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MACROECONOMIC FLUCTUATIONS IN SLOVENIA AND CROATIA[1]

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Abstract

This article analyzes macroeconomic activity in Slovenia and Croatia and compares it with the cyclical movements in Germany, as a proxy for the European Union as a whole. We use multivariate spectral analysis to detect and study cyclical movements in the period from 1991 to 2004. For Slovenia we find one spectral peak, at the frequency of thirty-six months. The frequency of the cyclical component corresponds to the length of a typical business cycle proposed by Mitchell and Burns. According to lag selection criteria, economic activity in Slovenia lags behind German economic activity by one month. We could not find any significant connection between economic activity in Croatia and Germany.

1. Introduction

Recent studies (Artis and Zhang, 1999) of the relationship of the Exchange Rate Mechanism (ERM) of the European Monetary System (EMS) to the international business cycle in terms of linkage and synchronization of cyclical movements found that the business cycle of the ERM countries have became more synchronized with the German cycle. In our paper we follow the same assumption as we analyse business cycles in Slovenia and Croatia. Our hypothesis is that 1) the series for Slovenia and Croatia should contain the cyclical component, which corresponds to the definition of business cycle proposed by Mitchell and Burns and has the same frequency as business cycle in Germany; and 2) the business cycles in Slovenia and Croatia should be synchronized with the German cycle.

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Such findings would confirm a general view in the business cycle literature that business cycles in the approach phase of integration are becoming more synchronized with the target integration bloc as a result of increased international trade, openness of financial markets, and global capital flows. Artis and Zhang (1999) suggest a high degree of synchronization of business cycle between EU and Germany. We therefore decide to choose Germany as an anchor country.

We test the hypothesis of the synchronization of cyclical movements on monthly data for the period 1991–2003. As can be seen in some applications, spectral analysis can be a valuable tool for studying business cycles (see, for example Sargent, 1987; Englund, Persson, & Svensson, 1992; Reiter, 1995; and Woitek, 1997). It has been used to study the existence of cycles in RBC models by Watson (1993), Söderlind (1994), Cogley and Nason (1995), and Wen (1998), and it has been suggested as an econometric method for measuring the goodness-of-fit for RBC models (Watson, 1993). We chose multivariate spectral analysis to study the relationship between business cycles of Germany, Slovenia, and Croatia. The selected method is used to estimate the strength of wavelength relationship between economic indicators.

In section 2 of the article we set out the analytical framework; in section 3, we present basic procedures that we apply to selected time series; section 4 summarizes the main findings; and section 5 offers a conclusion.

2. Analytical framework

Quantifying co-movements with the business cycle is conceptually difficult. Burns and Mitchell (1946) quantified co-movements in terms of leads or lags at turning points of each series relative to the reference cycle and in terms of their index of conformity. More recent work has focused on the second moment of the joint distribution of the series of interest. For example, Hymans (1973) summarized cyclical timing by estimating phases in the frequency domain at business cycle frequencies. We focus on the second moment properties of the series.

Business cycles are characterized by a high correlation between several macroeconomic variables over the business cycle. Multivariate time series analysis in the frequency domain can be employed to analyze this phenomenon by using coherence and phase. The coherence between two or more time series can be used to measure the extent to which multiple time series move together over the business cycle. The phase gives the lead of y over x at frequency ω. There is close relationship between the concept of the phase of two time series and the business cycle research of isolating leading, coincident, and lagging indicators. Furthermore, the concept of phase is closely connected to the concept of Wiener-Granger causality (Granger, 1980; Granger, 1988).

It is common that the cross-spectrum shows no regularities. This is because there is not enough information in the original signals to obtain a well-behaved curve. Using a longer series does nothing to correct this problem. The answer is to use smoothing and filtering procedures. Filters are normally applied on the input signals. They are used for two general purposes: separation and restoration. Signal separation is needed when a signal has been contaminated with noise. Signal restoration is used when a signal has been distorted in some way. An example of this problem can be seen in Lucas (1972), where rational agents solve a signal separation and restoration problem in order to react optimally to an observed price change, where it is unknown whether the price change reflects a change in the general price level or change in real demand on the individual market.

