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STUDYING BUSINESS CYCLES SYNCHRONIZATION

The paper researches business cycles synchronization. The fluctuations in post-Soviet countries are considered. The study examines different measures of synchronization in groups of countries according to some criteria.

Keywords: business cycle; synchronization; measures of synchronization; credit rating.

Introduction. Financial crisis in 2007-09 caused the deep and synchronized global recession in the world, which was accompanied by the significant reduction of the international trade. It is widely believed that the unprecedented synchronization of the downturn across countries is related to the economic globalization witnessed over the decades leading up to the crisis. Globalization has tied the countries more closely together in various ways [5, p.5].

The great part of world literature devoted to researches of economic cycles in different countries indicates the high correlation between developed countries. But despite on many studies on this field the causes of appearance of synchronization are unexplored [6, p.3].

The problem of business cycles synchronization is considered by foreign researches in cases of developed countries, especially for members of European Union and Great 8.

Existing theoretical models studying business cycle synchronization are mostly based on the standard international real business cycle model. In a two-country open economy model with complete financial markets, Backus et al. show that, in a world of fully integrated asset markets, high trade intensity is associated with lower business cycle correlations. Extending this model to account for vertical specialization, Kose and Yi (2001) suggest that higher trade integration might lead to more or less synchronization, depending on the nature of trade and the type of shocks hitting the economies [5, p.9 – 10].

Economists of IMF pay a special attention to mentioned problem. T.Gebling and T.Bayomi compared the turning points of business cycles in G7 countries during the 1973-2000 and revealed the synchronization not only of moments of peaks and bottoms but also coincidence of the duration of recession. The recession at the beginning of 1980th were synchronized too [3, c.134].

Heatcote and Perri measured synchronization of GDP, investment, consumption and employment cycles. The measurement is a correlation between time series of USA and non-USA during 1969 – 1981 and 1981 – 2002. Time series were detrended using Hodrick-Prescott filter, first differences and high-pass filters. Results showed the low degree of synchronization between cycles of USA and other countries.

Kose, Prasad and Terrones were the first to examine the correlations of output and consumption growth rates in each country with the growth rate of the composite measure of world output. They estimated dynamic unobserved factor models to decompose fluctuations in the macroeconomic aggregates into a factor common across all countries and a country-specific factor. Finally, they present a more formal regression analysis of factors that influence correlations of individual country.

Doyle and Faust researched changes in movements of growth rates in G7 (basically without Japany). They used not only describing methods but vector autoregression with lag and constant. Also they checked how chosen parameters, for example, correlation coefficients change in time. But there were no direct evidences that correlation increases with increasing integration during last years and decades.

Inklaar and Haan attempted to repeat researches of Artis and Zhang 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.

Inklaar and Haan compared correlation of business cycles

$$1 + \frac{(x_t - trend_t)^2}{trend_t}$$, with business cycle in Germany during 4

subperiods of 1960 – 1998. Unlike Artis and Zhang they did not reveal systematic relation between stability of currency exchange and business cycles synchronization.

Traistaru used filtered GDP data and compared the degree of business cycle synchronization between members of European Monetary Union and countries of Central Europe during 1990 – 2003. It was revealed the correlation between groups of countries is lower than correlation inside EMU. The analysis of regression models with dummies shows the similarity of economic structures and bilateral trade intensity positively and significantly related with correlation of business cycle.

Kamacho, Peres-Kiros and Saiz based their research on monthly industrial production time series of current members of European Union, partner countries and some economic development countries. They used a set of researches about comovements of business cycles in these countries. Firstly using the VAR-model the production indices and forecast are calculated. Then appropriate errors are estimated and synchronization of business cycles in two countries is measured as difference (1 – correlation) of their forecast errors. Then authors analyzed short-term and long-term properties of industrial time series filtered with Hodrick-Prescott filter and calculated dynamic correlation suggested but Reichlin. Finally separate binary cycles were constructed, where 1 is a recession and 0 – other case. The correlation is used as measurement of synchronization between business cycles of two countries. Analysis showed the economies of European Union are more synchronized with each other than with outside. Nevertheless close relations can be explained by establishment of Union, not by political values. That's why the deeper integration doesn't cause further increasing of synchronization.

