ECONSTOR
Make Your Publications Visible.

A Service of
ZBW
Leibniz-Informationszentrum Wirtschaft
Leibniz Information Centre for Economics

Inklaar, Robert; de Haan, Jakob

Working Paper

Is there Really a European Business Cycle?

CESifo Working Paper, No. 268

Provided in Cooperation with:
Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

Suggested Citation: Inklaar, Robert; de Haan, Jakob (2000) : Is there Really a European Business Cycle?, CESifo Working Paper, No. 268, Center for Economic Studies and ifo Institute (CESifo), Munich

This Version is available at:
https://hdl.handle.net/10419/75675

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

WWW.ECONSTOR.EU

Mitglied der Leibniz-Gemeinschaft

CESifo *Working Paper Series*

IS THERE REALLY A EUROPEAN BUSINESS CYCLE?

Robert Inklaar
Jakob de Haan*

Working Paper No. 268

March 2000

CESifo
Poschingerstr. 5
81679 Munich
Germany
Phone: +49 (89) 9224-1410/1425
Fax: +49 (89) 9224-1409
http://www.CESifo.de

* We thank two referees for their very helpful comments.

CESifo *Working Paper No. 268*
March 2000

IS THERE REALLY A EUROPEAN BUSINESS CYCLE?

Abstract

In this paper we argue that in contrast to the conclusion of Artis and Zhang, there is not much evidence in support of the view that increased exchange rate stability is related to more synchronised business cycles in Europe. This finding may have important consequences, as existing differences in business cycles in the EMU-countries may not disappear due to further monetary integration, making a common monetary policy hazardous.

Keywords: Business cycles, ERM, EMU

JEL Classification: E32, E42, N10

Robert Inklaar
Department of Economics
University of Groningen
9700 AV Groningen
The Netherlands

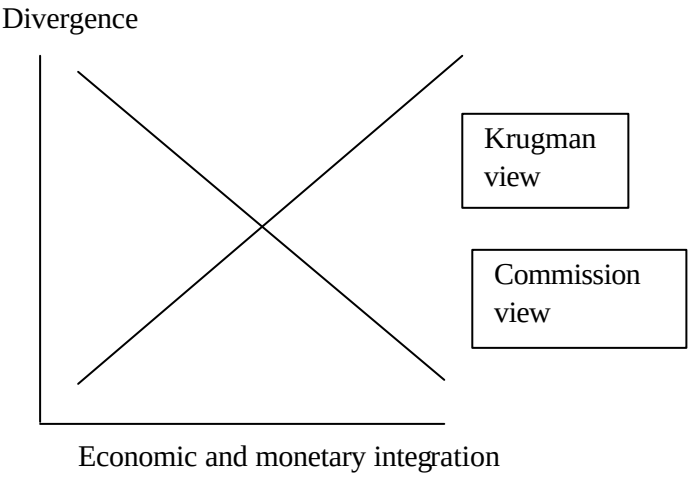
Jakob de Haan
Department of Economics
University of Groningen and CESifo
P.O. Box 800
9700 AV Groningen
The Netherlands
e-mail: j.de.haan@eco.rug.nl

1. Introduction

The Economic and Monetary Union in Europe (EMU) has been criticised because differences in business cycles in the EMU-countries may make a common monetary policy hazardous. The traditional Optimal Currency Area (OCA) literature suggests that in case of substantial divergence, the benefits of a common currency may not exceed the cost of giving up monetary sovereignty. Until quite recently most authors concluded that the divergence among the EMU member countries was so high and the flexibility of labour markets so low, that EMU as it exists now was considered not to be optimal (see Eijffinger and De Haan, 2000 for further discussion).

No matter how important asymmetric shocks have been in the past, in assessing the economic case for EMU the crucial question is how likely these shocks will be in the future. Two views have been put forward on this issue. According to a study by the European Commission (Emerson et al., 1992) further economic and monetary integration will lead to less divergence, i.e. income and employment will tend to diverge less between the countries involved. However, Krugman (1991) poses the opposite. He argues that trade integration will lead to regional concentration of industrial activities. In Europe a similar concentration of industries will take place as in the US (e.g. Silicon Valley). This concentration process is caused by economies of scale. Trade in Europe will change from intra-industry trade to inter-industry trade. Due to this concentration process, sector-specific shocks may become region-specific shocks, thereby increasing the likelihood of asymmetric shocks. Figure1 summarises both views (De Grauwe, 1997).