Although the spectral density diagram is an asymptotically unbiased estimate of the spectrum, it is not consistent. A whole set of literature has been developed on smoothing methods for the spectral density function, which are referred to as spectral windows. Care, however, must be exercised not to introduce a cyclical peak solely due to the smoothing technique.

When analyzing economic variables, a common problem is to have short and particularly volatile time series. To check if the spectrum of individual variables is stable (for cross-spectrum we use the Welch estimation procedure, which belongs to nonparametric methods), we introduce subspace methods, also known as super-resolution methods. They generate frequency component estimates for a signal based on an eigenanalysis or eigendecomposition of the correlation matrix. These methods are best suited for short signals and are effective in the detection of sinusoids buried in noise, especially when the signal to noise ratios are low. In our example we selected multiple signal classification method (MUSIC), which is normally used in digital signal processing. For additional confirmation of the results obtained by estimation of coherence and phase, we also use the Granger causality test.

3. Data

The monthly indexes of industrial production were obtained from the Bank of Slovenia (2004), European Central Bank (2004), Deutsche Bundesbank (2004), and Economic Institute of Zagreb (2004). Data cover the time-span from January 1991 to December 2003.

Almost each time series includes the impact of seasons in its movement. The use of such original monthly series can bring us to absolutely wrong conclusions about the further development of the observed phenomenon. It is therefore reasonable to employ special procedures in order to separate the seasonal component from other components. Of course, it is desirable as well as necessary that the series does not lose its characteristics in this process. A well-known example of the use of the method of moving averages is the Method II—version X11 from 1968. The main weakness of this method, and also the weakness of all other traditional procedures, lies in neglecting the fact that the seasonal component has a stohastic character and that it is related to other components. It is thus better to use the seasonal models ARIMA (Bundesbank, 1999). Despite the fact that numerous programs have been developed that enable the use of these methods, we use the program X11ARIMA (Statistics Canada, 1999) in the empirical part of our research.

Stationarity of time series is a common phenomenon, especially in periods with stable conditions. Nonstationary time series may have the "typical spectral shape" of Granger (1966), which makes it impossible to detect business cycle frequencies. Differentiation of time series can eliminate the presence of nonstationarity, but it also has drawbacks (Charemza and Deadman, 1992). Differentiation also affects long-term relationships between economic variables.

Testing for Stationarity has been done in two steps. In the first step, we tested original series. In the second step, we removed the trend. The testing of de-seasoned data showed that series are not stationary if the model does not include the trend. With the inclusion of trend, series become stationary. This is why the observed series need to be remodeled in the consequent testing. As the use of different forms of differentiation may negatively influence the results of further testing, we decided to eliminate the long-term linear trend by using a Hodrick-Prescott filter (λ 14400 suggested value for monthly data).

The discussions in Canova (1998) and Burnside (1998) make clear that different detrending methods emphasize different frequency ranges in the data, and that many stylized facts are sensitive to the choice of detrending method. As we apply the same procedure on all series, it seems, that in our application, this method gives good results.

Table 1. Results of stationarity test for industrial production

Coefficient:	**(_-1)**	**_**	**_**	**ADF**
SLOSA	-0,102138 (-1,705967)	-0,486705 (-5,624749)	9,945391 (1,726474)	-1,705967
SLOSAHP	-0,680244 (-5,744431)	-0,205232 (-2,227017)	-0,122836 (-0,405501)	-5,744431
CROSA	-0,125676 (-2,080821)	-0,398333 (-4,379440)	13,54788 (2,090006)	-2,080821
CROSAHP	-0,622601 (-5,256318)	-0,157049 (-1,612279)	-0,001295 (-0,003852)	-5,256318
GERSA	0,014685 (0,420257)	-0,521215 (-5,881761)	-1,263067 (-0,378521)	0,420257
GERHP	-0,375271 (-4,174619)	-0,364768 (-4,138464)	-0,061358 (-0,415437)	-4,174619

Critical values by MacKinnon:
-3,4928 at 1% significant level
-2,8887 at 5% significant level
-2,5811 at 10% significant level

Note: In each field we show first the coefficient value and then the t-statistics.