Shirwitz and Walde attempted to explore the changes of synchronization between countries during the time. They chose 17 countries (14 of EU and G7) and detrended their time series using 4 filters: Hodrick-Prescott filter, Christiano-Fitzgerald filter, modification of Baxter-King filter and difference filter. Also the coefficients of correlation and standard errors were calculated. The number of significant coefficients is not constant during the time, generally it reduced at the beginning, but at the end it increased again [4, c.1-3].

Gerlah found out the correlation in output fluctuations between countries with both currency regime fixed and floating. Bekus and Kahoe researched data of 10 industrial development countries and revealed the high degree of similarity between fluctuations in different countries. Canova and Marrinan emphasized on the relation of high correlation between economic cycles and different causes of shocks and transmission mechanisms. All these researches proved the high level of interdependent of industrial development countries.

Credit rating is an independent subjective quality estimation used by investors to define the degree of credibility of creditors and to take a decision about investments. The credit rating has an inverse relationship with the possibility of debt default. In the opinion of the rating agency, a high

credit rating indicates that the borrower has a low probability of defaulting on the debt; conversely, a low credit rating suggests a high probability of default. Sovereign credit ratings give investors insight into the level of risk associated with investing in a particular country and also include political risks. At the request of the country, a credit rating agency will evaluate the country's economic and political environment to determine a representative credit rating. Obtaining a good sovereign credit rating is usually essential for developing countries in order to access funding in international bond markets.

The biggest world credit rating agencies are:

• "Standard and Poor's Corporation" ("S&P") i "Moody's Investors Service, Inc." ("Moody's");

• Fitch Ratings Ltd. ("FITCH");

• Rating&Investment Information Inc. (Japan).

Sovereign rating criteria address the factors that affect a sovereign government's willingness and ability to service its debt on time and in full. An analysis focuses on a sovereign's performance over past economic and political cycles, as well as on factors that suggest to us greater or lesser fiscal and monetary flexibility over the course of future economic cycles.

The five factors that form the foundation of our sovereign credit analysis are:

• Institutional effectiveness and political risks, reflected in the political score.

• Economic structure and growth prospects, reflected in the economic score.

• External liquidity and international investment position, reflected in the external score.

• Fiscal performance and flexibility, as well as debt burden, reflected in the fiscal score.

• Monetary flexibility, reflected in the monetary score [2].

Problem. Increasing globalization causes the increased interest to business cycles synchronization. Understanding of degree of business cycles synchronization is the key to understanding such phenomena as coordination of international policy and shock transmission in different countries. Our study suggests dividing countries into groups according to their credit rating. The fluctuations in post-Soviet countries are considered.

The 18 countries such as USA, Canada, Germany, UK, France, China, Poland, Czech Republic, Slovakia, Russia, Italy, Turkey, Slovenia, Hungary, Croatia, Ukraine, Belarus and Moldova are chosen for research. We divided chosen countries into groups according to some criteria.

1) According to credit rating:
Group 1 – USA, Germany, Canada;
Group 2 – Great Britain, France, and China;
Group 3 – Poland, Czech Republic, and Slovakia;
Group 4 – Russia, Italy, and Turkey;
Group 5 – Slovenia, Hungary, and Croatia;
Group 6 – Ukraine, Belarus, Moldova.

2) According to economic development:
Group 1 – USA, Germany, Canada, Great Britain, France, China, Italy;
Group 2 – Poland, Czech Republic, and Slovakia, Russia, Turkey, Slovenia, Hungary, Croatia, Ukraine, Belarus, Moldova.

