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Synchronization of Business Cycles ***10/2004***

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Business cycles have been argued to have become less synchronized recently. While this is true for G3 and maybe G7 countries, it is not true for countries of the European union. While synchronisation does not increase strongly for EU14, there is a slight increase between the 1970s and today and a stronger increase between the beginning of the 1990s and today.

Synchronization of Business Cycles in G7 and EU14 countries

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1 Introduction

Several recent papers argue that globalization does not necessarily lead to more synchronization of economic activity across countries. Heathcote and Perri (2003) state that from 1960 to 2002 the U.S. business cycle has become less synchronized with the cycle in 15 countries of the European Union plus Japan. Kose, Prasad and Terrones (2003) conclude that their paper provides "at best limited support for the conventional wisdom that globalization leads to an increase in the degree of synchronization of business cycles".

While these findings are interesting in themselves, they become very important when thinking about economic policy, especially in Europe. The European union is built also on the idea that more integration across countries in terms of more trade in goods, freer capital markets and also more labour migration will make countries more similar. This allows for harmonisation of policies across Europe and joint decisions will become easier. If, however, integration does not make countries more similar with respect to the business cycle position they find themselves in, decision-making might become more difficult if this fact is not taken into account.

The objective of this note is therefore to provide, in section 2, a brief survey of recent analyses of globalization and synchronization and to document,

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in section 3, the extent to which GDP of member states of the European union and G7 countries become more synchronised over time. In contrast to previous analyses (e.g. ECFIN 2004, sect 4.3), we include a larger set of countries and start earlier in the past. We also introduce a novel summary measure that allows to handle a large number of country pairs. Our study differs from the ones cited at the beginning because of the more explicit focus on European countries. We also stress the importance of the choice of the filter for the results.

2 The approach

2.1 Methods and results in the literature

Heathcote and Perri (2003) measure synchronization for GDP (without government consumption), investment (gross fixed-capital formation), consumption (without government consumption), civilian employment and labour productivity. Measures of synchronization are correlation coefficients between U.S. and not-U.S. time series for the sub-periods from 1969 to 1981Q1 and 1981Q2 to 2002. Time series are de-trended in various ways by using the HP filter, first differences (i.e. looking at growth rates) and high-pass filters. They find that the U.S. business cycle has become less synchronized with the cycle in the rest of the world.

Kose, Prasad and Terrones (2003) first examine the correlations of output and consumption growth rates in each country with the growth rate of the composite measure of world output. They further estimate dynamic unobserved factor models to decompose fluctuations in the macroeconomic aggregates into a factor common across all countries and a country-specific factor and look if the common factor rises if estimated in period 1981–1999 compared to 1960–1980. Finally, they present a more formal regression analysis of factors that influence correlations of individual country macroeconomic aggregates with the corresponding world aggregates.

Doyle and Faust (2003) investigate changes in the variability of and comovement among growth rates of G-7 countries (often without Japan). Besides descriptive methods, they employ a vector autoregression with one lag and a constant where all the parameters are allowed to break at a fixed number of dates. They test whether the parameters they are interested in, e.g. correlation coefficients, change over time. They find no clear evidence that correlation has increased with the rising economic integration of the last years and decades.

Inklaar and de Haan (2000) try to reproduce findings by Artis and Zhang

(1997, 1999) who stated that after installment of the European Monetary System the business cycle synchronisation of most member countries shifted from the United States to Germany. Repeating their methodology, Inklaar and de Haan compare the correlation of the single business cycles, represented by a cyclical index which takes the form $1 + \frac{(X_t - trend_t)}{trend_t}$[2], with the German business cycle for four sub-periods, starting in 1960 and ending in 1998, each representing a distinctive development concerning exchange rate volatility. In contrast to Artis and Zhang, they are not able to find a systematic relationship between stable exchange rates and business cycle synchronisation.

Using band-pass filtered GDP data, Traistaru (2004) compares the degree of business cycle synchronisation between current EMU members and Central European Countries in the period 1990-2003. She finds that correlations between countries from both groups are less than between only EMU countries. Analyzing regression models with suitable dummy variables shows that similarity of economic structures and bilateral trade intensity (measured by bilateral trade flows relative to total trade flows) are positively and significantly associated with business cycle correlations.