SLOSA	Industrial production (Slovenia)—seasonally adjusted
SLOSAHP	Industrial production (Slovenia)—seasonally adjusted and HP trend removed
CROSA	Industrial production (Croatia)— seasonally adjusted
CROSAHP	Industrial production (Croatia) —seasonally adjusted and HP trend removed
GERSA	Industrial production (Germany)—seasonally adjusted
GERSAHP	Industrial production (Germany)—seasonally adjusted and HP trend removed

4. Results

A major impression from recent studies (Bergman, Bordo & Jonung, 1998) of contemporaneous correlations of output for developed countries is that the correlations tend to increase over time. Most of the significant correlations are reported from the post-Bretton Woods period. The cyclical co-movements for real GDP across countries suggest growing international linkages over time. Some authors have researched changes over time in correlation patterns. Angeloni and Dedola (1998) find that GDP correlations between Germany and other EU countries were much higher during period 1993–97 than during 1986–92. As noted by Clark and Shin (2000), Imbs (1998), and Krugman (1993), among others, greater similarity in production structures is likely to increase business cycle correlations. Industry-specific shocks will create more co-movement among regions with similar production structures than among regions with dissimilar structures. Industry structures of transition economies are increasingly adapting to the structures of developed economies.

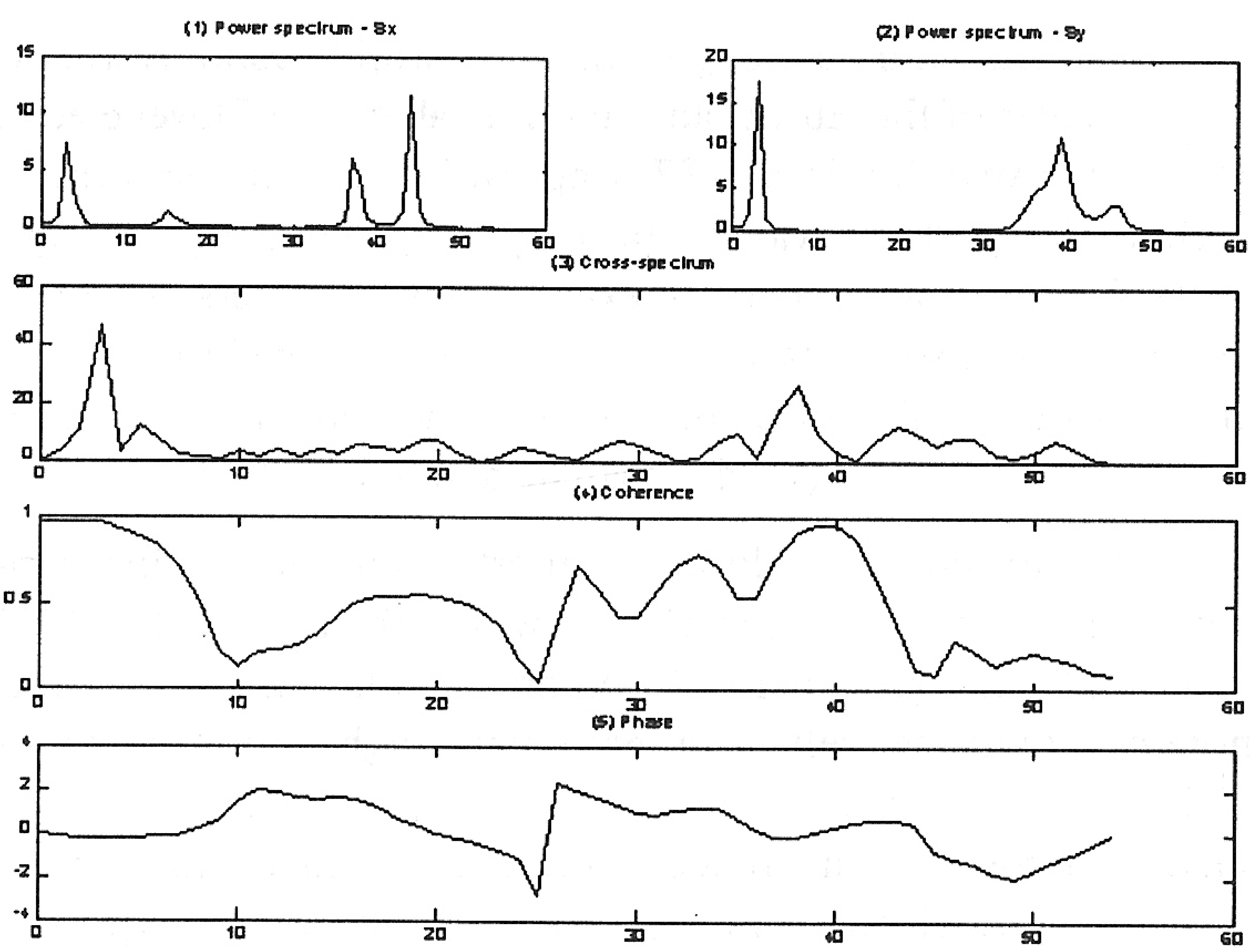
Virtually all economies experience recurrent fluctuations in economic activity that persists of several quarters to several years. There is a definite tendency for the business cycles of developed countries to move together. In our research we try to ascertain whether Slovenia and Croatia correspond to this trends.