3) According to geographical location:
Group 1 – USA, Germany;
Group 2 – Great Britain, France, Germany;
Group 3 – Slovenia, Italy, and Croatia;
Group 4 – Hungary, Czech Republic, and Slovakia;
Group 5 – Ukraine, Poland, Belarus, Moldova;
Group 6 – Russia, China, and Turkey;

Results. First we determine for each country GDP trend applying a Hodrick-Prescott filter to the log of each country GDP, and then compute its own cycles: $h_{it} = y_{it} - trend_{it}$,

where h_{it} – cycle, y_{it} – export, $trend_{it}$ – trend.
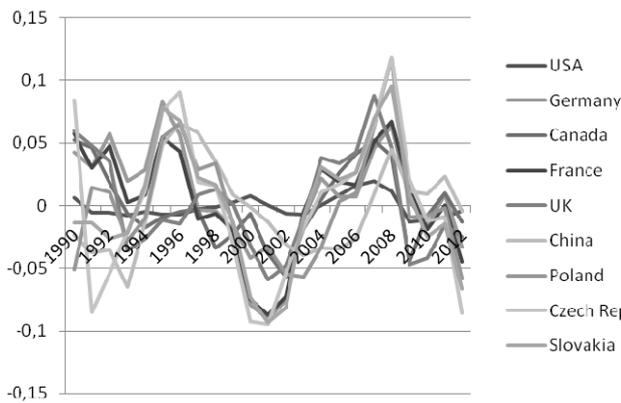
Fig. 1. GDP cycles

Fig. 2. GDP cycles

To make it convenient to demonstrate we divided our cycles on 2 graphs. Nevertheless we can see the general recession at the beginning of 1990th and in 1999 – 2003. The similar behavior of cycles let us to assume about the existence of synchronization between different business cycles.

There are two classes of synchronization measures. The first class is based on regression models. The second class is built directly from the series. We tested the measures of the second class. All indices are calculated for each pair of countries (153 pairs). The first of them was purposed by Giannone and Reichlin and Kalemli-Ozcan et al.:

$$SYNCH_{ijt} = -\left| \left(\ln Y_t^i - \ln Y_{t-1}^i \right) - \left(\ln Y_t^j - \ln Y_{t-1}^j \right) \right|$$

This coefficient a direct measure of the difference in growth rates therefore the different variability across series will have a direct impact on the period-by-period synchronization index. [1, p.5-8].
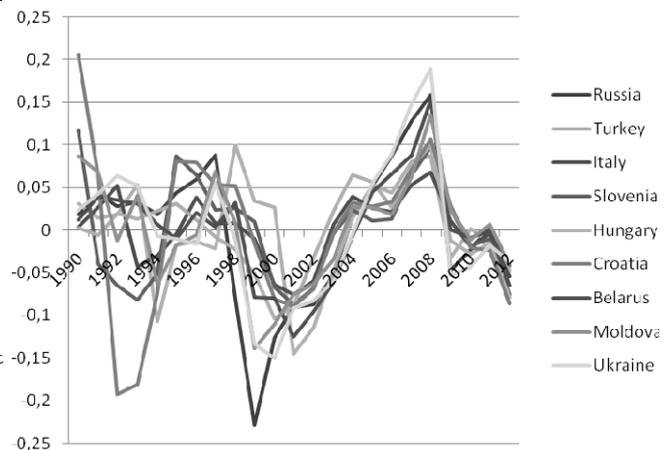
This index is non-positive, being that the closer to zero the higher is the measured synchronization between the series. Furthermore it does not over a metrics to know if the cross-correlation is positive or negative and so the analysis of the evolution over time is just done in relative terms.

The next index is the one used in Cerqueira and Martins:

$$SYNCHa_{ijt} = 1 - \frac{1}{2} \left(\frac{(y_{i,t} - \bar{y}_{i,t})}{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(y_{i,t} - \bar{y}_{i,t})^2}} - \frac{(y_{j,t} - \bar{y}_{j,t})}{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(y_{j,t} - \bar{y}_{j,t})^2}} \right)$$

where $y_{i,t}$ represents the output gap or growth rate at time t for country i and its variations purposed by Cerqueira:

$$SYNCHb_{ijt} = \frac{1}{2}\ln\left(\frac{1+\dfrac{SYNCHa_{ijt}}{2T-3}}{1-SYNCHa_{ijt}}\right)$$

$$SYNCHc_{ijt} = \tanh\left(SYNCHb_{ijt}\right).$$

Cerqueira and Martins showed that the average of $SYNCHa_{ijt}$ is the unconditional correlation coefficient over the whole period. However Cerqueira showed that this index has an asymmetric support between $3 - 2T$ and 1, and by giving to much weight to periods where the index exhibits negative correlation it may bias the result of the analysis

performed. To overcome this shortcoming and provide a balanced support for the index Cerqueira purposed two transformations: one that transforms the original index in an unbounded index (version b), and another that limits the index between -1 and 1 (version c). Contrary to the previous three indexes, these are able to distinguish between positive from negative correlation [1, p.9-10].

