COMENIUS UNIVERSITY IN BRATISLAVA
FACULTY OF MATHEMATICS, PHYSICS AND INFORMATICS

META-ANALYSIS OF OCA ENDOGENEITY

MASTER THESIS

2015 Bc. Andrej VARHOĽ

COMENIUS UNIVERSITY IN BRATISLAVA
FACULTY OF MATHEMATICS, PHYSICS AND INFORMATICS

META-ANALYSIS OF OCA ENDOGENEITY

MASTER THESIS

Study programme:	Economic and Financial Mathematics
Field of Study:	9.1.9. Applied Mathematics
Department:	Department of Applied Mathematics and Statistics
Supervisor:	doc. Ing. Jarko Fidrmuc, Dr.

Bratislava 2015 **Bc. Andrej VARHOĽ**

UNIVERZITA KOMENSKÉHO V BRATISLAVE
FAKULTA MATEMATIKY, FYZIKY A INFORMATIKY

META-ANALÝZA OCA ENDOGENITY

DIPLOMOVÁ PRÁCA

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Vedúci práce:	doc. Ing. Jarko Fidrmuc, Dr.

Bratislava 2015 **Bc. Andrej VARHOĽ**

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THESIS ASSIGNMENT

Name and Surname:	Bc. Andrej Varhoľ
Study programme:	Economic and Financial Mathematics (Single degree study, master II. deg., full time form)
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Type of Thesis:	Diploma Thesis
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Title: Meta-Analysis of OCA Endogeneity

Aim: The master paper should analyze the available literature on endogeneity of optimum currency area criteria. The discussion goes back to two different views between business cycle synchronization stated by Krugman (1993) and Frankel and Rose (1998). Especially the latter findings were often supported by the subsequent literature. The master paper should address the influence of time, estimation period on the established results. Finally, publication bias should be discusses as well.

Supervisor:	doc. Ing. Jarko Fidrmuc, Dr.
Department:	FMFI.KAMŠ - Department of Applied Mathematics and Statistics
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Assigned:	29.01.2014

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ZADANIE ZÁVEREČNEJ PRÁCE

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Sekundárny jazyk: slovenský

Názov: Meta-Analysis of OCA Endogeneity
Meta-Analýza OCA Endogenity

Cieľ: Cieľom záverečnej práce je analýza dostupnej literatúry na tému endogenity kritérií optimálnej menovej oblasti. Diskusia o synchronizácii hospodársky cyklov sa vracia k dvom rôznym pohľadom uvedených Krugmanom (1993) a Frankelom a Roseom (1998). V neskoršej literatúre sa autori prikláňajú najmä k zisteniam Frankela a Rosea. V práci analyzujeme vplyv času a dĺžky periódy na stanovené výsledky. Súčasťou práce je aj diskusia o tendencii autorov vykazovať pozitívne výsledky (tzv. publication bias).

Vedúci: doc. Ing. Jarko Fidrmuc, Dr.
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Abstract

VARHOĽ, Andrej: Meta-analysis of OCA Endogeneity [Master Thesis], Comenius University in Bratislava, Faculty of Mathematics, Physics and Informatics, Department of Applied Mathematics and Statistics; Supervisor: doc. Ing. Jarko Fidrmuc, Dr., Bratislava, 2015, 50p.

In this master thesis we present a meta-analysis of the determinants of business cycle correlation between European countries. Our meta-analysis examines 29 individual studies with more than 1900 estimates of correlation coefficients between the business cycles of 23 European countries. In surveyed studies we find a robust positive publication bias. Despite that all countries report positive degree of business cycle synchronization, for many of them it is still relatively low. Based on the results we cannot confirm the endogeneity hypothesis.

Keywords: Meta-analysis, optimum currency area, endogeneity of OCA, publication bias

Abstrakt v štátnom jazyku

VARHOĽ, Andrej: Meta-Analýza OCA Endogenity [Diplomová práca], Univerzita Komenského v Bratislave, Fakulta matematiky, fyziky a informatiky, Katedra aplikovanej matematiky a štatistiky; školiteľ: doc. Ing. Jarko Fidrmuc, Dr., Bratislava, 2015, 50 s.

V diplomovej práci sa zaoberáme meta-analýzou faktorov korelácie hospodárskych cyklov medzi európskymi krajinami. Naša meta-analýza skúma 29 samostatných štúdií s viac ako 1900 odhadmi korelačných koeficientov medzi hospodárskymi cyklami 23 európskych krajín. V analyzovaných štúdiách sme zistili silný publication bias, tj. tendencia autorov vykazovať pozitívne výsledky. Napriek tomu, že všetky krajiny vykazujú pozitívny stupeň synchronizácie hospodárskych cyklov, pre viaceré z nich je stále relatívne nízky. Na základe výsledkov nemôžeme potvrdiť hypotézu endogenity.

Kľúčové slová: Meta-analýza, optimálna menová oblasť, OCA endogenita, publication bias

Contents

Introduction

Ever since the first decision about creating European Monetary Union (EMU) wave of criticism followed, mainly from US. The critics argued that Europe does not meet OCA criteria, in particular, labour mobility (due to cultural differences and language barrier) and fiscal integration (each country has its own laws, restrictions, limitations, etc.). On the other hand, many European economists were more optimistic. Implying the endogeneity hypothesis claimed that the fact of monetary union itself may increase trade and synchronization of business cycles so that, even if a country group had not qualified as an OCA *ex ante*, it may turn into an OCA *ex post*. [27]

In 1999 EMU has been established and 11 countries dropped their national currencies. First years of EMU seemed very promising, euro zone gradually sprawled out. Last, 19th member Lithuania joined EMU just recently, on 1st of January 2015. About ten years after the creation of the euro zone, the crisis in 2007-2009 has put the euro under high pressure. The asymmetric shock generated by the global financial crisis has divided EMU into creditor and debtor countries. Nowadays, how to turn the euro zone into OCA is a topic in lots of discussions. The most strict euro-skeptics recommend the disbandment of euro zone. The availability of literature instigated us to use meta-analysis to merge previous results into one.