In our analysis we employed the monthly index of industrial production (1999=100) under the assumption that the selected series represent economic activity. Such a choice enabled us a sufficient number of observations for empirical testing. Since time series have to be stationary and must not include the trend, the long-term trend was subtracted from original time series.

The results of testing data for Slovenia are presented in figure 1. The first graph presents a spectral density diagram for index of industrial production in Slovenia (1999=100). We find one spectral peak at the frequency of thirty-six months. The spectrum of industrial production has also two additional peaks at higher frequencies, which can be attributed to the strong stochastic component of selected time series. In the second graph the spectral density diagram for German industrial production is presented. We find again one spectral peak with the same frequency but the peak diverges stronger. As in case of Slovenia, an additional spectral peak can be found at the frequency range, which is typical for stochastic component. In this way the first hypothesis for Slovenia is confirmed—the frequency of cyclical component corresponds to the length of typical business cycle proposed by Mitchell and Burns and is significant for both countries.

By using the spectral analysis, we were able to estimate the length of the business cycle in Slovene economy from 1991 to 2004. Following the results from our analysis we can conclude that the first years of Slovenian transition were marked by a typical transformation depression. This is not surprising, since the Slovenian economy was hit by a series of market losses: the collapse of CMEA markets; the Gulf War, and the collapse of the Yugoslav internal market. This collapse has strongly influenced the economic activity and the financial position of the economy. The production was pushed down rapidly to a decline by 9.3 percent in 1991 and 6.0 percent in 1992.

Fig. 1. Cross-spectral analysis results (Slovenia – Germany; note: on the x-axes are the frequency values.)



Our analyses identify June 1993 as a trough and as a start of a new cycle (we used inverse real discrete Fourier transformation). This was confirmed by Mencinger (1995), who also found that in the middle of 1993 Slovenia suddenly reached the bottom of depression. The recovery that can be explained by an increase in aggregate demand in which moderate growth of foreign demand coincided with fast growth of domestic demand. The peak was reached in January 1995. The turnaround could be attributed to Holland disease and to a debt crises in the Slovene economy. The peak was also anticipated by *Surveys on Business Trends* published by the Statistical Office of the Republic of Slovenia (1994), which reported continued worsening export demand from October 1994 (the diffuse index was steadily growing from 34 percent in October to 43 percent in December).