Fig. 1 Two views on the relationship between economic and monetary integration and divergence



Which view is correct? Some recent research provides support for the view that more economic and monetary integration will lead to less divergence. For instance, Artis and Zhang (1997; 1999)[1] find that over time the business cycle affiliation of most countries participating in the Exchange Rate Mechanism of the European Monetary System has shifted from the United States to Germany.[2] Although Artis and Zhang are more careful in interpreting their results[3], De Grauwe (1997, pp. 74-5) summarises their findings as follows: "the business cycles of EU countries has become much more correlated since the early 1980s. Thus there are now fewer asymmetric shocks among a relatively large group of EU countries than 15 years ago. The authors credit the European Monetary System (EMS) for this. The EMS has forced countries to follow similar monetary policies. In so doing it has reduced the possibility of following independent monetary policies. The latter are a major source of asymmetric shocks. This seems to confirm what we said earlier, i.e. that with economic integration the occurrence of asymmetric shocks tends to diminish."

In this paper we shed some doubt on the results of Artis and Zhang. First, we distinguish more than two periods in comparing cycle synchronicity and exchange rate stability. Second, we show that there is no systematic relationship between cycle synchronicity and exchange rate stability. The remainder of the paper is organised as follows. The next section outlines the methodology. Section 3 presents our results and the final section offers some concluding comments.

2. Methodology

Artis and Zhang (1997; 1999) conclude that the countries participating in the Exchange Rate Mechanism (ERM) of the EMS since March 1979 have changed their business cycle affiliation. From 1961 to 1979 these countries had business cycles which tended more towards the US business cycle. In the period after the institution of the ERM they tended more towards the German cycle. This effect does not occur for non-ERM countries like Canada or Japan. Using seasonally adjusted monthly OECD data on industrial production Artis and Zhang calculated a cyclical index for each series, which takes the following form:

$$1+\frac{(X_t - trend_t)}{trend_t}$$

X_t is the raw series and $trend_t$ is the detrended series. In their 1997 paper, they used several filters to detrend the series. These filters were the Hodrick-Prescott filter (HP filter, with a λ of 50000 and 500000), a filter used by the OECD and a linear trend. In Artis and Zhang (1999) only OECD filtered data are used. Next, Artis and Zhang compared the correlation between a country's cyclical index and the US and German cyclical index. Artis and Zhang

(1999) also define a measure for exchange rate volatility: the standard deviation of the logarithm of the exchange rate at t=1 divided by the exchange rate at t=0. They report the rank correlation between business cycle correlation and exchange rate volatility. This too leads them to conclude that during the ERM period a European business cycle has emerged.

In our view, from the EMU perspective, it is not so interesting whether the business cycle in a particular country is affiliated to the US cycle or to the German cycle. The main issue is whether exchange rate volatility has led to synchronisation of business cycles in Europe. Therefore, we do not report the correlation with the US cycle.[4] Instead, we compare the correlation with the German cycle before and after the institution of the ERM. We have calculated the correlations in the same way as Artis and Zhang. We use almost the same countries as Artis and Zhang (1999): Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom and the United States. We excluded Portugal because the data was too unreliable. We have used seasonally adjusted monthly figures for industrial production from the *International Financial Statistics* (IFS) of the IMF.[5] For Denmark, Ireland and Switzerland the series were not long enough for monthly data, so we resorted to quarterly data. All our series start in January 1960 except Spain (in 1961), Switzerland (1965) and Denmark (1968). All our series end in December 1998. To detrend these series, we have used a HP filter with λ=50000. This filter takes the following form :

$$\min_{g_t}\left[\sum_{t=1}^{N}\left(y_t-g_t\right)^2+l\sum_{t=2}^{N-1}\left[\left(g_{t+1}-g_t\right)-\left(g_t-g_{t-1}\right)\right]^2\right]$$

In this formula y_t represents the series and g_t the growth component. The first part is the cyclical component and the second part the trend. When l goes to infinity, the formula converges to a linear trend. For monthly data Hodrick and Prescott suggest using l=14400. Artis and Zhang used l=50000 and l=500000. They justify this arguing that industrial production is very volatile and the trend is usually upwards. For our research we have followed Artis-Zhang and use l=50000. For Denmark, Ireland and Switzerland (quarterly data) we have used λ=5555.[6] After detrending the series, we calculated the cyclical index like Artis and Zhang and computed the correlations between each country's index and the German index.