We measured synchronization with all presented coefficients. Let analyze the results of using $SYNCHc_{ijt}$. Calculations were done on historical data of mentioned countries during 1991 – 2012. On the table 1 indices of synchronization between each pair of countries (153 pairs) in 2012 are presented.

Table 1. Indices of synchronization

	USA	Germany	Canada	France	UK	China	Poland	Czech R-c	Slovakia	Russia	Italy	Turkey	Slovenia	Hungary	Croatia	Belarus	Moldova	Ukraine
USA																		
Germany	-0,94																	
Canada	0,26	0,34																
France	-0,98	0,75	0,10															
UK	-0,14	0,57	0,74	0,43														
China	0,65	-0,99	-0,66	-0,99	-0,88													
Poland	-0,92	0,76	0,41	0,75	0,61	-0,99												
Czech Repu	-0,99	0,70	-0,34	0,74	0,09	-0,99	0,68											
Slovakia	-0,97	0,76	0,19	0,76	0,48	-0,99	0,75	0,73										
Russia	0,59	-0,21	0,72	-0,50	0,63	-0,09	-0,10	-0,81	-0,41									
Italy	-0,99	0,74	-0,07	0,76	0,31	-0,99	0,73	0,75	0,75	-0,65								
Turkey	0,12	0,44	0,76	0,24	0,75	-0,76	0,50	-0,18	0,31	0,70	0,08							
Slovenia	-0,99	0,73	-0,13	0,76	0,27	-0,99	0,72	0,76	0,75	-0,69	0,76	0,03						
Hungary	-0,99	0,73	-0,15	0,76	0,25	-0,99	0,72	0,76	0,75	-0,70	0,76	0,01	0,76					
Croatia	-0,95	0,76	0,29	0,76	0,54	-0,99	0,76	0,71	0,76	-0,28	0,74	0,40	0,74	0,74				
Belarus	-0,36	0,64	0,72	0,54	0,76	-0,94	0,67	0,27	0,58	0,55	0,45	0,74	0,42	0,41	0,62			
Moldova	0,51	0,01	0,75	-0,29	0,68	-0,30	0,10	-0,69	-0,19	0,76	-0,47	0,73	-0,52	-0,54	-0,06	0,63		
Ukraine	0,72	-0,68	0,60	-0,85	0,40	0,36	-0,60	-0,96	-0,80	0,73	-0,91	0,54	-0,92	-0,93	-0,73	0,24	0,70	

We marked with grey the groups divided according to the credit rating of countries. Then we calculated dispersion in each group.

Table 2. Dispersion in groups (1st)

Group 1	0,5150
Group 2	0,6238
Group 3	0,0014
Group 4	0,4532
Group 5	0,0002
Group 6	0,0606

The high degree of synchronization is in 3d and 5th groups. Cycles in Poland, Czech Republic and Slovakia, and Slovenia, Hungary and Croatia are well synchronized. The reason for this is similar economics, and conditions of development.

Table 3 demonstrates dispersion in countries divided according their economic development.

Table 3. Dispersion in groups (2nd)

Group 1	0,513346
Group 2	0,355652

The results indicate such way of dividing is too rough. The dispersion is high, so we can't make a conclusion about synchronization. Nevertheless economic development is a good criterion to distinguish countries with similar economies and fluctuations. So it is necessary to divide countries not only into 2 groups, but some more.