Camacho, Perez-Quiros and Saiz (2004) base their investigations on monthly industrial production series of current EU members, negotiating countries and some further industrialized countries. They employ a number of analyses concerning business cycle comovement across these countries. Firstly, they identify the logs of the industrial production indexes by a VAR model and, using this, calculate a 48 months ahead forecast. After calculation of the corresponding forecast errors, they measure business cycle synchronisation of a pair of countries by the difference $(1 - correlation)$ of their forecast errors. Secondly, they change perspective from time to frequency domain to separate and analyse short-run and long-run properties of the HP-filtered industrial production series and calculate the so called dynamic correlation suggested by Reichlin et al. (2001). In their final approach Camacho et al. construct individual reference cycles as a binary variable having value one when a country is in recession and zero otherwise and use inter alia the sample correlation between the reference cycles of two countries as measurement of pairwise business cycle synchronisation. Further analyses explore their results e.g. in terms of clusters and business cycle features. Their conclusions are that EURO economies are more synchronized with each other than with the newcomers. However, the closer relationships between the EURO economies seem to be prior to the installment of the union and can not be explained by policy variables. Therefore one can not expect a further increase of synchronization due to deepening integration.

[2] X_t is the raw series and $trend_t$ is the HP-detrended series.

2.2 Our approach

We would like to understand whether countries became less or more synchronised over time. We look at all pairs of countries for EU14 (European Union as until 30th April 2004, except for Luxembourg) and G7. This gives 17 countries, i.e. $16 + 15 + ... + 1 = 136$ country pairs. We use annual data on GDP for the period from 1965 to 2002, provided by Eurostat.

We compute cyclical components for these countries by using 4 filters: Hodrick-Prescott filter with $\lambda = 100$ (HP100), Christiano-Fitzgerald filter (CF), a modified version of the Baxter-King filter (modBK) and a difference filter, i.e. growth rates. For each filter we then compute correlation coefficients for 10 year moving averages. The first correlation coefficient is therefore available for the period from 1965 to 1974 and the last is available for the period from 1993 to 2002. We then end up with $4 * 136$ time series for correlation coefficients. As it is difficult to give a visual impression of these results, we plot the mean, 33, 50 and 67 percentile of the correlation coefficients ρ_{if} across countries i, one plot for each filter f.

We also compute the significance of correlation coefficients with standard errors corrected for heteroskedasticity and autocorrelation by employing Newey-West errors. We found that HP100 produces the largest number of significant results, followed by FOD, modBK and CF. The number of significant correlation coefficients is not constant over time, in general declining in the beginning but rising since the late 1980s again. As it will be seen in the next section, this just follows the general pattern of decline and rise of the average correlation coefficients and therefore brings no further information. We use the significance measure later, however, to identify the countries that are most highly synchronised.[3]

3 Empirical results

3.1 Overall impression

3.1.1 EU14

A general impression can be gained by looking at the following figures for EU14. The mean correlation coefficient for the HP100 filter is quite flat over time. The other filters typically slightly decrease in the first years, followed by an equivalent rise in the 1990s. The current trend is one of an increasing correlation of the business cycles within the European Union.

[3] All programmes and the data are available from the authors upon request and can be downloaded from e.g. www.waelde.com -> publications.

Mean correlation in the last 10 years exceeds that from the first 10 years. While this rise is only marginal in the case of HP100, the increase for other filters is on average 38% relative to the initial level: Taking the CF-filter as an example, mean correlation in the first period is about 0.36 and about 0.49 in the last one, i.e. an increase of about 37%. Whether this should be taken as an indication of an overall trend, however, can only be answered by time. In the 1970s, an equally strong *de*crease was observed, which was overcompensated, however in the 1980s and 1990s.

