Methodological aspects of business cycle synchronization research

This paper analyses the business cycle synchronization research, main methodological assumptions, and methods. In this research paper the techniques to analyse business cycle synchronization intensity are analysed, such as correlation, Granger causality, spatial vector auto regression; to analyse the determinants influence – multiple regression, structural models, extreme bound analyses. There are the advantages and shortcomings of these methods identified emphasizing the necessity of dynamic and spatial approach.

**Keywords**: business cycle, synchronization, static model, multiple regression, vector auto regression, extreme bound analysis.

**Introduction**

Business cycle synchronization is the phenomenon which has been widely investigated during the last two decades. There were many attempts to prove that a synchronization process recognised in nature can also be identified in economics studying the behaviour of business cycles (Goodwin, 1947, 1951; Hillinger and Weser, 1986; Selover, Jensen, 1999; Süssmuth, 2003). This interest led to a number of studies that analyse, if business cycles tend to synchronize, and what the main business cycle synchronization determinants are.

There could be two different approaches identified in the research of this field. The first approach is related to the field of mathematical physics. For example, M. Goodwin (1951), C. Hillinger and T. Weser (1986) were one among others to assign mode locking phenomenon found in laser mechanical systems to business cycle synchronization. The authors aimed to find interconnection

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between business cycles with the help of mathematical tools such as differential equations. On the other hand, there are important stochastic and deterministic characteristics of (business) cycles that physicists and economists are both concerned with (peaks, amplitude, period, phase, lags, noise/signal ratio), although the economists make slightly different theoretical assumptions linked to the latent notion of business cycle. This requires different modelling strategies and goals that are grounded by broadened concepts of synchronization. The key authors in this field worth to be cited are F. Frankel and A. Rose (1998), J. Imbs (2004), M. J. Artis and other (2003, 2006), M. Baxter, M. Kouparitsas (2004) among many others. These scientists look for the reasons of business cycle synchronization process formation; what is more, they also choose different econometric tools for investigation.

The research problem is that despite a huge amount of business cycle synchronization research the business cycle synchronization phenomenon is not revealed enough, especially regarding dynamic and spatial aspects of analyses.

The aim of this research paper is to analyze the methodological aspects of business cycle synchronization research. Referring to the methodological aspects the authors mean the main theoretical concepts and the ideas of business cycle research and methods which are or could be widely used. This aim of the paper led to three objectives:

- To define the main assumption of business cycle synchronization research.
- To discern the goals and strategies of business cycle synchronization research.
- To analyze the methods as the tools to investigate the business cycle synchronization phenomenon.

Methodological assumptions of business cycle research

Synchronization concept (from Greek syn – the same, common and chrono – time) explains the process of two or more systems’ rhythm adjustment due to their weak interaction. There are many examples of synchronization processes in nature. If economy is seen as a system that can be adequate with some biological or mechanical system, and if economy’s activity fluctuation could be interpreted in the same way as biological system rhythms, then the parallel between physics and economy sciences can be identified. In other words, economy has a feature to fluctuate (it has 4 business cycle phases – trough, expansion, peak, contraction), it has some kind of its own rhythms, called activity fluctuation or business cycle. If two economies interact or are affected by the same external influence, they can start to act at the same rhythm. And this would be called synchronization of their business cycles.

It is essential to mention that in business cycle synchronization research two concepts (business cycle synchronization and business cycle synchronicity) are used as synonyms, though actually they are not. Synchronization is a process when the systems move to the synchronicity state (Kanišauskas, 2008). Synchronicity state of business cycles is illustrated in Figure 1. There are free time series that represent three business cycles. All of them are in some kind of synchronicity state, because there can be a particular time lag \((t_1 - t_2)\) between their peaks identified. While saying synchronous we mean a physical approach in business cycle synchronization research.
It is worth mentioning that earlier definition of synchronization as a process of movement to synchronicity state does not necessarily imply either simultaneous movement or the achievement of this state. The significant correlation or causality identified between business cycles can be interpreted as the existence of business cycle synchronization. For example, when countries interact, the shock in one country could be the cause of changes in the other one. This means that due to their interaction countries can move from one state to another, but not necessarily to an identical one, where ‘not identical’ means that the business cycle should not necessary have the same characteristics, such as fixed downturn lags in time. Therefore the economists tend to interpret this phenomenon more philosophically than physically, while saying that due to interconnection of the countries, the statistical similarity between business cycles paths could be identified, which is definitely measured broader than in physics.