Apart from calculating the correlation for the periods 1960:1-1979:3 and 1979:4-1998:12 we also distinguish four sub-periods because the two periods are not uniform with respect to exchange rate volatility. It is not true that before 1979 ERM currencies had a volatile exchange rate with respect to the Deutsche Mark while during the ERM these rates were stable. Up to 1971 the Bretton-Woods system was still in place, insuring quite stable exchange rates. From 1971 to 1979 an unstable exchange rate system was in place in Europe

(the so-called Snake-in-the-tunnel). In March 1979 the ERM was instituted but until 1987 many realignments occurred. After the Basle-Nyborg agreement of September 1987 further realignments were avoided up to 1992 (apart from the technical adjustment of the Italian lira in January 1990). In August 1992 the ERM was hit by a speculative crisis, which forced the Pound Sterling and the Lira out of the system. Therefore, we have also compared business cycle synchronisation for four sub-periods:

I: 1960:1-1971:3

II: 1971:4-1979:3

III: 1979:4-1987:9

IV: 1987:10-1998:12

Each of these periods is long enough to capture a full business cycle, but gives a more accurate division with respect to exchange rate volatility. We have also examined a further division of the full sample period.

We present the correlations between the cyclical component of output of all countries vis-à-vis Germany and examine whether patterns have changed over time. We will do this for two periods (pre ERM and post ERM) and for the four periods outlined above. As a second step, we present simple scatter diagrams of actual exchange rate volatility (defined as in Artis and Zhang) and the degree of business cycle homogeneity with Germany.

3. Results

We start with a comparison of the business cycle synchronisation before and during the ERM for 19 OECD countries. As Table 1 shows, there are some striking differences with the results of Artis and Zhang. It is especially remarkable that there is no general increase in correlation between Germany and the other ERM-countries after the institution of the ERM. While some countries show an increase in correlation (France, Ireland, Italy), others have a lower correlation (Belgium, Denmark, Luxembourg, and the Netherlands). A decline in the correlation was to be expected for non-ERM countries, as DM-exchange rates with those countries were not especially stable in the post 1979 period. For ERM countries however, this comes as a surprise. It certainly is at odds with the findings of Artis and Zhang.[7]

Table 1. A comparison between our results and the results in Artis and Zhang

	Inklaar-DeHaan		Artis-Zhang 97		Artis-Zhang 99	
	pre-ERM	post-ERM	pre-ERM	post-ERM	pre-ERM	post-ERM
Sample:	1960:1-1979:3	1979:4-1998:12	1961:1-1979:3	1979:4-1993:12	1961:1-1979:3	1979:4-1995:10
Austria	0.61	0.62	--	--	0.68	0.78
Belgium	0.54	0.49	0.66	0.50	0.58	0.74
Canada	0.48	0.28	0.50	0.17	0.48	0.14
Denmark	0.74	0.35	--	--	--	--
Finland	0.28	0.26	0.37	-0.04	0.34	-0.08
France	0.48	0.67	0.55	0.59	0.48	0.65
Greece	0.56	0.25	--	--	0.32	0.48
Ireland	0.34	0.47	0.38	0.17	0.48	0.04
Italy	0.20	0.39	0.15	0.33	0.15	0.56
Japan	0.52	0.54	0.52	0.62	0.49	0.76
Luxembourg	0.62	0.46	--	--	0.64	0.54
Netherlands	0.75	0.42	0.62	0.59	0.78	0.80
Norway	0.18	0.18	0.14	0.26	0.13	0.37
Portugal	--	--	0.28	0.29	0.47	0.65
Spain	0.39	0.42	0.38	0.24	0.38	0.51
Sweden	0.34	0.42	0.35	0.27	0.27	0.16
Switzerland	0.78	0.57	--	--	0.40	0.16
United Kingdom	0.58	0.28	0.58	0.08	0.61	0.35
United States	0.43	0.28	--	--	--	--

Note: the results of Artis & Zhang (1997) are those with λ=50000 in the Hodrick-Prescott filter (taken from their table 1); in our calculation we have also used λ=50000. The results of Artis & Zhang (1999) are with data filtered by the OECD and taken from their table 1.