We collected 29 individual papers coping with business cycle synchronization in Europe. We involved 23 countries in total[1] from which 15 are EMU members. We were able to collect 1911 correlation coefficient estimates of business cycle synchronization between European countries and Germany or euro area aggregate. For core EMU countries (e.g. France, Finland, Italy, Spain, etc.) we have more than 100 observation, CEECs countries are represented by about 70 observations. The least observations are available for Norway - only 28.

[1] Observed countries are : Germany, Austria, Belgium, Greece, Spain, Finland, France, Ireland, Italy, Netherlands, Portugal, Denmark, UK, Sweden, Norway, Czech republic, Hungary, Poland, Slovakia, Slovenia, Estonia, Latvia and Romania.

From our meta-regression analysis we see that all countries have positive correlation coefficients and many of them are also statistically significant. We find that the highest correlation coefficients are for core EMU countries. CEECs countries has generally lower coefficients (except of Hungary). Greece, one of the first countries that accepted euro, also reports lower correlation coefficient of business cycle synchronization, what could be explain as presence of asymmetric shocks.

This paper is structured as follows. In the next section we review available literature on OCA theory. Furthermore we define OCA criteria, examine the endogeneity hypothesis and recap recent papers on this topic . In section 2 we present meta-analysis as a tool to summarize and aggregate research results. In section 3 we discuss the publication bias and we test it using funnel plots and funnel asymmetry test. The fourth section provides meta-regression analysis of European business cycles synchronization. In the last section we presents our conclusions.

1 Optimum currency area

1.1 Definition of OCA

An optimum currency area theory, also known as OCA theory, was firstly introduced in early 1960s by Robert Mundell [49], Ronald I. McKinnon [45] and Peter B. Kenen [41]. Mundell describes OCA as the geographical region in which the goals of internal balance (low inflation and full employment) and external balance (a sustainable balance-of-payments position) could most easily be achieved. In this region several OCA criteria has to be fulfilled , including the mobility of labour and other factors of production, price and wage flexibility, economic openness, diversification in production and consumption, similarity in inflation rates, fiscal integration and political integration. In such OCA is then only one currency used which can fluctuate against the rest of the world.

At early stages the OCA theory has triggered a wider discussion about possible benefits and costs. Many authors described criteria, which would determine whether the given currency area is optimal. Later on, several criteria have been considered, such as symmetry of shocks and gave more structure to the analysis of the costs and benefits. However, the authors did not come with the same conclusions, and in most cases even contradicted. Such discrepancy led to lower interest for this topic because it seemed like this problem was too complex and difficult to quantify precisely.

Due to effort of the European Communities to create a common currency in late 80's, the OCA theory was reconsidered again. The question about optimum currency area was seen as a part of a problem of how to choose optimum exchange rate regime. Horvath ([36]) divides authors into tree groups according to their approach in searching for an optimum exchange rate regime. First group of authors discuss a macroeconomic model, to find the exchange rate regime that would moderate the consequences of different economic disturbances. Second approach considers the exchange rate regime suitable for a country with high inflation that would like to stabilize with minimal cost of adjustment. The last group consider general-equilibrium model based on microeco-

nomic foundations. [36].

Since 80's OCA criteria have been empirically tested. These empirical studies have sought to assess why specific groups of countries may form an optimum currency area by analyzing and comparing a variety of OCA properties and applying several econometric techniques. Two different paradigms have been stated : specialization versus endogeneity of OCA. Since the beginning of crisis in 2007 the OCA theory became an object of criticism. Many of current economists are skeptic about this theory, because the criteria and methods are not unequivocally defined (missing exact methods, measures of business cycles and benchmarks) [25]

1.2 The OCA criteria

Optimum currency area examines the conditions, which determine suitability of the countries to give up their national currencies and establish a monetary union. In particular, the OCA theory discusses the following criteria:

- **Mobility of factors of production including labour** - High factor market integration within a group of partner countries can reduce the need to alter real factor prices and the nominal exchange rate between countries in response to disturbances [49]. In the very short run this mobility is likely to be slight and its effect could be seen in longer period of time. The mobility of factors of production is limited by the pace at which direct investment can be generated by one country and absorbed by another. Similarly, labour mobility is likely to be descent in the short run, because of costs associated with migration and retraining are presented. In the medium and long run the mobility may increase. High labour mobility eases adjustment to deal with asymmetric shocks and also lower the need for exchange rate adjustments.

- **The degree of economic openness** - The higher the degree of openness, the more changes in international prices of tradables are likely to be transmitted to

the domestic cost of living. This would in turn reduce the potential for money and/or exchange rate illusion by wage earners [45]. Also, a devaluation would be more rapidly transmitted to the price of tradables and the cost of living, negating its intended effects. Hence the nominal exchange rate would be less useful as an adjustment instrument. Economic openness needs to be assessed along several dimensions, including the overall openness of a country to trade with the world; the degree of openness vis-à-vis the countries with which it intends to share a single currency; the share of tradable versus non-tradable goods and services in production and consumption; and the marginal propensity to import.

- **Financial market integration** - McKinnon [46] analyzes in depth the implications of a second seminal contribution by Mundell [48] discussing the role of financial integration, in the form of cross-country asset holding, for international risk-sharing. Countries sharing a single currency can mitigate the effects of asymmetric shocks by diversifying their income sources,. This can operate through income insurance when a country's residents hold claims to dividends, interests and rental revenue from other countries. Such *ex ante* insurance allows the smoothing of both temporary and permanent shocks as long as output is imperfectly correlated. In other words a new currency could be shared by countries subject to asymmetric shocks as long as they "insure" one another through private financial markets.

- **Price and wage flexibility** - When nominal prices and wages are flexible between and within countries contemplating a single currency, the transition towards adjustment following a shock is less likely to be associated with sustained unemployment in one country and/or inflation in another. This will in turn diminish the need for nominal exchange rate adjustments [29]. Alternatively, if nominal prices and wages are downward rigid some measure of real flexibility could be achieved by means of exchange rate adjustments. In this case the loss of direct control over the nominal exchange rate instrument represents a cost [40].

- **The diversification in production and consumption** - High diversification in production and consumption, such as the "portfolio of jobs", and correspondingly in imports and exports, dilutes the possible impact of shocks specific to any particular sector. Therefore, diversification reduces the need for changes in the terms of trade via the nominal exchange rate and provides "insulation" against a variety of disturbances [41]. Highly diversified partner countries are more likely to incur reduced costs as a result of forsaking nominal exchange rate changes between them and find a single currency beneficial.