It is important to admit that according to strict physical assumptions in order to achieve synchronicity, systems should be identical, but the economies are not and cannot be. The economic systems could be in some ways similar or be closely connected. These could be the reasons for synchronization process, but, as mentioned before, this does not necessarily lead to the achievement of synchronicity in a narrow physical sense.

**Goals and strategies of business cycle synchronization research**

There can be two objectives in business cycle synchronization research identified. The first one concerns the estimation of extent of business cycle synchronization between particular groups of countries. The second one is bound with the ambition to explain the reasons why business cycles tend to synchronize, which explanatory variables are most and least significant. In order to achieve these objectives there is a wide range of methods used (Figure 2).
We briefly go through these models and show their positive and negative features that limit the business cycle synchronization phenomenon and its determinants’ valuation.

**Methods of business cycle synchronization research**

There are different methods used in business cycle synchronization research. Some of them are used to identify business cycle synchronization, others – to estimate determinants of business cycle synchronization. In this part of paper those methods are represented.

**Correlation and Causality**

The first problem the researchers face is how to measure business cycle synchronization in order to identify its intensity between regions, countries, and groups of countries. The most common solution is to calculate correlation coefficients between the macroeconomic variables, such as investment, savings or output gaps. The correlation coefficient takes values from -1 to 1 and allows the researchers draw a conclusion about the business cycle synchronization strength, as illustrated in Figure 3. Since the conclusion about the existence of business cycle synchronization is used despite the fact that the macroeconomic variables of
time series could have characteristics that according to a physical approach would be seen as not synchronous, the correlation between business cycle could be identified as a part of broader philosophical approach.

The researchers who take the physical approach are very much concerned about the mechanical (deterministic) characteristics of business cycles time series. According to them, the times series that have a constant lag, could be synchronous, for example, there is a constant lag between cycles’ peaks or troughs. According to a philosophical approach, the researchers are more concerned with synchronization of a business cycle as a process, that are measured by correlation coefficient between two time series \((a \text{ and } b)\):

\[
Corr(a,b) = \frac{Cov(a,b)}{\sqrt{\text{var}(a) \cdot \text{var}(b)}} \quad (1)
\]

The alternative to static correlation coefficient is Concordance index (Harding, Pagan, 2002). This index \((I_{ij})\) is calculated as shown in equation 2. It is a nonparametric coefficient, constructed using binary indicator \(S_{nt}\), which has the value 1, if a country is in upturn phase and 0, when it is in downturn phase.

\[
I_{ij} = \frac{1}{T} \left( \sum_{t=1}^{T} S_{it} S_{jt} + \sum_{t=1}^{T} (1 - S_{it}) (1 - S_{jt}) \right) \quad (2)
\]

The concordance index shows that part of time, the two countries are in the same economic state – economic upturn or downturn. This index is more flexible than correlation coefficient while the data could be used according to both business cycle methodologies: classical (Burns, Mitchell, 1946) and growth (Hodrick, Prescott, 1997), while both could be rewritten as binary indicators.

Although the correlation approach is the most common method to measure business cycle synchronization in business cycle synchronization research it still has several shortcomings.