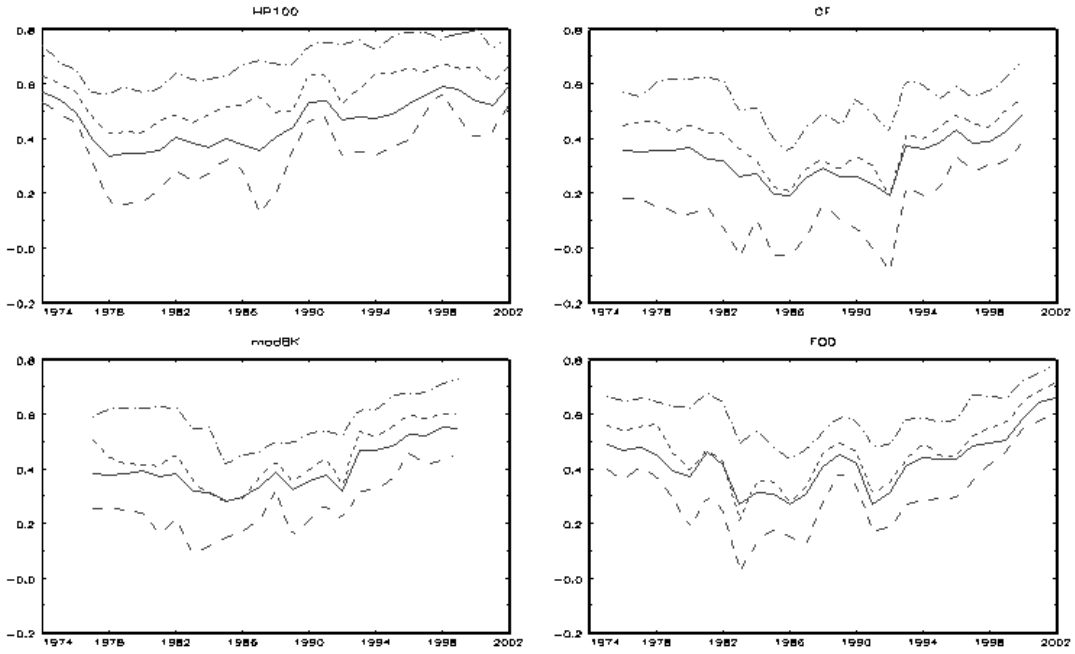

Figure 1: Distribution of 10-year correlation coefficients EU14
Notes: Horizontal axes show year in which 10-year windows ends.
Mean (——), Median (- - -), 33rd Percentile (− −), 67th Percentile (− · −)

According to the filters used here, mean correlations range between about 0.19 and 0.66 over time and across filters, reaching about 0.57 on average in the last period considered. Typically, the mean value is slightly below median value. But besides the case of the HP100 filter, where considerably many values reach high levels, correlation seems still to be quite equally distributed around the mean.

The difference between the 33rd and 67th percentile, including 33% of all values by construction, can be used as a measure of variance. On average its range is about 0.34, which however varies over time. If we take the HP100 filter as an example, this range is initially in the period 1965-74 relatively

small at 0.21, indicating that most of the pairwise coefficients are close to the mean. In subsequent years, e.g. from 1970-79, the range increases up to 0.43. Apparently there is no common pattern of the different filters which describes the development of the variance for all of them.

If we look in more detail into the distribution of a specific filter in a specific 10-year period one typically finds a negative skewness like in the following example:

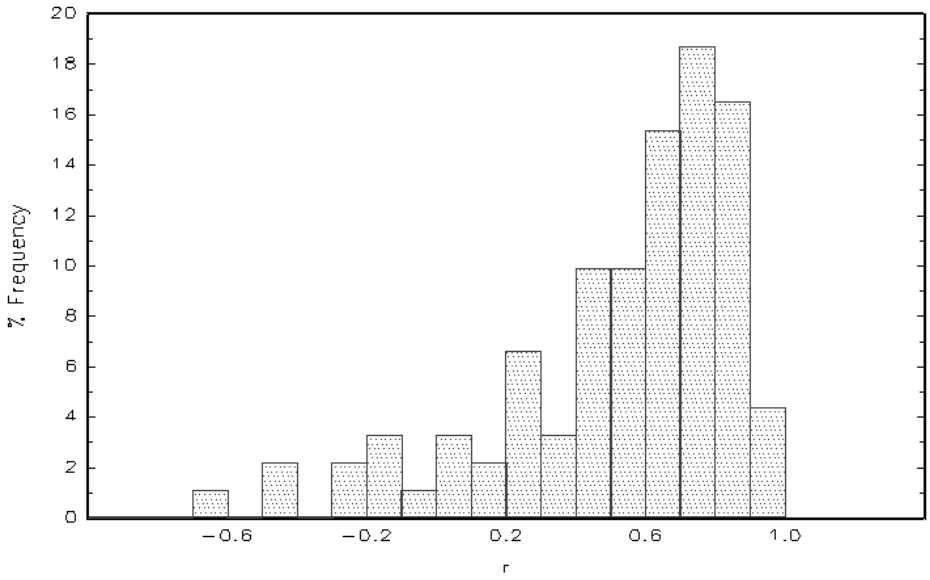

Figure2: A typical histogram of correlation coefficients of HP-filtered series 1981-1990