The end of the first cycle was reached in June 1996. After reaching trough, economic development improved in the second part of the year mainly due to economic recovery in Europe and improved export competitiveness. According to the Institute of Macroeconomic Analysis and Development (1997), export competitiveness (measured in terms of unit labor costs in the basket of currencies) improved in 1996 by 7.3 percent after a market drop of 11.9 percent in 1995. Competitiveness improved as a consequence of increased productivity, the lower tax burden on wages, and the real deprecation of the tolar.

Acceleration in rate of growth of the world economy as a whole, and in particular of the European Union, enabled the Slovene economy to extend the expansion into 1997. Improved economic performance of main economic partners was the primary factor enabling the export to rise in 1997 without an increase in export competitiveness. That year the consensus between social partners on wages was reached timely. Thus an adequate income policy mechanisms were adopted which succeeded in keeping the wage growth behind growth in labor productivity.

The slowdown in Slovenia's most important trading partners' economic growth and export market growth in the last quarters 1997 and in 1998 held back growth in Slovenian exports, and with some lag, economic activity as well. The extremely high value of the export multiplier of the Slovene economy (0.6) explains the high degree of sensitivity of Slovene macroeconomic activity to changes in export growth. Cyclic deceleration in 1998 was therefore not a surprise, since the contagious effects of the Asian crises spread to Europe.

The cross-spectral density diagram (figure 1, graph 3) confirms the hypothesis of a relationship between the cyclical component of industrial production in Slovenia and Germany. The spectral peak is again at frequency of thirty-six months. The peak is statistically significant, which is confirmed with the maximum value of coherency at the selected frequency (figure 1, graph 4).

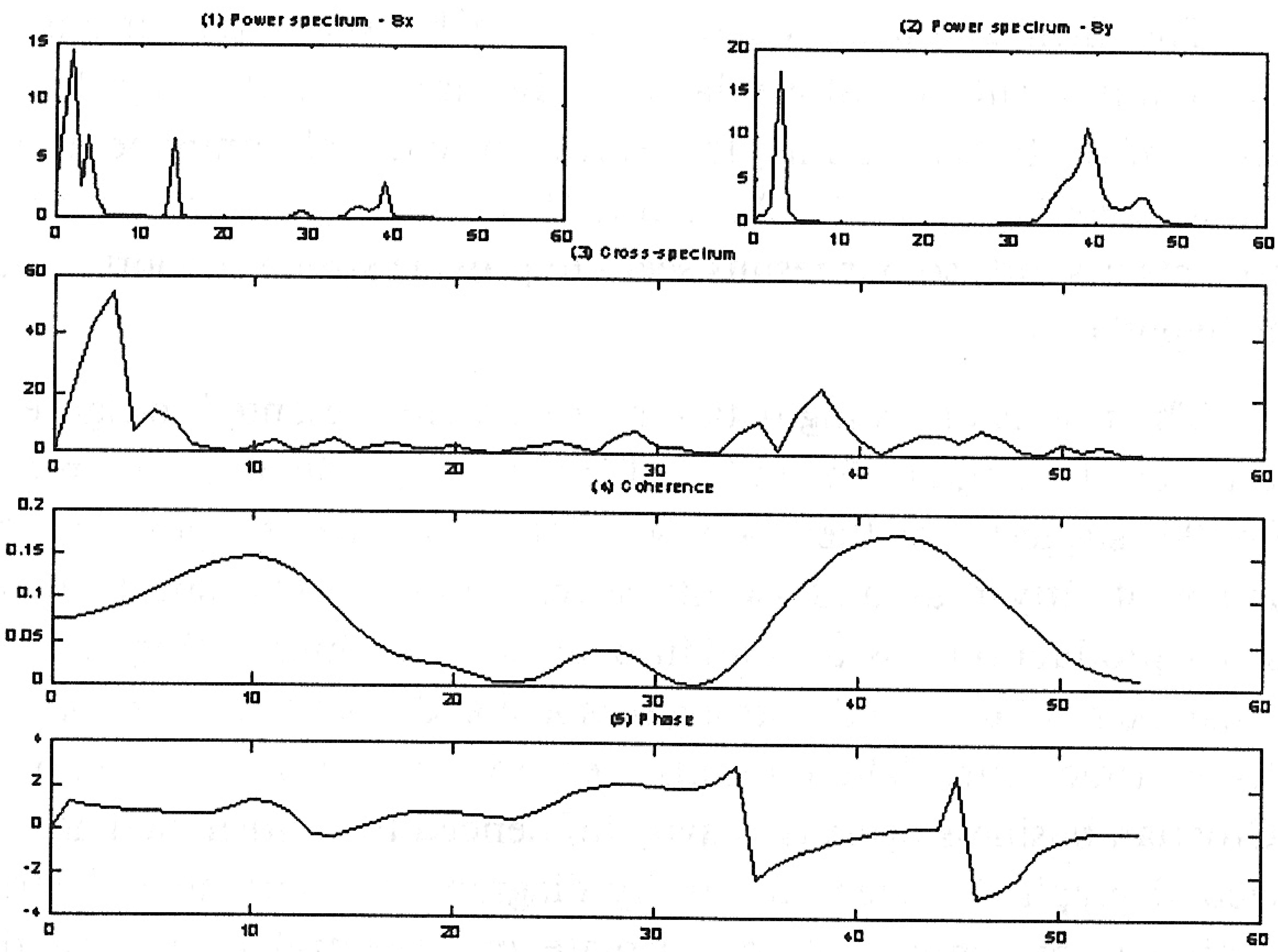
The fifth graph shows the time lag between oscillations of cyclical components of Slovenia and Germany. At the significant frequency of thirty-six months, the Slovenian cyclical component lags with an average lag-time of 1.2 months. The time lag between cyclical components is short, so our results seem to provide strong support to our second hypothesis.

