencing, using the growth rate of the real GDP. The second method is the Hodrick–Prescott (HP) filter, proposed by Hodrick and Prescott (1980). Letting $y_{i,t} = \ln(Y_{i,t})$ the filter consists to decompose the series in a cyclical ($c_{i,t}$) and a trend component ($g_{i,t}$), by minimizing respect to $g_{i,t}$ the following formula: $\sum_{t=1}^{T}(y_{i,t} - g_{i,t})^2 \lambda \sum_{T=2}^{T-1}(g_{i,t+1} - g_{i,t-1})^2$ for $\lambda > 0$, where λ is the smoothness parameter. The value recommended by the authors for this parameter is 1600 for quarterly data. The third method makes use of the recently very popular Band-Pass (BP) filter proposed by Baxter and King (1999) and evaluated by Stock and Watson (1998) and Christiano and Fitzgerald (1999), who also compares its properties to those of the HP filter. The low pass (LP) filter $\alpha(L)$, which forms the basis for the band pass filter, selects a finite number of moving average weights α_h to minimize

$$Q = \int_{-\pi}^{\pi} |\delta(\omega)|^2 \mathrm{d}\omega$$

where $\alpha(L) = \sum_{h=-K}^{K} \alpha_h L^h$ and $\alpha_K(\omega) = \sum_{h=-K}^{K} \alpha_h e^{-i\omega h}$. The LP filter uses $\alpha_K(\omega)$ to approximate the infinite MA filter $\beta(\omega)$. Define $\delta(\omega) \equiv \beta(\omega) - \alpha(\omega)$. Then, minimizing Q, we minimize the discrepancy between the ideal LP filter $\beta(\omega)$ and its finite representation $\alpha_K(\omega)$ at frequency ω. The main objective of the BP filter as implemented by Baxter and King (1995) is to remove both the high frequency and low frequency component of a series, leaving the business cycle frequencies. This is formed by subtracting the weights of two LP filters. We define ω_L and ω_H, the lower and upper frequencies of two LP filters as, respectively 32 and 6 for quarterly data. The frequency representation of the band pass weights becomes $\alpha_K(\omega_H) - \alpha_K(\omega_L)$, and forms the

basis of the Baxter–King filter which provides an alternative estimate of the trend component $\bar{y}_{i,t}$, and the cyclical $y_{i,t} - \bar{y}_{i,t}$.

Appendix B

Here we report the business-cycles synchronization results obtained with the Band-Pass filter (BP 6,32) and with differencing. (Tables B1 and B2). Although, the magnitude of the increase in synchronization varies according to the different detrending methods used, the main predictions are strongly robust with those reported in the text in Table 2.

Appendix C

The results obtained by flipping the instruments for the two different proxies for trade intensity are reported in the Table C1. We see that only remarkable departure from the results in Table 5 is the magnitude of the trade intensity (normalized by total trade) effect. The impact, however, remain strongly positive and significant.

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Table B1. Business-cycle syncronization (GDP components, BP)

		Pre-EMU					Post-EMU					
		C	*I*	*G*	IMP	EXP	*C*	*I*	*G*	IMP	EXP	Change
EMU	Austria	0.294	0.408	−0.266	0.249	0.736	0.451	0.479	−0.101	0.837	0.583	++++−
	Belgium	0.059	−0.179	−0.155	0.845	0.618	0.472	0.409	−0.195	0.935	0.935	++−+−
	Finland	0.303	0.232	0.112	0.838	0.898	0.696	0.288	0.697	0.777	0.663	+++−−
	France	0.739	0.784	0.338	0.910	0.937	0.553	0.873	0.577	0.853	0.972	−++−+
	Germany	0.379	0.882	0.869	0.857	0.818	0.873	0.944	0.828	0.886	0.961	++−++
	Greece	0.150	−0.173	−0.002	0.040	−0.036	−0.162	0.292	0.411	0.107	−0.021	++−−+
	Italy	0.225	0.070	0.374	0.897	0.831	0.617	0.409	0.047	0.760	0.885	++−−+
	Netherlands	0.262	0.591	−0.089	0.759	0.449	0.007	0.186	0.582	0.956	0.922	−−+++
	Spain	0.272	0.677	−0.332	0.800	0.634	0.003	0.588	0.175	0.655	0.593	−−+−−
NonEMU	Denmark	−0.257	0.580	0.621	0.522	−0.017	0.296	−0.054	0.171	0.621	0.663	+−−++
	Sweden	−0.069	0.151	0.000	0.599	0.516	0.131	0.074	0.165	0.592	0.330	+−+−−
	UK	−0.498	0.226	0.302	−0.042	0.640	0.142	0.297	0.194	0.809	0.876	++−++

Notes: (+) Means increase, (−) means decrease. Pre-EMU: From April 1993 to April 1998. Post-EMU: From January 1999 to January 2004.

Table B2. Business cycle syncronization (GDP components, differencing)

		Pre-EMU					Post-EMU					
		C	*I*	*G*	IMP	EXP	*C*	*I*	*G*	IMP	EXP	Change
EMU	Austria	−0.280	0.527	0.316	−0.137	0.209	0.497	0.052	0.005	0.368	0.454	+++−+
	Belgium	−0.062	0.220	0.165	0.739	0.582	0.598	0.362	0.372	0.772	0.631	+++++
	Finland	0.546	−0.235	0.032	0.758	0.528	0.298	0.202	0.217	0.578	0.494	−++−−
	France	0.820	0.386	0.157	0.651	0.753	0.610	0.759	0.268	0.794	0.858	−++++
	Germany	0.672	0.931	0.961	0.739	0.745	0.877	0.911	0.836	0.755	0.839	+−−++
	Greece	−0.080	0.029	−0.580	−0.323	−0.326	0.017	0.012	0.145	0.331	0.364	+−+++
	Italy	0.310	0.259	0.167	0.779	0.792	0.567	0.567	0.388	0.476	0.657	+++−−
	Netherlands	0.230	0.719	0.201	0.635	0.629	0.270	0.331	0.554	0.709	0.732	+−+++
	Spain	0.319	0.344	0.160	0.189	0.535	0.393	0.610	0.028	0.450	0.436	++−+−
NonEMU	Denmark	−0.092	0.444	−0.173	0.286	0.076	0.110	0.092	0.483	0.422	0.284	+−+++
	Sweden	−0.156	0.394	0.126	0.069	0.190	−0.229	−0.181	0.104	0.333	0.068	−−−+−
	UK	0.203	0.130	−0.424	0.284	0.261	0.401	−0.064	−0.045	0.518	0.372	+−+++

Notes: (+) Means increase, (−) means decrease. Pre-EMU: From April 1993 to April 1998. Post-EMU: From January 1999 to January 2004.

Table C1. IV Estimates (effect of trade on cyclical income correlation)

Detrending	Normalized by total trade		Normalized by GDP	
HP	2.1651	(2.30)	0.7340	(2.17)
BP	2.3246	(2.29)	0.7590	(2.16)
Differencing	2.0747	(2.29)	0.7007	(2.28)

Notes: Instrumental variable for trade normalized by GDP is log of maximum distance; Instrumental variable for trade normalized by total trade is log of average distance; *t*-statistics in parenthesis, all significant at 5%. Intercepts not reported.

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