In periods with less significant correlations coefficients the distribution is more equal but still the shape is similar.

3.1.2 EU14 and G7

When we include USA, Canada and Japan into the sample, we obtain the following figure, giving quite a similar overall impression. Compared to the smaller sample, however, the growth at the end of the time periods under consideration is not as distinct. Only modBK and FOD show a clear increase over the initial level with about 9.3% and 22.8%, respectively. The mean level is in general slightly below the case of EU14, but this difference becomes stronger in the last periods. Correlations reach a value of only about 0.47 on average in the end. There is not much change concerning the percentiles.

The flatter time paths as well as the lower means show that pairwise correlation in this bigger sample is on average not as strong as before. As the

sample increased only by 3 countries, implying just 3 out of the 136 correlation coefficients that are between these 3 countries, and considering that 91 of the correlation coefficients are the same as before, the difference must mainly be caused by the 42 pairwise correlations of the EU14 countries with the USA, Canada and Japan. It therefore reflects the fact that business cycle synchronisation among EU14 countries in general was higher than between EU 14 and non-European G7 countries, especially in most recent years.

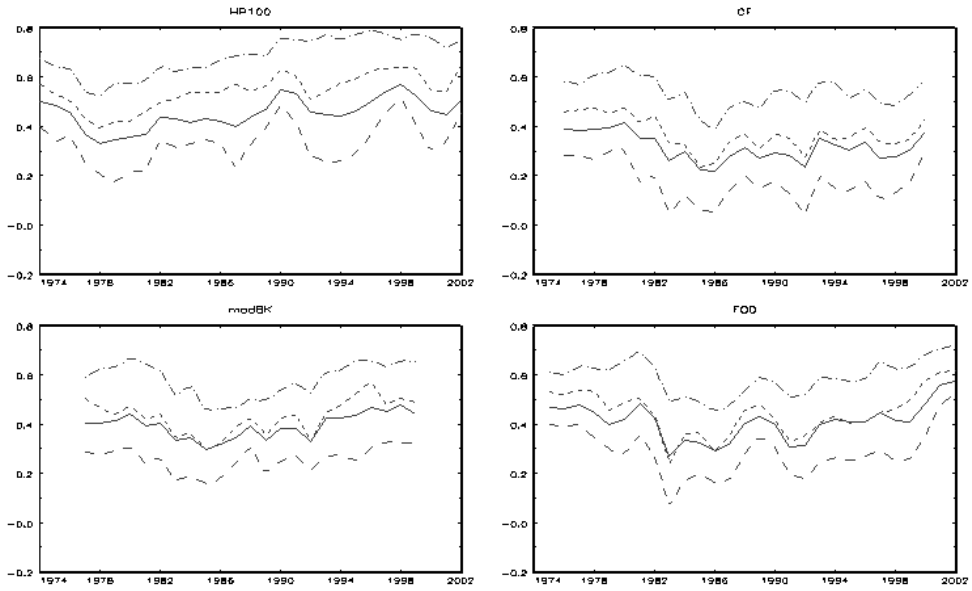

Figure3: Distribution of 10-year correlation coefficients, EU14 and G7 (see figure 1 for further notes)

3.1.3 The EURO countries

If we instead narrow the sample and consider only countries which adopted the EURO, the results confirm the pattern found so far; no systematic change in the variance but a higher correlation on average. Time paths in the last considered periods are steepest among all the cases looked at. The average correlation coefficient is 0.43 compared to 0.40 in the EU14 and 0.39 in the

EU14 and G7-sample. Nevertheless, the choice of the filter again plays a role.