- **Similarities of inflation rates** - External imbalances can arise also from persistent differences in national inflation rates resulting from differences in: structural developments, labour market, economic policies, and social preferences (such as inflation aversion). Fleming [26] notes that when inflation rates between countries are low and similar over time, terms of trade will also remain fairly stable. This will foster more equilibrated current account transactions and trade, reducing the need for nominal exchange rate adjustments.

- **Fiscal integration** - Countries sharing a supranational fiscal transfer system to redistribute funds to a member country affected by an adverse asymmetric shock would also be facilitated in the adjustment to such shocks and might require less nominal exchange rate adjustments [41]. However, this would require an advanced degree of political integration and willingness to undertake such risk-sharing.

- **Political integration**- The political will to integrate is regarded by some as among the most important condition for sharing a single currency [47]. Political will fosters compliance with joint commitments, sustains cooperation on various economic policies, and encourages more institutional linkages. Haberler [34] stresses that a similarity of policy attitudes among partner countries is relevant in turning a group of countries into a successful currency area.

1.3 Endogeneity of OCA

At early stages the OCA theory assumed that the countries have to fulfill criteria before establishing a successful monetary union. Two opposite views were introduced later on. On one side it is an argument by Paul R. Krugman [43] that increased economic integration increases the likelihood of asymmetric shocks. On the other side, Jeffrey A. Frankel and Andrew K. Rose [27] claimed that increased economic integration (including, most importantly, customs and monetary union and increasing factor mobility) increases convergence between nations, hence reducing the costs of monetary union in terms of loss of exchange rate control. Furthermore, they argued that the OCA criteria are endogenous and therefore conclusions about country's suitability for entry into a currency union can be inaccurate.

For empirical testing of this hypothesis they estimated regressions as follows :

$$\begin{aligned} Corr(Q_i, Q_j) &= \alpha + \beta log(TI_{ij}^T) + \epsilon_{ij} \\ \text{where } TI_{ij}^T &= \frac{T_{ij}}{T_i + T_j}, \end{aligned} \tag{1}$$

$Corr(Q_i, Q_j)$ stands for the correlation between country i and country j de-trended (with method : fourth-differencing, quadratic de-trending or HP filtering) indicator of economic activity (such as real GDP, industrial production, employment or unemployment rate). TI_{ij}^T represents the average bilateral trade intensity between country i and country j defined in relation to exports, imports or trade turnover specified by T. α and β are the regression coefficients and ϵ_{ij} stands for regression error which can be explained as other influences on bilateral activity correlations. Using a panel of thirty four years of data from twenty one industrialized countries, they found a strong positive relationship between the degree of bilateral trade intensity and the cross-country bilateral correlation of business cycle activity.

This hypothesis was re-examined by Fidrmuc [21] on sample of twenty two OECD countries in period between 1990 to 1999. He noticed that equation (1) neglects the similarity of trade structure and explain the similarity of business cycles only via bilateral trade. Therefore, he introduced the enhanced formula with added effect of

intra-industry trade (IIT) :

$$Corr(Q_i, Q_j) = \alpha + \beta log(TI_{ij}^T) + \gamma log(IIT_{ij})$$
$$\text{where } IIT_t = 1 - \left[\frac{\sum_i |X_{it} - M_{it}|}{\sum_i (X_{it} + M_{it})}\right]. \tag{2}$$

Q and TI are defined in the same way as in equation (1), X and M stands for exports and imports. He reports significant and positive estimated coefficients for IIT. On the contrary, the coefficients of bilateral TI are close to zero and insignificant. Therefore TI_{ij} is left out from equation (2). The new model confirms high significance of IIT's coefficients. *"As a result, the endogeneity hypothesis of OCA criteria is confirmed but with respect to IIT."*[21]

1.4 Recent papers on OCA theory

The establishment of European Monetary Union (EMU) has expanded the possibilities of discussion on OCA theory. We can divide authors addressing OCA theory in EMU into two separated groups. While, first groups of authors review current state of EMU members and influences of common currency on their economies (convergence of business cycles, similarity of shocks, etc.), the other groups investigates the suitability of new member to join EMU. In neither group authors do not report the same results. In general, there are two main reasons for which we find conflicting conclusions in various studies. The first is the methodology employed for the calculation of the cyclical component. The second source of conflicting results is that there is no consensus on the minimum value of the correlation coefficient that would indicate business cycle synchronization. There are many methods how to compute the cyclical component. We describe the most commonly used methods in studies from our research.

- The Hodrick-Prescott (HP) filter - is widely used in the field of economics to estimate trends and cycles from time series data. Although the filter has been informally used in many fields for many decades, it was more recently introduced to the study of business cycles in 1997 by Hodrick and Prescott [35]. The filter decomposes the series into a cyclical ($c_{i,t}$) , and a trend ($g_{i,t}$) component, by minimizing with respect to $g_{i,t}$, for the smoothness parameter $\lambda > 0$ the following

quantity:

$$\sum_{t=1}^{T}(y_{i,t} - g_{i,t})^2 + \lambda \sum_{t=2}^{T-1}(g_{i,t+1} - g_{i,t-1})^2 \quad (3)$$

- Baxter-King (BK) filter - the band-pass filter developed by Baxter and King [11] is a widely used and the preferred method in the synchronization literature. Main advantage of the band-pass filter is that it eliminates both the high frequency fluctuations of less than 6 quarters, which may be due to measurement errors and low frequency fluctuations of more than 32 quarters reflecting long term growth components, while retaining only the cyclical components of the series.

- Christiano-Fitzgerald (CF) filter - is an additional band pass filter which has been developed by Christiano and Fitzgerald [17] in 2003. This filter has an asymmetrical weighting scheme which uses all observations for the calculation of the filtered values. They find the weights under the assumption that the series is a random walk provide a reasonable approximation.