Table 4. **Indices of synchronization**

	USA	Germany	Canada	France	UK	China	Poland	Czech R-c	Slovakia	Russia	Italy	Turkey	Slovenia	Hungary	Croatia	Belarus	Moldova	Ukraine
USA																		
Germany	-0,94																	
Canada	0,26	0,34																
France	-0,98	0,75	0,10															
UK	-0,14	0,57	0,74	0,43														
China	0,65	-0,99	-0,66	-0,99	-0,88													
Poland	-0,92	0,76	0,41	0,75	0,61	-0,99												
Czech Rep	-0,99	0,70	-0,34	0,74	0,09	-0,99	0,68											
Slovakia	-0,97	0,76	0,19	0,76	0,48	-0,99	0,75	0,73										
Russia	0,59	-0,21	0,72	-0,50	0,63	-0,09	-0,10	-0,81	-0,41									
Italy	-0,99	0,74	-0,07	0,76	0,31	-0,99	0,73	0,75	0,75	-0,65								
Turkey	0,12	0,44	0,76	0,24	0,75	-0,76	0,50	-0,18	0,31	0,70	0,08							
Slovenia	-0,99	0,73	-0,13	0,76	0,27	-0,99	0,72	0,76	0,75	-0,69	0,76	0,03						
Hungary	-0,99	0,73	-0,15	0,76	0,25	-0,99	0,72	0,76	0,75	-0,70	0,76	0,01	0,76					
Croatia	-0,95	0,76	0,29	0,76	0,54	-0,99	0,76	0,71	0,76	-0,28	0,74	0,40	0,74	0,74				
Belarus	-0,36	0,64	0,72	0,54	0,76	-0,94	0,67	0,27	0,58	0,55	0,45	0,74	0,42	0,41	0,62			
Moldova	0,51	0,01	0,75	-0,29	0,68	-0,30	0,10	-0,69	-0,19	0,76	-0,47	0,73	-0,52	-0,54	-0,06	0,63		
Ukraine	0,72	-0,68	0,60	-0,85	0,40	0,36	-0,60	-0,96	-0,80	0,73	-0,91	0,54	-0,92	-0,93	-0,73	0,24	0,70	

The last criterion of dividing countries into groups is geographical location. It can influence the interdependency of countries and their business cycles via export and import relations and other neighborhood advantages.

Table 5. **Indices of synchronization**

	USA	Germany	Canada	France	UK	China	Poland	Czech R-c	Slovakia	Russia	Italy	Turkey	Slovenia	Hungary	Croatia	Belarus	Moldova	Ukraine
USA																		
Germany	-0,94																	
Canada	0,26	0,34																
France	-0,98	0,75	0,10															
UK	-0,14	0,57	0,74	0,43														
China	0,65	-0,99	-0,66	-0,99	-0,88													
Poland	-0,92	0,76	0,41	0,75	0,61	-0,99												
Czech Repu	-0,99	0,70	-0,34	0,74	0,09	-0,99	0,68											
Slovakia	-0,97	0,76	0,19	0,76	0,48	-0,99	0,75	0,73										
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Italy	-0,99	0,74	-0,07	0,76	0,31	-0,99	0,73	0,75	0,75	-0,65								
Turkey	0,12	0,44	0,76	0,24	0,75	-0,76	0,50	-0,18	0,31	0,70	0,08							
Slovenia	-0,99	0,73	-0,13	0,76	0,27	-0,99	0,72	0,76	0,75	-0,69	0,76	0,03						
Hungary	-0,99	0,73	-0,15	0,76	0,25	-0,99	0,72	0,76	0,75	-0,70	0,76	0,01	0,76					
Croatia	-0,95	0,76	0,29	0,76	0,54	-0,99	0,76	0,71	0,76	-0,28	0,74	0,40	0,74	0,74				
Belarus	-0,36	0,64	0,72	0,54	0,76	-0,94	0,67	0,27	0,58	0,55	0,45	0,74	0,42	0,41	0,62			
Moldova	0,51	0,01	0,75	-0,29	0,68	-0,30	0,10	-0,69	-0,19	0,76	-0,47	0,73	-0,52	-0,54	-0,06	0,63		
Ukraine	0,72	-0,68	0,60	-0,85	0,40	0,36	-0,60	-0,96	-0,80	0,73	-0,91	0,54	-0,92	-0,93	-0,73	0,24	0,70	

Analysis of dispersion showed the high level of synchronization in 3d and 4th groups.

Cycles in Slovenia, Hungary and Italy are well synchronized. The reason for this is similar economics, and conditions of development. Czech Republic, Slovakia and Hungary also are characterized by similar development, so it's not a surprise that their business cycles are synchronized.