Firstly, correlation coefficient is a static indicator thus has no time dimension even though it is constructed from the time series objects. To put it another way, both concordance index and correlation coefficient are appropriate to indicate how much the business cycles of two countries are relative, but it is incapable of showing the evolution of business cycles synchronization in time, the dynamic changes. To solve this shortcoming a dynamic correlation coefficient suggested by P. A. Cerqueira and R. Martins (2008) can be used.

\[
DC_{ij,t} = 1 - \frac{1}{2} \left( \frac{1}{\sqrt{T}} \sum_{t=1}^{T} (d_{ij,t} - \bar{d}_{t})^2 - \frac{1}{\sqrt{T}} \sum_{t=1}^{T} (d_{ij,t} - \bar{d}_{t})^2 \right) \quad (3)
\]

where \(DC_{ij,t}\) – dynamic correlation between the GDP growths for the countries \(i\) and \(j\) in time \(t\), \(d\) – GDP growth, \(\bar{d}\) – GDP average growth during the time period \(t\).

It is straightforward to identify the dynamic correlation for business cycle synchronization in (3) changing the GDP growth the business cycle related measures – output gaps and there mean values.

The advantage of the dynamic correlation coefficient is that it is capable of showing asynchronous movements of business cycle paths, due to shocks, system disequilibria, and synchronization in stable periods. While static coefficients smoothen the change in time, and the longer the period the higher is the degree of smoothness. The dynamic correlation coefficient solves this problem and, according to A. Cerqueira and R. Martins (2008), avoids “ghost effect” which is evident when the information is only partially used.
Secondly, it is worth mentioning that functional dependence (1) does not imply causality. The causality identification in business cycle research would, in our opinion, explain the business cycle phenomenon in a broader sense. In this case the most appropriate could be a vector autoregressive (VAR) model. One of the key prior steps to VAR analysis is testing for Granger (non-) causality (Granger, Newbold, 1974). The latter test enables to validate the hypothesis if the business cycle of one country could be the reason of a business cycle of another one. Two null hypotheses in analysed case could be written as follows:

\[ H_0: \text{business cycle of country Y is not Granger cause of business cycle of country X}. \]

\[ H_0: \text{business cycle of country X is not Granger cause of business cycle of country Y}. \]

There could be four cases identified: (i) \(X\) is a cause of \(Y\), (ii) \(Y\) is a cause of \(X\), (iii) \(X\) is a cause of \(Y\) and \(Y\) is a cause of \(X\), (iv) \(X\) is not a cause of \(Y\) and \(Y\) is not a cause of \(X\).

If at least one of the hypotheses is rejected, it could be stated that the causal relationship between the cycles exists. For example, simplified model could be written as shown in equation 4:

\[
Y_t = \alpha_{10} + \sum_{i}^{k} \beta_{i} X_{t-i} + \sum_{j}^{m} \gamma_{j} Y_{t-j} + \epsilon_{1t} \\
X_t = \alpha_{20} + \sum_{i}^{n} \theta_{i} X_{t-i} + \sum_{j}^{m} \delta_{j} Y_{t-j} + \epsilon_{2t}
\]

(4)

where \(X\) – the business cycle measure of country \(X\), \(Y\) – the business cycle measure of country \(Y\), \(\alpha, \beta, \gamma, \theta, \delta\) – coefficients, \(\epsilon_{1t}, \epsilon_{2t}\) – standard errors. In order to prove that causal relationship is statistically significant, the VAR model equations coefficients should not be equal to zero.

Still Granger causality test has one shortcoming. It ignores the fact that causal relationship identified between, for instance, two time series could be conditioned by the third reason not included in the model (Rudzikis, Kvedaras, 2003).

**Spatial VAR models**

The models used in business cycle research lack not only a dynamic viewpoint, but also a spatial one. There could be no direct interconnection between countries, these countries could have no impact on each other, but could be affected through the third country. It is very important not only to look at the connection of two countries but also at their context. These countries could belong to some country group; they could be neighbours or neighbours’ neighbour, they could be close trade partners. This spatial connection is very important in evaluating the shock propagation between countries. The spatial interconnection and its consequences to research object could be analyzed using spatial econometric tools developed by L. Anselin (1988), G. Upton and B. Fingleton (1985) among many others.

If economy \(i\) country is isolated (like Robinson Crusoe economy) it is evident that shock would affect only this country. However as far as all economies are closely connected the spatial VAR model covers equations which consider the spatial bind. These could be represented by the matrices that show how economies are connected through trade (import, export), also if they are neighbours or perhaps neighbours’ neighbour (geographical interconnection).