Afonso and Sequeira [3] used data between 1970 and 2009, to study business cycle synchronization of GDP and aggregate demand components. Using HP filter they find that there is correlation between individual countries and the EMU aggregates, and that these correlations rose in particular after the introduction of the euro. Crowley [18] uses model-based clustering (a maximum likelihood-based technique) in a sample of 32 countries (all European except the USA, Canada, and Japan) for the 1970-2005 period. National (dis)similarities are assessed not only with reference to Germany but also relative to euro area variables. The author finds some evidence of a geographical core-periphery pattern, where contiguous countries in the centre of Europe tend to cluster together. Inklaar and De Haan [32] reach the conclusion that the periods of cyclical convergence are alternated with those of divergence, this being a defining feature of the euro area. These results contrast with the vision that the deepening of European integration will mean a better synchronization of business cycles. Boreiko [15] uses fuzzy clustering to study the readiness of Central and Eastern European countries for EMU membership. Gogas and Kothroulas [31] estimated that the common monetary policy tends to destabilize the economies from euro area periphery, as they are less correlated with the group of the three biggest countries, which achieve 60% of

the entire Euro area GDP. Fidrmuc and Korhonen [22] found that, on the basis of data for 1991-2000, a number of the countries that had failed to meet the convergence criteria for membership in an EU-based optimal currency area during earlier period now displayed considerably more convergence. Based on supply and demand shocks correlations between these CEECs countries and Eurozone they conclude that EMU accession would be easy for Hungary, and have mixed results for Poland and Czech republic.This finding is important for the methodology used in this paper because it highlights the time-varying nature of convergence, which Korhonen and Fidrmuc rightly view as an evolving rather than a static concept. Frenkel and Nickel [28] used a structural vector autoregression model to identify and compare demand and supply shocks between euro area countries and central and eastern European countries (CEECs). The shocks and the shock adjustment dynamics of these countries are also compared to western European EU countries that have not yet adopted the euro. Focusing on the period 1993-2001, they found that there are still considerable differences in the shocks and in the adjustment process to shocks between the euro area and the CEECs.

2 Meta-Analysis

Meta-analysis, also known as regression of regression analysis, is used to describe quantitative methods for combining evidence across studies while controlling for heterogeneity among studies. One advantage of meta-analysis is that it can potentially address the subjectivity associated with traditional narrative literature surveys, and it may indeed provide a more systematic and objective (quantitative) assessment of an existing body of findings. Meta-analysis as a tool was generally used in field of medicine, pharmacy and psychology, but is relatively new in economics. In this context, the meta-analysis is used to quantify the share of variance within a given set of estimates that is due to variation in methodologies, assumptions and other factors [52].

Rose and Stanley [51] with the meta-analysis of 754 estimates of the impact of currency unions on trade, concluded that the formation of a currency union typically is associated with a trade increase of thirty to sixty percent. Part of this is caused by publication bias. Fidrmuc and Korhonen [23] performed meta-regression to analyze the 35 studies regarding the business cycle correlation between countries in Central and Eastern Europe and the euro area. With more than 450 point estimates of business-cycle correlation they concluded that several CEECs already exhibit high correlation with the Euro-zone business cycles; however, correlation coefficients are sensitive to estimation methodologies. Fidrmuc and Korhonen [24] surveyed 74 individual papers dealing with China's business cycle synchronization. With meta-analysis of 1894 correlation coefficients they concluded that business cycle synchronization between China and its neighbors in the Asia-Pacific region is relatively high. Also they found out high business cycle correlation with US, what is in direct contrast with so-called decoupling hypothesis.

2.1 Meta-Statistic

In our meta-analysis we have included 29 independent studies published between 2000 and 2014 with total of 1911 correlation coefficients of European countries. As a referring country we used Germany or Euro area aggregate. A full listing of the studies can be

found in Appendix A. In table 1 we present descriptive statistics for individual countries and total as well.

Table 1: Meta-statistics

	Number of obs.	Mean	St. deviation	Median	Maximum	Minimum
Germany	74	0.756	0.216	0.83	0.985	0.18
Austria	103	0.645	0.233	0.68	0.984	-0.037
Belgium	99	0.692	0.23	0.73	0.996	0
Greece	103	0.384	0.337	0.4	0.971	-0.65
Spain	109	0.628	0.269	0.7	0.99	-0.08
Finland	100	0.447	0.306	0.46	0.994	-0.21
France	111	0.729	0.193	0.753	0.98	0.26
Ireland	99	0.485	0.343	0.51	0.975	-0.365
Italy	108	0.641	0.282	0.705	0.992	-0.28
Netherlands	103	0.607	0.306	0.68	0.98	-0.581
Portugal	102	0.527	0.281	0.57	0.975	-0.179
Denmark	86	0.48	0.308	0.52	0.952	-0.267
UK	90	0.434	0.321	0.435	0.966	-0.656
Sweden	85	0.502	0.297	0.506	0.96	-0.303
Norway	28	0.122	0.251	0.182	0.54	-0.62
Czech Rep.	67	0.353	0.379	0.368	0.972	-0.901
Hungary	69	0.525	0.314	0.5	0.993	-0.33
Poland	69	0.385	0.306	0.364	0.92	-0.69
Slovakia	71	0.307	0.43	0.33	0.937	-0.673
Slovenia	67	0.494	0.351	0.58	0.973	-0.489
Estonia	59	0.443	0.365	0.42	0.891	-0.37
Latvia	56	0.446	0.383	0.43	0.927	-0.49
Romania	53	0.278	0.381	0.392	0.89	-0.5
Total	1911	0.519	0.334	0.57	0.996	-0.901

We collected correlation coefficients of 23 European countries where the largest number of available estimates is 119 for France. Similar numbers are reported for Italy

and Spain. On the other hand, the least numbers are reported for Norway - only 29 estimates. First members of EMU (Germany, France, Spain etc.) have highest average correlation coefficients from 0,5 to 0,75. CEECs countries and countries which have not joined EMU (UK, Norway, Sweden) reports lower average correlation from interval 0,2 to 0,5. More detailed view of correlation estimates can be seen in following histograms (Figure 1, Figure 2)