The results of testing data for Croatia are presented in figure 2. Spectral density diagram for index of industrial production in Croatia (1999=100) suggest that there are two significant spectral peaks at the frequency of fifty-four and twenty-seven months. The spectrum of industrial production has also additional peaks at higher frequencies, which can be attributed to the strong seasonal and stochastic components of selected time series. These results seem to confirm the presumption, that Croatian business cycle is heavily influenced by tourism activity. In the second graph the spectral density diagram for German industrial production is presented. We can isolate one spectral peak with the frequency of thirty-six months. Therefore the first hypothesis for Croatia can be confirmed only partially—there are two strong cyclical components that correspond to the length of a typical business cycle proposed by Mitchell and Burns, but the length is not the same as in the case of Germany.

The cross-spectral density diagram (figure 2, graph 3) confirms, that there is no strong relationship between business cycles in Croatia and Germany. The spectral peak is at frequency of thirty-six months but is not statistically significant, which is confirmed with the low value of coherency (less then 0.5) at the selected frequency (figure 2, graph 4).

The fifth graph shows the time lag between oscillations of cyclical components of Croatia and Germany. As there is no significant frequency, it is no worth to determine the lead or lag relation-ship. The results only suggest, that Croatian economic activity lags after German activity at all business cycle frequencies. Blanchard and Watson (1986) draw attention to large shocks, which contribute to macroeconomic instability along with the small ones. Large shocks presumptively occur at irregular intervals—war is a typical case. Such events and their direct and indirect effects are likely to increase the diversification and irregularity of business cycle over time.

Fig. 2. Cross-spectral analysis results (Croatia—Germany; note: on the x-axes are the frequency values.