Table 6. **Dispersion in groups (3^d)**

Group 1	0,26
Group 2	0,026621
Group 3	0,000132
Group 4	0,000194
Group 5	0,252915
Group 6	0,534049

Conclusion. Besides others business cycles synchronization became one of the features modern business cycles. So it's not a big surprise the increasing interest to the analysis of business cycle synchronization across different countries has in both academic and policy fields. Terms such as "globalization" or "world integration" can be found everyday in the press, with all kinds of associated implications. Developed economies have become more tightly integrated in recent years. In these countries, international trade flows have increased substantially and financial markets have become more homogeneous. Promoted by this international integration, growing attention is being devoted to examine whether the efforts to coordinate their economic policies lead to higher business cycle synchronization.

There are a great number of studies devoted to research and measurement of synchronization phenomenon. It is important to take into account all characteristics and to develop a complex methodology of the research. We set a goal to continue working in this direction, especially for developing and post-Soviet countries.

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ДОСЛІДЖЕННЯ СИНХРОНІЗАЦІЇ ЕКОНОМІЧНИХ ЦИКЛІВ

В статті вивчаються способи оцінки синхронізації економічних циклів. Вивчаються коливання економічної активності в пострадянських країнах. Оцінюються різні міри синхронізації в групах країн згідно визначених критеріїв.
Ключові слова. Економічний цикл, синхронізація, міри синхронізації, кредитний рейтинг.

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ИССЛЕДОВАНИЕ СИНХРОНИЗАЦИИ ЭКОНОМИЧЕСКИХ ЦИКЛОВ

В статье изучаются способы оценки синхронизации экономических циклов. Исследуются колебания экономической активности в постсоветских странах. Оцениваются разные меры синхронизации в группах стран согласно определенным критериям.
Ключевые слова. Экономический цикл, синхронизация, меры синхронизации, кредитный рейтинг.

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LABOUR MARKET IN UKRAINE: AN EMPIRICAL DYNAMIC ANALYSIS USING ERROR CORRECTION MODEL

The labor market background in Ukraine has not only economic but also significant social value, and therefore is an important element of social and economic policy. The effectiveness of the state socio-economic regulation mechanisms requires profound analysis, modeling and forecasting of the processes of the labor market by means of modern flexible econometric tools, taking into account the short-term dynamics of economic processes and features that are characteristic of the unstable economic development of our country. As a result of empirical research on relationships between the macroeconomic indicators of the labor market in Ukraine, we developed a set of dynamic econometric models using an error-correction mechanism which take into account the long-run equilibrium relationships, as well as provide an opportunity to model the short-term effects of several factors such as the rate of change of wages, size of the labor force, employment and unemployment. The developed model is used to predict future trends of the labor market, as well as to describe the dynamics of its operation under various alternative scenarios of economic development. The application of the developed specifications in the structure of an integral macroeconometric model of Ukraine will allow us to carry out a comprehensive analysis of economic processes in the national economy and its prospects both in the short term and in the long run.

Keywords: labour market; econometric modeling; error-correction model; wage; employment; unemployment; scenarios of development; forecasting.

Introduction (Problem definition). Long-term negative trends on the labor market in Ukraine generate economic and social problems associated with poverty and unemployment. They prevent creation of conditions for stabilization and economic growth, deepen social tension in society. The development of economic processes and events in Ukraine demonstrates the need for increased attention to the national labour market, which is an important element of the socio-economic system of the country. The background for carrying out qualitative changes in the socio economic area is a systematic analysis of the dynamics of local labour market development, which will help to form an effective mechanism for the use of human potential. Therefore, the development of relevant dynamic structural economic and mathematical models will allow us to reveal the particular nature of the relationships between the main macroeconomic indicators of the labor market and to predict the future situation in the socio-economic sphere.

Analysis of the latest research and publications. Scientific works by S. Babych, D. Bohynya, V. Vovk, V. Heyets', Yu. Gorodnichenko, O. Hrishnova, T. Holubyeva, O. Yermolenko, D. Zoidze, T. Kiryan, M. Kyzym,