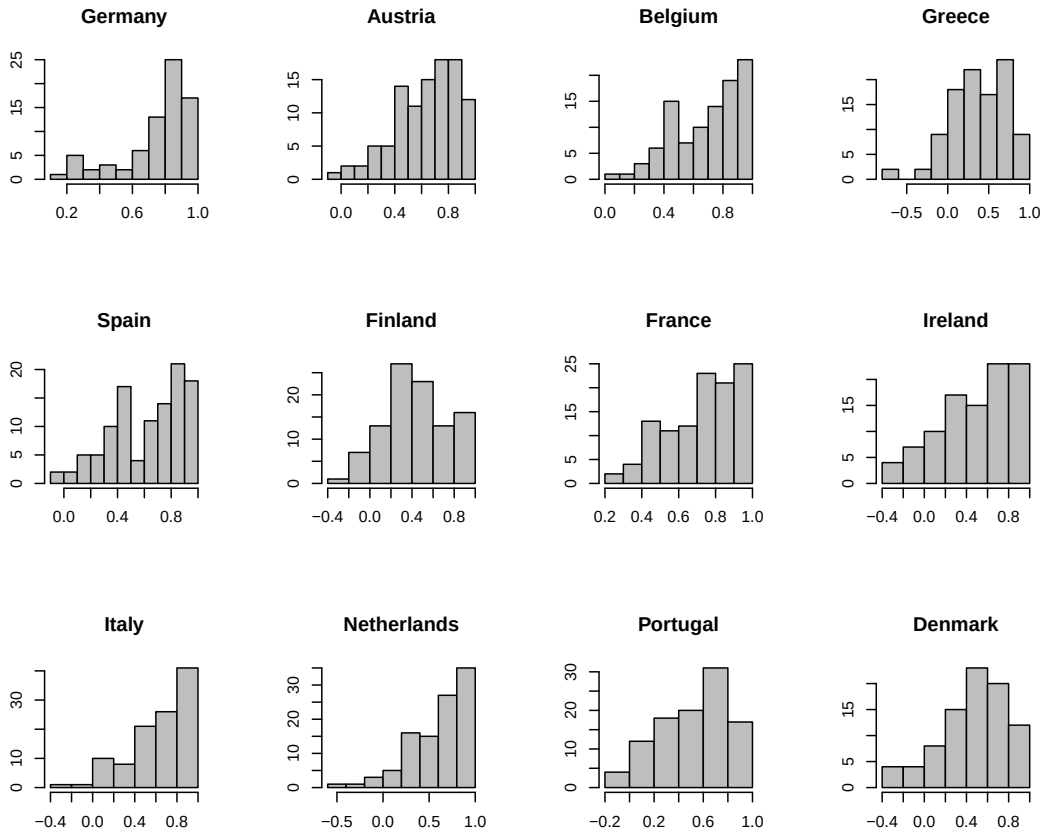

Figure 1: Histogram of correlation estimates

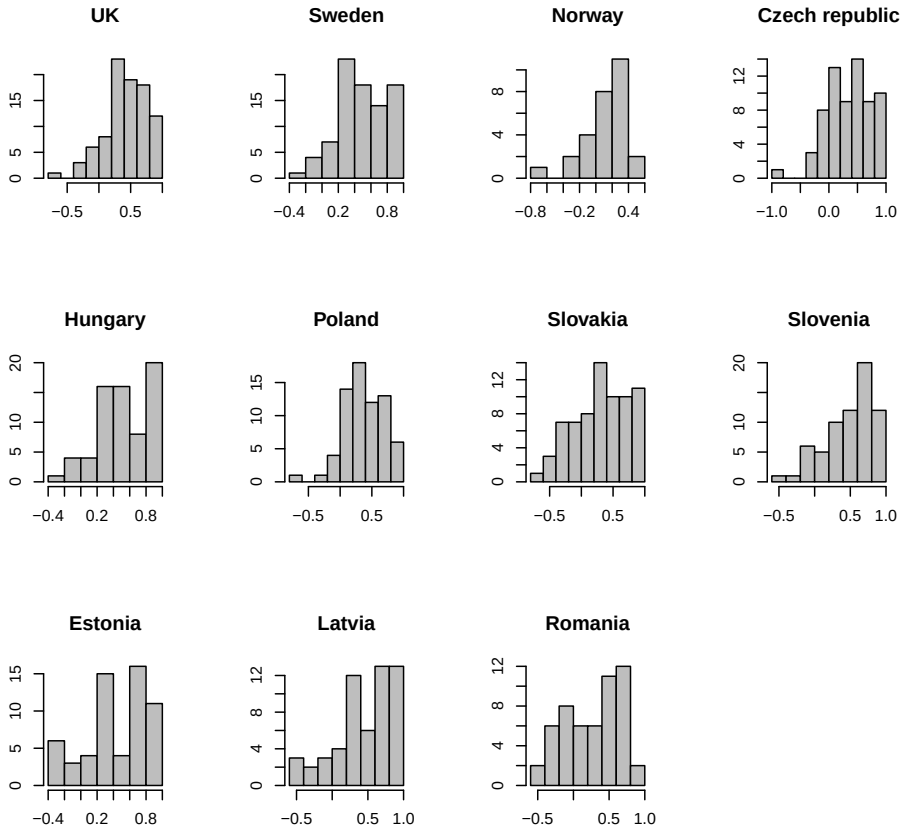

Figure 2: Histogram of correlation estimates

In this paper we consider both journals and working papers. Figure 3 represents numbers of papers published in journals and working papers sorted by year. As we can see, the most of papers were published around years 2003 and 2005. In contrast, we have not used any publication from 2010.

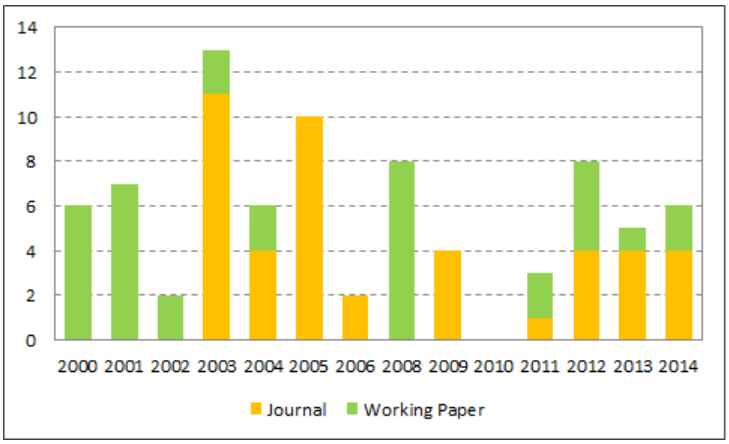

Figure 3: Number of publications

3 Publication Bias

Publication bias is defined as the tendency for certain kinds of studies, typically those showing a significant positive result in a clinical trial or an observational study, to receive more favorable publication decisions than equally well-conducted studies that report a negative or null result. Publication bias is a potential threat in all areas of research, including qualitative research, primary quantitative studies, narrative reviews, and quantitative reviews, that is, meta-analysis. Publication bias is usually investigated through funnel plots.