The initial conditions for transition differed in Croatia considerably from other former socialist countries. Unlike the case of Slovenia, the most disadvantageous characteristic imposed on the economic growth in independent Croatia was the war. Economic events in Croatia in early 1990s had typical properties of transformational depression: a contraction of output surpassing stabilization expectations, a drop in employment and the standard of living, high inflation. Cumulative fiscal problems, fast liberalization of trade and prices, and a dramatic reduction of trade with former Yugoslav republics resulted, in 1993, in one of the highest inflation rates in transition economies (1149.7%) and in a strong cumulative drop in output (37%) from 1989 to 1993. Economic recovery started 1994, with a one-year lag behind Slovenia. The economic damage that was inflicted on Croatia by the war dampened economic activity so that GDP level and industrial production level were in 1995 at 71.4% and 61.1%, respectively, of 1990 performance (WIIW, 1996). The unusu-ally long business cycle trough is undoubtedly related to these facts.

Several factors affect the degree of synchronization of business cycles in different economies. First, business cycles in small, open economies with strong trade links with major economies are likely to be more synchronized with them than is the case for larger, more closed economies. This fact seems to be confirmed in the case of Slovenia. A high degree of synchronization with the German cycle may be attributed to Slovene economy's increased openness after independence and the rising EU share of Slovenian foreign trade. We presume that the lesser synchronization of the Croatian cycle is due to the war conditions that prevailed in the early 1990s and impacted the Croatian economy for the rest of decade.

Second, the extent to which domestic demand movements are correlated across countries depends on whether there are common pressures affecting all economies, and the extent to which countries adopt a common policy stance (OECD, 1995). The process of integrating to EU is deepening the economic integration between Slovenia and Croatia on one side and present members of EU on the other. The need to adopt a common policy stance will undoubtedly increase, so some synchronization of business cycle is expected also from this factor.

Third, the shift to an exchange rate regime in which the currencies float against each other has been an important facilitation of desynchronization. Fixed rates or a single currency is therefore a factor of synchronization. The exchange rate systems and movements in the next years in Slovenia and Croatia will be in the function of adjustment to EU and EMU, so we may expect synchronization with German and EU cycle also from this point of view. Such trends would be in line with current trends in Europe, where ERM membership has promoted a shift of business cycle affiliation to that of the anchor country of the system.

The conclusions made in this paper are based on results of empirical testing. As we described earlier, the multivariate spectral analysis was adopted in our example. These types of tools work best when analysing long stretches of high frequency data in stable regimes. In our case data can cover only the period from 1990. Since in the year 1990 the former Yugoslavia broke apart, this year could not be included in the sample. On the other hand, the results seem to be very stable. We tested single spectrum for each time-series with two different methods: nonparamteric Welch method, and Multiple Signal Classification (MUSIC) method, which belong to parametric methods. All these procedures gave same results (results are available upon request by the authors).

To support additionally the results obtained with multivariate spectral analysis, we also employed the Granger causality test. The results are presented in table 2. According to lag selection criteria presented in the table 3, economic activity in Slovenia lags behind German economic activity for one month. Additional significant lags were discovered, however the value of F-statistic is significantly lower. Granger causality test also supports the results for Croatia. We could not find any significant connection between economic activity in Croatia and Germany.

5. Conclusions

The results in the paper confirm the first hypothesis for Slovenia. The frequency of the detected cyclical component corresponds to the length of a typical business cycle proposed by Mitchell and Burns and is significant. Based on the results of the cross-spectral density diagram, we can also confirm the second hypothesis. Based on the results we can conclude that there is a strong and significant relationship between the cyclical component of industrial production in Slovenia and Germany. The Slovenian cyclical component lags behind the German activity.

The results for Croatia, however, did not fully confirm our two hypotheses. The spectral density diagram for Croatia suggests that there are two significant spectral peaks. Therefore the first hypothesis for Croatia can be confirmed only partially—there are two strong cyclical components that correspond to the length of a typical business cycle proposed by Mitchell and Burns, but the length is not the same as in the case of Germany. The cross-spectral density diagram shows no strong relationship between business cycles in Croatia and Germany. This indicates that the second hypothesis does not hold for Croatia.