The model specification is shown in equation 5:

\[
\Delta w = aw^2 + bw + c + \epsilon = Xf + \epsilon, \; \epsilon \sim N(0, \sigma^2) \\
\Delta w = Xf + \xi \\
\xi = \rho W \xi + \epsilon, \; \epsilon \sim N(0, \epsilon^2 I)
\]

(5)

where \(\Delta w \rightarrow\) between countries exist and 0 if it doesn’t.
We should mention that this method is not so common in business cycle synchronization research, but it could be a very good alternative, which allows evaluating the economies that are dominant, the main generators of impulses influencing other countries; thus those countries that cause the business cycle synchronization process.

**Factorial models**

The other model, used by the researchers M. A. Kose, A. Prasad and Ch. Torones, (2009) is a factorial model. They constructed a model that contains: (i) a global factor common to all variables (and all countries) in the system; (ii) a factor common to each group of countries; (iii) a country factor common to all variables in each country; and (iv) an idiosyncratic component for each series. The model is shown in equation 6:

\[ Y_{t,i,j,k} = \beta_{i,j,k}^{\text{global}} f_{t}^{\text{global}} + \beta_{i,j,k}^{\text{grup}} f_{t}^{\text{grup}}, + \]

\[ + \beta_{i,j,k}^{\text{laus}} f_{t}^{\text{laus}}, + \beta_{i,j,k}^{\text{sal}} f_{t}^{\text{sal}}, + \varepsilon_{i,j,k}^{\text{sal}} \]

\[ f_{t}^{m} = \varphi^{m}(L)f_{t}^{m} + \eta_{t}^{m}, m = 1,\ldots,1+K+J. \]

Firstly, it is important to identify the main latent component \( f_{t}^{m} \), which allows to measure individual responses to specific different level shocks \( \eta_{t}^{m} \) for each country. Practically the latent variables \( f_{t}^{m} \) involve a data rich set analysis, when the ratio between separate indicator’s general useful information (signal) and inessential information (noise) is either low or even statistically insignificant, but excluded common components have a significant signal. In very rare cases these latent factors can be interpreted; however, more often they are considered as specific determinants having no direct interpretation and related to different cross-sectional views. The impact of different cross-sectional groups can be analysed comparing standard parameters (beta coefficients) and making imitation scenarios of response to factorial shocks \( \eta_{t}^{m} \).

As stated by M. A. Kose, Ch. Torones, A. Prasad (2008), such factorial model does not require one to average across variables or define a “numeraire” country. Instead, they identify the common component and, at the same time, detect how each country responds to the common component. For example, suppose one country is positively affected by a shock while a second is negatively affected by the same shock. The factor model will assign a positive factor loading to one country, and a negative one to the other, thereby correctly identifying the sign of the common component for each country. More importantly, factor models are flexible enough that multiple factors can be specified in a parsimonious way to capture the extent of synchronicity across the entire dataset as well as the synchronicity specific to subsets of the data (e.g., particular groups of countries). Furthermore, since the factors are extracted simultaneously, we can assign a degree of relative importance to each type of factor.

In other words, equation system 5 enables to identify different influence of common shocks (one country could be affected in negative, the other one in a positive way). Moreover, the econometric procedure allows estimating the significance of common components to countries’ cyclical fluctuations or other macroeconomic variables \( Y_{t,i,j,k} \). Still this model explains how different groups of countries, regions, etc. are affected.

A typical example of a factorial model was constructed by A. Kose, Ch. Torones, A. Prasad (2008). They show that during...
the globalization period in 1985-2005 industrial countries and developing countries were synchronized, but the global factors’ influence had a downtrend. The conclusion is that the synchronization of business cycles could be identified inside a group of countries, but separate groups of countries tend to decouple.