As we have followed Artis-Zhang in almost all possible respects, only two possible explanations for the differences exists:

1. We have used data from the IMF while Artis and Zhang (1997, 1999) used OECD data. As explained before, we only could only acquire the necessary data from the IMF.
2. In our research the post-ERM period is longer than in Artis and Zhang.

As the first possibility should not lead to large differences, we disregard it. To deal with the second possibility, we have redone our calculations focusing on the same sample periods as in Artis and Zhang (1997, 1999). The results are presented in Table 2. It follows that substantive differences remain.

Table 2. Our results using the same sample periods as in Artis and Zhang

	pre-ERM	post-ERM	post-ERM
Sample:	1961:1-1979:3	1979:4-1993:12	1979:4-1995:10
Austria	0.61	0.67	0.66
Belgium	0.54	0.58	0.52
Canada	0.48	0.26	0.28
Denmark	0.74	0.39	0.37
Finland	0.28	0.22	0.24
France	0.48	0.67	0.68
Greece	0.34	0.29	0.27
Ireland	0.56	0.46	0.46
Italy	0.20	0.41	0.41
Japan	0.52	0.63	0.61
Luxembourg	0.62	0.49	0.46
Netherlands	0.75	0.48	0.47
Norway	0.18	0.17	0.16
Portugal	--	--	--
Spain	0.39	0.40	0.42
Sweden	0.34	0.42	0.44
Switzerland	0.78	0.56	0.56
United Kingdom	0.58	0.28	0.29
United States	0.43	0.28	0.28

Note: the sample period in the third column corresponds to that of Artis & Zhang (1997), while that in the fourth column corresponds to the sample period in Artis & Zhang (1999).

As we mentioned above, a division of the entire sample period into four sub-periods may be more appropriate than into two periods. For all four periods as distinguished in the previous section, we have calculated the cyclical correlations with Germany. Table 3 shows the average correlation per period.

Table 3. Correlation between cyclical component of output in each country and Germany in each period.

	1960-1971	1971-1979	1979-1987	1987-1997
Austria	0.55	0.68	0.62	0.62
Belgium	0.37	0.74	0.53	0.47
Canada	0.23	0.74	0.54	-0.12
Denmark	0.75	0.77	0.42	0.32
Finland	0.27	0.29	0.37	0.20
France	0.26	0.82	0.59	0.74
Greece	0.15	0.58	0.45	0.05
Ireland	-0.08	0.77	0.48	0.47
Italy	-0.27	0.64	0.44	0.35
Japan	0.16	0.87	0.58	0.52
Luxembourg	0.62	0.69	0.62	0.29
Netherlands	0.79	0.76	0.46	0.38
Norway	0.27	0.11	0.25	0.09
Spain	0.22	0.61	0.22	0.56
Sweden	0.52	0.13	0.46	0.38
Switzerland	0.91	0.77	0.56	0.58
United Kingdom	0.59	0.61	0.41	0.09
United States	-0.01	0.80	0.50	-0.07

Note: the precise sample periods are stated in the text.

As can be seen, most ERM countries show an increase in the correlation during the period 1971-79, while in the period 1979-87 the correlations decline.[8] This development is certainly not in line with the view that further monetary integration and business cycle synchronisation are related. To analyse this issue somewhat further we have examined the relationship between exchange rate volatility and business cycle synchronisation. Using the same definition of exchange rate volatility as Artis-Zhang for the four periods that we have distinguished and using the correlations shown in table 3 we have made a simple scatter diagram (see Figure 2).