3.1 Funnel Plots

Funnel plots are graphs designed to examination of presence of publication bias. A funnel plot is a scatter-plot of effect against a measure of study size (e.g. standard error or variance of effect). In the absence of bias, the plot will resemble a symmetrical around the true effect, shaped as inverted funnel, on the contrary if bias is present because smaller studies which show no statistically significant effects remain unpublished, then estimates appear in lower part of the chart and the funnel plot will appear extremely wide and asymmetrical. Therefore, funnel plots can be used as a visual tool to detect publication bias. Besides that we have to be careful with conclusions because modeling issues (e.g. omitted variables, estimation techniques) can also be a source of misspecification bias that can be mistakenly attributed to the publication bias [53].

We review the funnel plots for collected estimates of business cycle synchronization, which are displayed in Figure 4, keeping in mind restriction mentioned above. The precision (y-axis) is usually defined as the inverse standard error. Standard errors are not available for correlation coefficients, but the approximation by the inverse number of observations can be used. Therefore, we use the number of observations to measure the quality of publications. Furthermore, the basic level of business cycle synchronization can differ by country. Therefore, we present funnel plots by country [24]. Figure 4 shows us some asymmetries, mostly for Slovakia, Slovenia, Romania and Latvia.

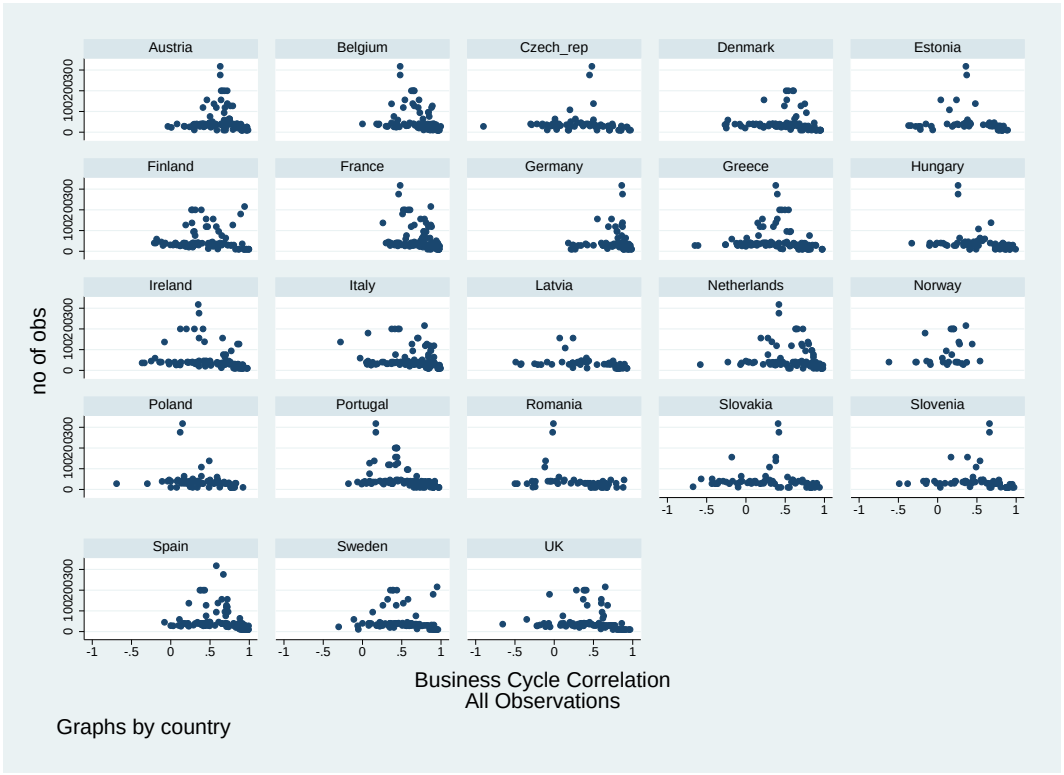

Figure 4: Funnel plots by country

3.2 Funnel assymetry test

Despite that, we can see asymmetries on funnel plots, we cannot derive any (exact) conclusion from that, whereupon we test the symmetry more formally using funnel asymmetry test (FAT). This test is based on on the simple meta-regression of available effects and corresponding standard errors [8] :

$$\frac{1}{2}ln\left(\frac{1+\rho_{ij}}{1-\rho_{ij}}\right) = \tilde{\rho}_l + \beta\frac{1}{T} + \epsilon_{ij} \tag{4}$$

where we use the Fisher transformation to transform our correlation coefficients ρ_{ij}. As we mentioned earlier, standard errors are not available for correlation coefficients, thus we approximate the precision with inverse number of observation, T. $\tilde{\rho}_l$ stands for country effect, which is the estimate of basic level of business cycle synchronization that is assumed to vary around the so called "true" effect, while $\frac{1}{T}$ a stands for the so-called publication bias. If coefficient β is close to zero, the estimates are distributed symmetrically around the true effect $\tilde{\rho}_l$ [20].

We use standard and weighted versions of the FAT test to test null hypothesis $\beta = 0$, which confirm the presence of asymmetry (potentiality of publication bias). In our case we use a fixed-effects model with robust standard errors.