In some ways this method helps to identify common factors, but differently from other researchers’ (such as Frankel, Rose, 1998; Imbs, 2004) methods, it does not give economic reasoning why business cycle synchronizes or not. It identifies the main trends and answers the following questions: do business cycles synchronize, and how much is it caused by common global, group of countries or countries’ specific context.

In the next section we go through the methods that attempt to measure the determinants of business cycle synchronization and its significance to this phenomenon in a more particular way: multiple regression models, structural equations and extreme bound models analysis.

**Multiple Regression models**

Spatial VAR model gives a possibility to evaluate the business cycle synchronization in accordance to the spatial bind. The model considers trade, neighbourhood as the determinants of countries’ interconnection thus their business cycle synchronization. But there are many more reasons why some countries’ business cycles do synchronize and others do not. Another strategy used in the business cycle research is multiple regression models which allow evaluating a very wide range of determinants. This method in the context of business cycle synchronization to our knowledge was first applied by J. A. Frankel and A. K. Rose (1998). This model has some specific shortcomings: one of them is the smoothness of radical changes of indicators. The original model is actually static, but this problem is solved by separating the period and applying the model for these different periods.

On the other hand, the advantage of this method is that more parameters that represent business cycle determinants could be added:

$$BCS_{ijτ} = f(T_{ijτ}, Z_iτ, Z_jτ, Z_{ijτ} | β), \tag{7}$$

where $BCS_{ijτ}$ – business cycle synchronization measure (correlation coefficient) between countries $i$ and $j$ at the time period $τ$, $T_{ijτ}$ – is the main independent variable (could be vector), that is always included in such kind of models, $Z$ variables – auxiliary variables – covariates (their vectors) that define countries or countries pairs’ specific features, $β$ – model’s parameters.

This model would be appropriate in the absence of multicollinearity between the independent variables (determinants of business cycle synchronization) included in the model. If so, the model would lack statistic significance. It is worth mentioning that among many determinants of business cycles that are included in the business cycle synchronization research there exist a strong interrelation, correlations. In order to analyse this phenomenon in a complex way, the method that avoids a multicollinearity problem is needed. J. Imbs (2004) suggested using structural equations model.

**Structural equations models**

In the model of other researchers there are more variables included, for example, trade integration, financial integration, specialization measures. In this way the variable set is extended. On the one hand, it allows the researcher to analyse business cycle synchronization in a more complex way; on the
other hand, the endogeneity problem of the variables is not avoided: between the variables there exists a simultaneous relationship. Moreover if correlated variables are included in the model, it causes the multicollinearity and uncertain model estimates. What is more, as stated by A. G. Herrero and J. M. Ruiz (2008), reversible influence of the determinants in empirical models could neutralize each other. This results in insignificant influence of these variables. For example, in A. Kose, E. Prasad and M. Terrones’ (2003) model two correlated variables of business cycle synchronization (trade and financial openness) were included in a regression model. This caused insignificant financial openness influence upon business cycle synchronization.

To solve this problem J. Ims (2003), S. Kalemli-Ozcan, etc. (2009) suggested the use of two-stage-least-square method. This method enabled the researches to control the differences between the main determinants (for example, trade, specialization) and other determinants which could exert reverse influence upon business cycle synchronization. J. Imbs (2003) introduced the structure of the two least stage square system for business cycle synchronization research shown in equation 8:

\[
\begin{align*}
BCS_{ij} & = \alpha_0 + \alpha_1 T_{ij} + \alpha_2 S_{ij} + \alpha_3 I_{1,ij} + \varepsilon_{1,ij}, \\
T_{ij} & = \beta_0 + \beta_1 S_{ij} + \beta_2 I_{2,ij} + \varepsilon_{2,ij}, \\
S_{ij} & = \gamma_0 + \gamma_1 T_{ij} + \gamma_2 I_{3,ij} + \varepsilon_{3,ij},
\end{align*}
\]

where \( T \) - Trade integration measure, \( S \) - specialization measure, \( I_1, I_2, I_3 \) - additional exogenous measures that explain business cycle synchronization (BCS), trade integration (T), or specialization (S). According to J. Imbs (2003), \( I_1 \) vector could include financial integration measure, \( I_2 \) - gravity variables, such as the distance between countries capitals, the binary variable “one”, if countries have a common border and “zero” if they do not.