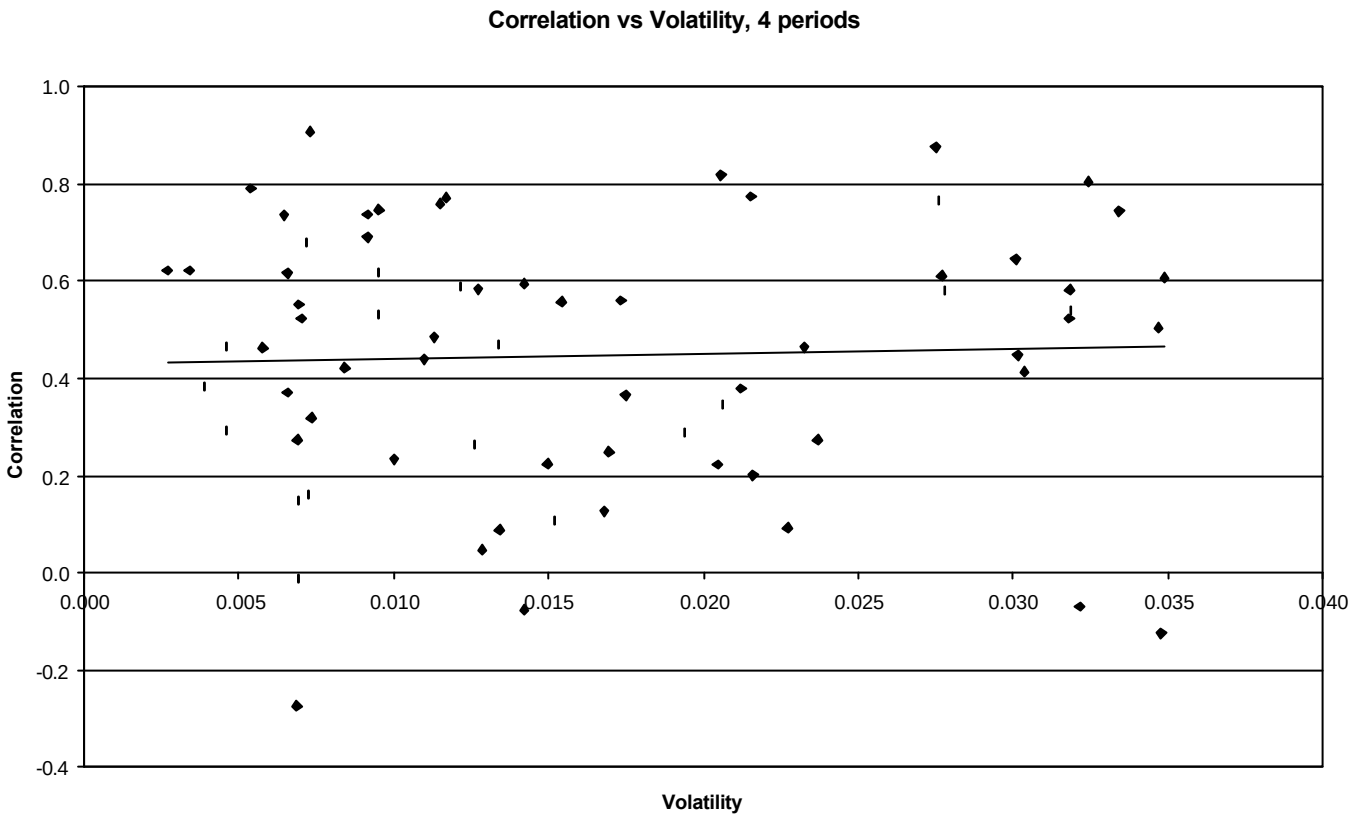


Fig. 2. The relationship between business cycle correlation and exchange rate volatility for every country and every period

The scatter graph does not show a clear relationship between cycle correlation and exchange rate stability. If such relationship were present a country like Canada would be expected to have a large exchange rate volatility (no effort is being made to stabilise the Canadian $ / DM rate) coupled with low correlation. The French exchange rate volatility is much lower, so a higher correlation would be expected. The lack of a relationship is confirmed by the regression output as only the constant term is significant and the explanatory power is almost zero (not shown). So also with this comparison between business cycle correlation and exchange rate stability we cannot conclude that exchange rate stability is related to cycle synchronisation. There might be a difference and a relationship if only ERM countries are considered. Fig. 3 shows a scatter graph for ERM countries only.