The conclusions of this article are based on results of empirical testing. As we described earlier, the multivariate spectral analysis was adopted in our example. These types of tools work best when analysing long stretches of high frequency data in stable regimes. In our case, data can cover only the period from 1990. Since in the year 1990 the former Yugoslavia broke apart, this year could not be included in the sample. On the other hand, the results seem to be very stable.

Table 2. Granger causality test for the period 1991–2004 (Note: In each field we show first the value of the F-statistic and then significance level; SLO=Slovene industrial production, CRO=Croation, GER=German).

	Lags					
Null Hypothesis:	**1**	**2**	**3**	**4**	**5**	**6**
SLO does not Granger Cause GER	1.387 27 (0.24 190)	1.180 45 (0.31 190)	0.679 38 (0.56 703)	0.542 16 (0.70 519)	0.435 92 (0.82 222)	0.613 54 (0.71 878)
GER does not Granger Cause SLO	8.322 34 (0.00 488)	2.113 44 (0.12 685)	1.339 21 (0.26 700)	2.172 44 (0.07 917)	2.733 32 (0.02 484)	2.551 24 (0.02 630)
CRO does not Granger Cause GER	0.017 15 (0.89 611)	0.613 65 (0.54 365)	0.858 27 (0.46 603)	1.569 26 (0.19 015)	1.406 18 (0.23 099)	1.220 04 (0.30 527)
GER does not Granger Cause CRO	1.981 00 (0.16 265)	1.365 46 (0.26 056)	1.543 65 (0.20 905)	1.530 74 (0.20 080)	1.781 01 (0.12 616)	1.507 03 (0.18 707)
	7	**8**	**9**	**10**	**11**	**12**
SLO does not Granger Cause GER	0.804 90 (0.58 587)	1.142 68 (0.34 614)	0.922 87 (0.51 107)	0.977 20 (0.47 179)	0.873 71 (0.56 988)	0.778 64 (0.66 963)
GER does not Granger Cause SLO	4.600 91 (0.00 026)	3.840 72 (0.00 084)	4.156 09 (0.00 027)	3.340 80 (0.00 148)	2.709 15 (0.00 646)	2.203 08 (0.02 301)
CRO does not Granger Cause GER	1.018 54 (0.42 547)	0.879 60 (0.53 797)	0.690 59 (0.71 492)	0.596 68 (0.81 085)	0.508 27 (0.89 061)	0.413 09 (0.95 267)
GER does not Granger Cause CRO	1.780 01 (0.10 404)	1.663 00 (0.12 274)	1.602 19 (0.13 221)	1.131 68 (0.35 309)	1.220 44 (0.29 297)	1.118 93 (0.36 278)

An important assumption of the applied method is time-invariance. The data come from economies in transition, whose structures are changing. When more data are available, it seems useful to continue our testing with procedures used by Sargent and Cogley (2001). Their use of Bayesian methods to estimate vector autoregressions with drifting parameters, and impute drift in spectral densities from the VAR estimates. The application of such methods would enable us to analyze how the coherence across selected countries has changed in the observed period.

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POVZETEK

Članek obravnava makroekonomsko aktivnost v Sloveniji in Hrvaški, ter jo primerja s cikličnimi spremembami v Nemčiji, ki je uporabljena kot cenilka poslovnega cikla v EU. Za zaznavo in preučevanje cikličnih gibanj v obdobju od leta 1991 do leta 2004 je uporabljena multivariatna spektralna analiza. Spekter za Slovenijo vsebuje en vrh pri frekvenci 36 mesecev. Frekvenca ciklične komponente ustreza definiciji tipičnega poslovnega cikla, ki sta jo podala Mitchell in Burns. Glede na kriterij izbire časovnega odloga, ekonomska aktivnost v Sloveniji zaostaja za aktivnostjo v Nemčiji za en mesec. Za Hrvaško pa analiza ni pokazala statistično značilne povezave z ekonomsko aktivnostjo v Nemčiji.