Summarizing the positive and negative features of this model, two conclusions could be drawn. This model solves the multicolinearity problem of the variables included, but still it is not clear and on the debate which variables should be included. Secondly, the J. Imbs (2003) system is static and the variables included in the model are also static, do not have time dimension; they could be estimated only for a specific period that is chosen according to the subjective position of the researcher. In that way it lacks the capability to show how business cycle synchronization changes in time and the main determinants responsible for these changes.

**Extreme bound models**

The pioneer of extreme bound analysis is E. Leamer (1983); it was further developed by R. Levine, D. Renelt (1992) and X. Sala-i-Martin (1997) in the context of empirical growth analysis and was widely used in business cycle synchronization research by F. Frankel, A. Rose (1998); M. Camacho, et. al. (2006); U. Böwer, C. Guilleminneau (2006); M. Baxter, M. Kouparitsas (2004); M. J. Artis (2003) among many others.

The idea of the extreme bound analysis procedure is to select a set of variables (determinants of business cycle synchronization) and test them for robustness. According to E. Leamer (1983), the variable is robust if its statistical significance is not dependent on the chosen additional control variables which are included to the model data set. Hence, the variable could be considered as robust, if additionally included variables do not have significant influence upon the tested variable variation limits, in other words, if the tested variable is not sensitive to external influence.
The multiple regression models could be rewritten as follows in equation 9:

\[ BCS = \beta_1 I + \beta_m M + \beta_z Z, \]  

(9)

where \( BCS \) – business cycle synchronization measure; \( I \) – measures of exogenous determinants of business cycle synchronization, their usage in business cycle synchronization research has already been theoretically validated in the previous studies; \( M \) – theoretically hypothetically validated measures that are tested for robustness; \( Z \) – conditional or control measures, in accordance to them the conclusions because of robustness are drawn.

The first two groups of indicators (\( I \) and \( M \)) are the measures of research focus; the other group of measures (\( Z \)) is auxiliary. It is not necessary for them to have direct influence. The test for robustness procedure means to add to the regression \( Z \) measures and follow how the influence of \( M \) measure upon the dependent variable (in this case business cycle synchronization) changes. This influence is measured by the parameter \( \beta_m \).

The test for robustness combines the induction (lot. induction) and deduction (lot. deduction) - scientific research process logic: the model's estimations and conclusions could be interpreted as making the theory in accordance to the research results, but at the same time the model is constructed by taking some theoretically validated arguments into account. It is important to mention that the model is like a simplified picture of the real world; therefore, the application of extreme bound analysis allows validating if the simplification of real world processes is compatible with theoretical conclusions about the influence of business cycle synchronization determinants (significance and direction of the influence). Business cycle synchronization is a complex phenomenon; it is the result of many determinants that are very closely related with each other, it is impossible to involve all of them into the model (and not necessary). The procedure from broad to specific allows disassociating from insignificant determinants; however, it has some shortcomings: it can only partly explain the reason of the phenomenon. Data mining has another weakness – the researchers can involve determinants that econometrically show very significant relationship but of theoretical grounding. The extreme bound analysis can only partly solve this problem.

**Conclusions**

Generalizing methodological aspects of business cycles synchronization research some features can be distinguished.

In business cycle synchronization research two concepts (business cycle synchronization and business cycle synchronicity) are used like synonyms. Synchrony is some kind of state of the economy. Synchronization is a process toward synchronicity, but not necessary its achievement. In parallel two approaches to this phenomenon could be distinguished, the physical one (it concentrates on mathematical characteristics of business cycle time series), and philosophical one, (it emphasis the causal or correlated relation of business cycles).