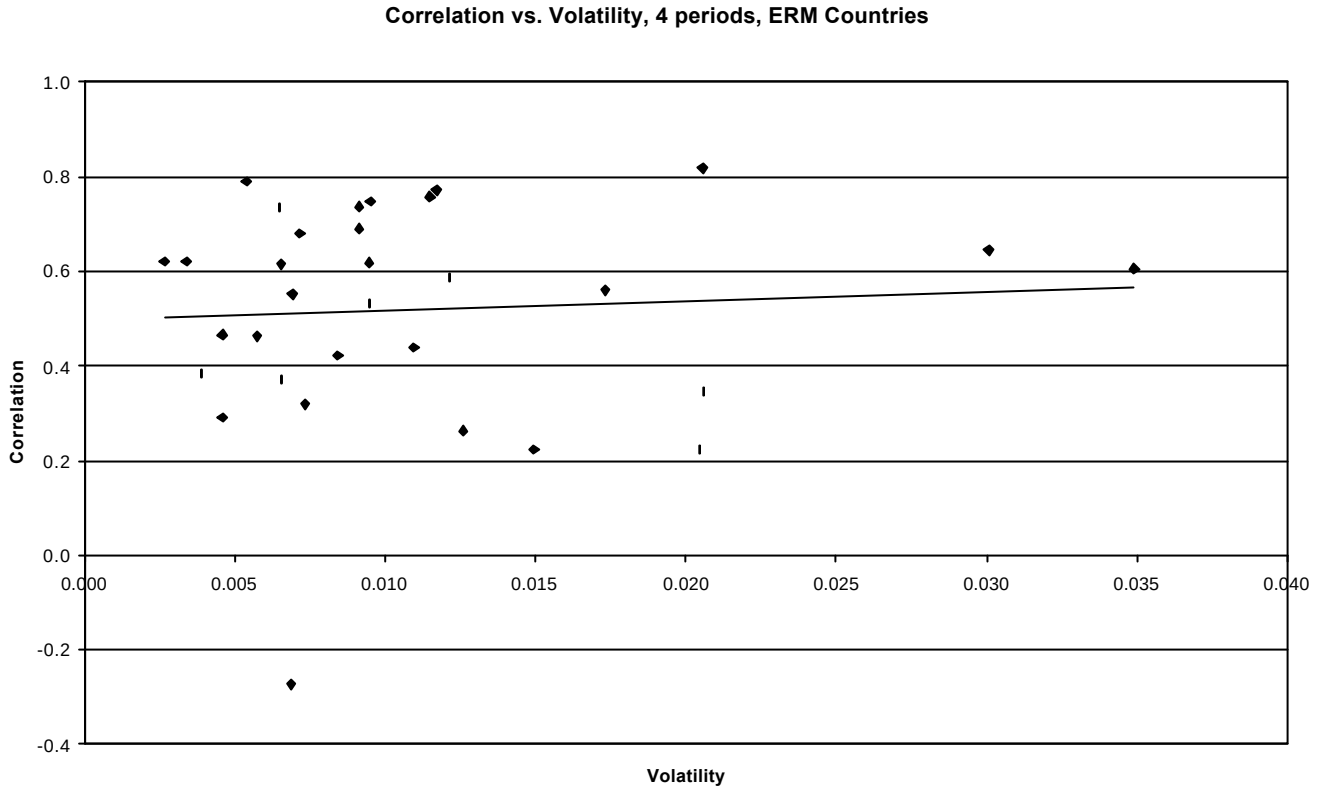


Fig. 3. The relationship between business cycle correlation and stability for ERM countries in each period.

Our conclusion remains the same if we consider ERM countries separately. In this case a significant relation between exchange rate stability and cycle correlation is also absent.

4. Concluding comments

In this paper, we have tried to give an answer to the question of whether exchange rate stability is related to business cycle synchronisation. This is an important question, as it may give an indication of the frequency of asymmetric shocks in the EMU and such shocks may have large effects on the cohesion of the monetary union. Artis and Zhang have found a relationship between stability of exchange rates in Europe and the real linkage between the ERM countries and Germany. They reached this conclusion from their observation of a shift in business cycle affiliation. During the ERM, the countries that were in the ERM had a business cycle more closely resembling the German cycle than the US cycle. This was not the case in the pre-ERM period (1961-1979).