Table 2: Funnel asymmetry test

	(1) OLS	(2) WLS
1/T	10.163***	7.138***
	(0.398)	(0.486)
Germany	0.767***	0.997***
	(0.063)	(0.0561)
Austria	0.544***	0.676***
	(0.045)	(0.030)
Belgium	0.681***	0.734***
	(0.050)	(0.044)
Greece	0.128***	0.278***
	(0.044)	(0.0356)
Spain	0.569***	0.606***
	(0.046)	(0.038)
Finland	0.269***	0.411***
	(0.049)	(0.076)
France	0.757***	0.796***
	(0.044)	(0.047)
Ireland	0.299***	0.378***
	(0.047)	(0.050)
Italy	0.603***	0.663***
	(0.050)	(0.060)
Netherlands	0.521***	0.610***
	(0.052)	(0.047)
Portugal	0.333***	0.372***
	(0.040)	(0.034)
Denmark	0.241***	0.410***

Table 2: Funnel asymmetry test

	(1) OLS	(2) WLS
	(0.045)	(0.048)
UK	0.176***	0.313***
	(0.042)	(0.046)
Sweden	0.298***	0.469***
	(0.048)	(0.089)
Norway	-0.067	0.086*
	(0.059)	(0.047)
Czech republic	0.041	0.217***
	(0.065)	(0.062)
Hungary	0.314***	0.391***
	(0.063)	(0.052)
Poland	0.045	0.186***
	(0.051)	(0.038)
Slovakia	0.002	0.168***
	(0.066)	(0.061)
Slovenia	0.247***	0.419***
	(0.060)	(0.067)
Estonia	0.133**	0.267***
	(0.058)	(0.044)
Latvia	0.131**	0.212***
	(0.061)	(0.056)
Romania	-0.123*	0.003
	(0.064)	(0.049)
Observations	1911	1911
R-squared	0.760	0.742

Note: *, **, and *** stand for significance at the 10%, 5%, and 1% level, respectively. Robust standard errors in parentheses.

As we can see in Table 4 the coefficient for our precision ($\frac{1}{T}$) is very high and strongly significant. Therefore we want to examine the proportion of publication bias for each country and we estimate a new model as follows :

$$\frac{1}{2}ln\left(\frac{1+\rho_{ij}}{1-\rho_{ij}}\right) = \tilde{\rho}_l + \beta\frac{1}{T} + \sum_{n=1}^{N}\gamma_i\frac{1}{T_i} + \epsilon_{ij} \tag{5}$$

where ρ_{ij}, $\tilde{\rho}_l$ and ϵ_{ij} are defined in same way as in previous model. N stands for total number of countries (in our case it is 23) and $\frac{1}{T_i}$ represents country specific precision. Moreover, all country specific precisions together are equal to total precision, therefore holds :

$$\frac{1}{T_i} = \frac{1}{T} * (\text{dummy for country i})$$
$$\frac{1}{T} = \sum_{n=1}^{N}\frac{1}{T_i}$$

Due to collinearity, precision of Latvia (se_Latvia) has been omitted from regression and we can classify it as comparative base. In Table 3 we see that for this base the publication bias is the strongest for Germany, Poland, Norway and Romania in both test specifications, Spain and Finland in OLS and 8 more using WLS.

Table 3: Funnel asymmetry test 2

	(1) OLS	(2) WLS
1/T	10.409***	10.618***
	(1.272)	(1.136)
se_Germany	-6.690**	-9.105***
	(2.847)	(2.556)
se_Austria	-2.377	-5.005**
	(2.255)	(1.983)
se_Belgium	1.235	-0.359
	(1.741)	(2.035)
se_Greece	-0.692	-6.034***
	(2.170)	(2.039)

Table 3: Funnel asymmetry test 2

	(1) OLS	(2) WLS
se_Spain	4.159**	0.799
	(1.836)	(2.037)
se_Finland	4.784*	-5.688
	(2.726)	(3.939)
se_France	1.230	0.419
	(1.823)	(2.279)
se_Ireland	2.261	-1.643
	(1.896)	(2.235)
se_Italy	2.766	-0.458
	(2.231)	(2.833)
se_Netherlands	0.169	-2.393
	(2.262)	(2.310)
se_Portugal	0.621	0.701
	(1.980)	(1.813)
se_Denmark	0.584	-6.782***
	(1.979)	(2.299)
se_UK	0.784	-4.993**
	(1.776)	(2.239)
se_Sweden	0.874	-6.740*
	(2.161)	(3.963)
se_Norway	-15.601***	-16.657***
	(4.047)	(4.410)
se_Czech Republic	-1.861	-6.305**
	(2.604)	(2.709)
se_Hungary	-1.336	-0.660
	(2.606)	(2.285)
se_Poland	-5.237**	-4.440**
	(2.137)	(1.945)

Table 3: Funnel asymmetry test 2

	(1) OLS	(2) WLS
se_Slovakia	-2.800	-5.912**
	(2.324)	(2.573)
se_Slovenia	-0.689	-5.835**
	(2.326)	(2.876)
se_Estonia	-2.344	-3.619*
	(1.861)	(1.888)
o.se_Latvia	-	-
	(omitted)	(omitted)
se_Romania	-4.277**	-2.920*
	(1.986)	(1.671)

Note: *, **, and *** stand for significance at the 10%, 5%, and 1% level, respectively. Robust standard errors in parentheses.

Complete table available in Appendix B.

4 Meta-regression Analysis

In economics meta-analysis is usually applied in the form of a meta-regression analysis (MRA), where in a simple regression the dependent variable becomes the summary statistic (or regression parameter) of interest drawn from each study and the researcher creates a set of explanatory variables describing differences (or similarities) in the design of the studies under scrutiny [39]. We apply this methodology to determine synchronization of business cycles of European countries referring to euro area or Germany. For correlation coefficients ρ_{ij} transformed via Fisher transformation we state meta-regression as follows :

$$\frac{1}{2}ln\left(\frac{1+\rho_{ij}}{1-\rho_{ij}}\right) = \tilde{\rho}_l + \sum_{k=1}^{K} \beta_{ijk} D_{ijk} + \epsilon_{ij} \tag{6}$$

where $\tilde{\rho}_l$ represents country dummy, D_{ijk} stands for explanatory variables for country i in publication j and ϵ_{ij} is estimation error.

Most of our explanatory variables are included in the form of binary dummies. Country dummy $\tilde{\rho}_l$ can be explained as the average correlation coefficient for country l in regression with K explanatory variables. If variables do not meet the specified criteria they are evaluated with zero, one otherwise. These explanatory variables can be divided in four groups :

- **Variables related to publication and authors** - in this group we include publication year, number of countries within each study, length (in years) of observed period, whether the paper was published in journal or only as working paper. We also include the dummies for authors having affiliation with an university or a central bank.