There are two goals of business cycle research. One of them is to measure the business cycle synchronization between intense countries, to identify business cycle synchronization existence. The other one is to analyse the importance of business cycle synchronization determinants in order to estimate, why some business cycles synchronize and other don’t. Despite the huge
amount of business cycle synchronization research there is no clear model, which would help to identify the business cycle synchronization intensity and the determinants’ significance of this phenomenon. It is still not clear which measure is best to estimate business cycle synchronization intensity between countries. To measure business cycle synchronization the correlation coefficient is widely used, but still it is static and inappropriate to measure the process which changes over time. Dynamic correlation could be more informative. On the other hand, most of the models constructed in business cycle synchronization research (multiple regression, two stage least square, extreme bound analysis) are also static, without time dimension, and need static variables (some averaged over time value) included. In other words, the indicators are derived as average from time series or correlation for a particular period between measures. This approach means that we lose time dimension. It can be justifiable when the objective is to find out if the interrelationships exist or not. In such kind of research a big data sample is used, while the researchers focus on interrelationship and analyze the derived indicators from the data of countries’ pairs. On the other hand, models with derived indicators without time dimension are unable to identify how synchronization varies in time. If, during the chosen period, some radical changes, let us say, the political ones, occur, such as joining some unions, like the European Union or monetary union, it is possible that this would lead to closer synchronization with other partners of the unions. According to R.E. Lucas (1976) critique, it is a mistake to believe that historical relations between macroeconomic indicators would stay unchanged after introduction of new politics. This critique can be applied to business cycle research; static model ignores the policy changes, does not give the answer to how business cycle synchronization reacts to the changing economic and political environment. What is more, business cycle synchronization is a process and that means that time dimension cannot be excluded in order to analyze the changes in time. The results of static analysis can be mistakenly interpreted; preference should be for dynamic analysis.

The models used in business cycle research lack not only a dynamic viewpoint, but also a spatial one. There could be no direct interconnection between countries, these countries could have no impact on each other, but could be affected through the third country. It is very important not only to look at the connection of two countries but also at their context. These countries could belong to some country group; they could be neighbours or neighbours’ neighbour, they could be close trade partners. The spatial interconnection and its consequences to research object could be analysed using spatial econometric and spatial VAR model.

Finally, business cycle synchronization research on determinants still lack theoretical reasoning. The models are used in many ways to solve the problems concerning determinant’s significant measurement. Although multiple regression model is one of the simplest ones, this model could be incomplete and give statistically insignificant results (missed indicators problem). If to include many variables which perform influence business cycle synchronization, the multicollinearity problem could appear, while all the variables could be closely related. The multicollinearity problem could be solved using two stages least squared method. Moreover, many researchers include different business cycle
synchronization determinant groups and use different indicators to measure these determinants. This is the reason why the analyses could be empirically inadequate, and the results ambiguously interpreted or even not correct. It is possible that theoretical arguments concerning the business cycle synchronization determinants’ influence upon this phenomenon have not been confirmed since some fundamental mistakes have been made related to the subjective position of researchers and specific features of econometrical analysis tools. The problem which business cycles synchronization determinants should be definitely included in the model partly solved using extreme bound model. Extreme bound procedure should leave only statically significant variables in the model and eliminate the insignificants ones.

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METODOLOGINIAI VERSLO CIKLŲ SINCRONIZACIJOS TYRIMŲ ASPEKTAI


Faktorinis modelis, taikytas M. A. Kose, Ch. Torones, A. Prasad (2008) tyrome atskleidžia, kurie šalių verslo ciklai ir kiti susiję endogeniniai rodikliai (inflacija, palūkanų norma, keitimo kursas) atkakliai įtakos joms duoda. Tik tada, kai šios kintamųjų koreliacijos yra statistiskai svarbios, galima konstatuoti, kad šios kintamųjų sąsaja yra reali ir turi strateginį reiškinį. Šios tyrimų metu buvo naudojami įvairūs faktoriniai modeliai, taip pat daugialypės regresijos modeliai, kuriems atitinka įvairios atimtys. Tokie modeliai gali būti naudojami įvairiuose tyrimų kontekstų, tačiau yra svarbu atsinešti įvairias metodologijas, kad būtų galima atlikti teisingus tyrimų paragimus.