In this paper we have made two contributions. First, we have tried to replicate the results of Artis and Zhang using IMF instead of OECD data on industrial production, focusing

on the business cycle affiliation with Germany as this is from the EMU perspective the more interesting. Although we have followed Artis and Zhang in all other respects, their results differ substantially from ours. Focusing on the entire sample period, there is no clear-cut trend among ERM countries. Whereas some countries have a more similar business cycle with Germany after the establishment of the ERM, others show a decline in business cycle synchronisation. This conclusion also holds if we employ exactly the same sample periods as Artis and Zhang (1997; 1999). Second, in our view the period 1960-1998 should be divided into in more sub-periods as each period displays different characteristics with regard to exchange rate stability. In the ERM, exchange rates were not uniformly stable just as rates in the pre-ERM period were not fully flexible. Finally, after we combined our measure of real integration (correlation between business cycles) with our measure of monetary integration (exchange rate volatility) no systematic relationship could be found. This result also holds when non-ERM countries were excluded.

Our results do not support the view that exchange rate stability is related to business cycle synchronisation. This is not to say that further integration in Europe may not affect business cycle synchronisation. There may be other mechanisms than exchange rate stability that lead to this. Frankel and Rose (1998) find a strong relationship between trade links and cycle synchronicity. These authors have estimated equations that take several measures of trade intensity as independent variables and the correlation between business cycles as dependent variables. Their estimations yield highly significant parameters. This is good news for the EMU, as trade continues to grow within Europe. Interestingly, when Frankel and Rose include a dummy variable, which is one when two countries have linked their currencies and zero otherwise, its coefficient is not significant. This result is in line with our findings. In addition, Baxter and Stockman (1989) find no effect of the exchange rate on business cycle synchronisation.

References

Artis, M. J. (1999), 'The UK and EMU', in: Cobham, D. and Zis, G. (eds.), *From EMS to EMU*, London: MacMillan.

Artis, M. J. and Zhang, W. (1997), 'International business cycles and the ERM: is there a European business cycle?' *International Journal of Finance and Economics,* **2**, 1-16.

Artis, M. J. and Zhang, W. (1999), 'Further evidence on the international business cycle and the ERM: is there a European business cycle?' *Oxford Economic Papers,* **51**, 120-132.

Baxter, M. and Stockman, A.C. (1989), 'Business cycles and the exchange rate regime' *Journal of Monetary Economics,* **23**, 377-400.

De Grauwe, P. (1997), *The Economics of Monetary Integration*, Oxford: Oxford University Press.

Eijffinger, S.C.W. and De Haan, J. (2000), *European Monetary and Fiscal Policy*, Oxford: Oxford University Press, forthcoming.

Emerson, M., D. Gros, A. Italianer, J. Pisani-Ferry and H. Reichenbach (1992), *One Market, One Money*, Oxford: Oxford University Press.

Fatás, A. (1997), 'EMU: Countries or regions? Lessons from the EMS experience', *European Economic Review*, **41**, 743-751.

Frankel, J.A. and Rose, A.K. (1998), 'The endogeneity of the optimum currency area criteria' *The Economic Journal,* **108**, 1009-1025.

Krugman, P. (1991), *Geography and Trade*, Cambridge Mass: MIT Press.

Appendix

Table A1 summarises tables 1 and 2 by focusing on the change in the business cycle synchronisation before and after the start of the ERM.

Table A1. Changes in correlation with Germany before and after ERM

	Inklaar-DeHaan			Artis-Zhang 97/99	
Sample:	1960:1-1998:12	1961:1-1993:12	1961:1-1995:10	1961:1-1993:12	1961:1-1995:10
Austria	0.01	0.07	0.05	--	0.10
Belgium	-0.05	0.04	-0.02	-0.16	0.16
Canada	-0.20	-0.22	-0.21	-0.33	-0.34
Denmark	-0.39	-0.35	-0.37	--	--
Finland	-0.02	-0.06	-0.04	-0.41	-0.42
France	0.19	0.19	0.20	0.04	0.17
Greece	-0.31	-0.05	-0.07	--	0.16
Ireland	0.13	-0.10	-0.10	-0.21	-0.44
Italy	0.19	0.21	0.21	0.18	0.41
Japan	0.02	0.10	0.09	0.10	0.27
Luxembourg	-0.16	-0.13	-0.16	--	-0.10
Netherlands	-0.33	-0.27	-0.28	-0.03	0.02
Norway	0.00	-0.02	-0.02	0.12	0.24
Portugal	--	--	--	0.01	0.18
Spain	0.03	0.02	0.03	-0.14	0.13
Sweden	0.08	0.08	0.10	-0.08	-0.11
Switzerland	-0.21	-0.22	-0.22	--	-0.24
United Kingdom	-0.30	-0.30	-0.29	-0.50	-0.26
United States	-0.15	-0.15	-0.14	--	--