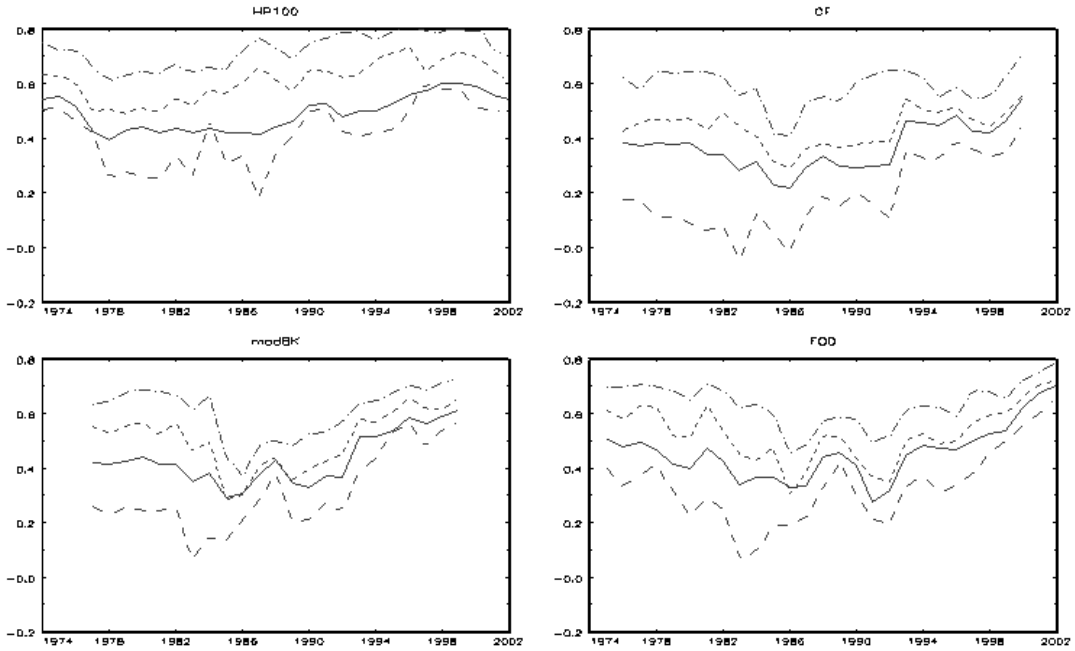

Figure 4: Distribution of 10-year correlation coefficients, EURO countries (see figure 1 for further notes)

3.2 Specific country pairs

Finally, we tried to detect the countries that are most highly synchronised. We consider two countries to be highly synchronized if, whatever filter is used, at least 2/3 of the correlation coefficients over time are significantly larger than zero. Using this criterion, we identified 10 country pairs: Belgium/Germany, Belgium/Italy, Belgium/Netherlands, Canada/USA, Finland/Sweden, France/Spain, Germany/Italy, Germany/Netherlands, Greece/Japan, and U.K./USA. As can be seen, there are only three pairs containing one or more non EU-members. Besides Finland/Sweden, the remaining pairs consist of EURO-countries.

When giving an interpretation to this, one should consider that the number of non-EU and non-EURO members, respectively, is low, compared to the total number of sample members. All things being equal, one would expect to find more high-correlation pairs with EU and EURO member states than with non-member states.

EU member states comprise about 67% of all of our considered country pairs and pure EURO member pairs about 40% of the total sample. Given

this pattern, our group of 10 significant country pairs should contain between 6 and 7 (6.69 to be precise) EU member pairs, from which about 4 would consist of only EURO countries and about 3 to 4 (3.31) not-only-EU pairs. Apparently, the actual group differs only slightly from that, showing a small overrepresentation of EURO-members. This seems to show that there is a higher synchronization within the EURO member states than between the EURO members and the rest of the world at work here.[4]

4 Conclusion

Are correlation coefficients in Europe on average higher than between European countries and other G-7 countries? If we take high correlation coefficients as an indicator that policy harmonisation is advisable, is policy harmonisation within Europe more advisable than between certain G-7 countries?

The evidence presented above seems to support this view. Recent years have witnessed an increase in correlation coefficients between EU14 member states and, even stronger, between EURO countries. This increase is not as strong when including the US, Canada and Japan into the sample. Policy harmonisation is more important and it should be easier within Europe than between Europe and the rest of the world.

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