As pointed out in the main text, the ERM went through various phases. In fact, the following six periods may be distinguished (see also Eijffinger and De Haan, 2000):

I 1/1960 – 5/1971: The Bretton-Woods system still functioned, thus ensuring relatively stable exchange rates.

II 6/1971 – 3/1979: During this period, Europe had essentially free-floating exchange rates.

III 4/1979 – 12/1983: This period saw a turbulent start of the ERM with many realignments.

IV 1/1984 – 9/1987: A calmer intermediate phase with few realignments.

V 10/1987 – 8/1992: After the Basle-Nyborg agreement a very calm period without realignments.

VI 9/1992 – 12/1998: Starting with the ERM-crises it ended relatively calm.

Table A2 shows the business cycle synchronisation with Germany during these periods. It clearly follows that there is no clear-cut relationship between exchange rate stability and business cycle synchronisation.

Table A2. Business cycle correlation with Germany in each period.

	I	II	III	IV	V	VI
Austria	0.55	0.68	0.67	0.49	0.68	0.50
Belgium	0.37	0.73	0.60	0.37	0.45	0.40
Canada	0.24	0.73	0.71	0.01	-0.66	0.61
Denmark	0.75	0.77	0.87	0.52	-0.23	0.64
Finland	0.27	0.29	0.53	-0.12	-0.18	0.65
France	0.26	0.81	0.66	0.33	0.55	0.78
Greece	0.15	0.56	0.52	0.32	-0.18	0.16
Ireland	-0.08	0.77	0.74	-0.25	-0.20	0.70
Italy	-0.28	0.64	0.58	0.07	-0.03	0.42
Japan	0.16	0.87	0.84	0.23	0.49	0.37
Luxembourg	0.62	0.69	0.69	0.42	0.05	0.35
Netherlands	0.79	0.76	0.71	0.00	0.44	0.28
Norway	0.27	0.11	0.54	-0.14	0.06	0.18
Spain	0.23	0.58	0.34	-0.08	0.11	0.70
Sweden	0.52	0.13	0.57	0.22	-0.11	0.68
Switzerland	0.91	0.77	0.72	0.14	-0.01	0.71
United Kingdom	0.60	0.61	0.45	0.20	-0.35	0.63
United States	-0.01	0.79	0.60	-0.14	-0.54	0.63

Notes

[1] The second article is an extension of the first and uses more countries and more sophisticated measures of exchange rate volatility.

[2] Frankel and Rose (1998) find that the more countries trade the more business cycles in these countries are synchronised. Another relevant study is Fatás (1997).

[3] For instance, in their 1997 paper they state that: "our results do not in themselves support an unequivocal causal interpretation. Whether membership of the ERM itself produced a shift in business cycle affiliation or whether the shift in business cycle affiliation permitted sustained participation in the ERM is not settled by our findings." (p. 14).

[4] Although our results with respect to the US cycle are somewhat different, we certainly agree with Artis and Zhang that the business cycle synchronisation of ERM-countries and the US has diminished. Artis (1999) employs a more extended data period, which also supports the change in business cycle affiliation vis-à-vis the US.

[5] We did not have access to the OECD data as used by Artis and Zhang. Despite several requests, Artis and Zhang did not make their data available to us.

[6] Hodrick and Prescott suggest using λ=1600, but since we use λ =50000 for monthly data λ=5555 seems appropriate

[7] Table A1 in the Appendix shows the change in correlation before and after the start of the ERM in more detail.

[8] Table A2 in the Appendix shows the results if the full sample period is split according to the various phases that can be distinguished in the development of the ERM. A potential drawback of this further division is that the sub-sample periods may not cover a full business cycle.