- **Variables related to referring country** - in this group we include dummies for referring countries used during estimation of correlation coefficients. In our case it is EU aggregate and Germany

- **Variables related to the indicator of economic activity** - in this group we include dummies for supply and demand shocks, industrial production, GDP and inflation used to calculate the business cycle synchronization.

- **Variables related to methodology and data frequency** - in this group we include dummies for Blanchar-Quah decomposition, different filters such as Hodrick-Prescott, Baxter-king or Christiano-Fitzgerald, simple correlation in time series models and also frequency of data (annual, quarterly).

Other than dummy variables (e.g. number of observations, and number of analyzed countries, publication year) are demeaned. We perform our meta-regression using OLS analysis in several steps. We always include the country-fixed effects, but only one group of explanatory variables at time. Results of our regression are shown in Table 4, where columns are sorted by groups of explanatory variables. Last column presents our preferred specification with the most significant variables from previous four columns.

First, we include all variables related to the publication. We see that all country effects are relatively high and statistically significant. This can be explained by publication bias mentioned in Section 3. Number of available years ($obsydm$) has negative and significant impact on the reported degree of business cycle synchronization. Papers published in journals ($journal$) and working papers (wp) tend to report lower degree of business cycle synchronization. Moreover, influence of journals is most significant in this group. On the other hand, year of publication (ydm) has a positive and strongly significant effect on the results. Authors affiliated with the central bank ($cbank$) and universities ($univ$) have no significant effect.

Next group of included variables is related to referring country. Surprisingly, euro area as referring country (Ref_EU) has positive but insignificant effect on reported levels of correlation. In contrary, Germany (Ref_DE) has negative and significant effect.

In the next step, we include variables related to the indicator of economic activity. All variables in this group have statistically significant effect but only GDP (*gdp*) has positive degree of business cycle synchronization. Last group of included explanatory variables is describing methodology used. Annual data (*annual*) lead to higher reported correlation coefficients than quarterly data. The application of Blanchar-Quah decomposition (*bandq*) and filters ($filters$) have robust effect on the level of business cycle synchronization - B-Q negative and filters positive.

Finally, we include the most significant variables from each group and drop all the others. Thus we get our preferred meta-regression which involves only year of the publication, dummy for journal, GDP, Blanchar-Quah decomposition and filters. In this specification we see that dummy for journal is no longer significant. All other explanatory variables are confirmed to have same effect as described above.

According to preferred specification, we now present country-fixed effects. For almost all countries we find positive and significant correlation of business cycles. The only exceptions are Norway and Romania. It could be caused due to smaller number of available observation for these countries. Unsurprisingly, the highest level of synchronization, above 0.6 is estimated for Germany, Austria, Belgium, Spain, France, Italy and Netherlands. The lowest correlation coefficients are reported mostly for CEECs countries. Also estimates for Greece, Finland, UK and Denmark are relatively low. Hungary, as non-EMU member, has the highest degree of business cycle synchronization among all the CEECs.

Table 4: Meta-regression

	(1)	(2)	(3)	(4)	(5)
	publication	ref_country	variable	method	preferred
obsydm	-0.007***				
	(-4.910)				
nocntrdm	0.007				
	(1.259)				
ydm	0.031***				0.021***
	(8.612)				(5.888)
journal	-0.479***				-0.047
	(-12.342)				(-1.303)
wp	-0.290***				
	(-4.665)				
univ	0.054				
	(0.809)				
cbank	-0.062				
	(-1.465)				
Ref_country_Germany		-0.284**			
		(-2.216)			
Ref_country_EU		0.130			
		(1.111)			
gdp			0.248***		0.158***
			(7.611)		(4.184)
indprod			-0.191***		
			(-3.308)		
demand			-0.397***		
			(-7.452)		
supply			-0.336***		
			(-7.145)		
infl			-0.196***		

Table 4: Meta-regression

	(1) publication	(2) ref_country	(3) variable	(4) method	(5) preferred
			(-3.669)		
annual				0.337***	0.212***
				(8.749)	(5.470)
quarterly				0.096**	
				(2.179)	
cor				-0.095**	
				(-2.553)	
tser				-0.099**	
				(-2.371)	
bandq				-0.282***	-0.161***
				(-9.149)	(-4.903)
filters				0.270***	0.174***
				(9.063)	(5.158)
Germany	1.339***	1.046***	1.059***	0.824***	0.853***
	(28.167)	(8.979)	(37.918)	(14.930)	(16.745)
Austria	1.159***	0.913***	0.842***	0.590***	0.642***
	(23.332)	(7.607)	(27.555)	(11.465)	(12.604)
Belgium	1.284***	1.040***	0.982***	0.742***	0.792***
	(25.379)	(8.761)	(33.092)	(14.551)	(15.936)
Greece	0.729***	0.491***	0.427***	0.184***	0.227***
	(14.574)	(4.134)	(14.359)	(3.534)	(4.488)
Spain	1.176***	0.925***	0.869***	0.626***	0.673***
	(22.761)	(7.786)	(28.838)	(11.923)	(13.140)
Finland	0.866***	0.644***	0.568***	0.329***	0.373***
	(16.787)	(5.413)	(18.685)	(6.494)	(7.735)
France	1.343***	1.111***	1.038***	0.802***	0.843***
	(26.115)	(9.339)	(34.773)	(15.628)	(17.418)
Ireland	0.914***	0.679***	0.616***	0.364***	0.410***

Table 4: Meta-regression

	(1)	(2)	(3)	(4)	(5)
	publication	ref_country	variable	method	preferred
	(17.895)	(5.711)	(20.198)	(7.109)	(8.027)
Italy	1.194***	0.970***	0.891***	0.653***	0.695***
	(23.078)	(8.148)	(29.046)	(12.612)	(14.410)
Netherlands	1.123***	0.876***	0.816***	0.581***	0.627***
	(22.441)	(7.386)	(27.469)	(11.275)	(12.519)
Portugal	0.941***	0.682***	0.633***	0.403***	0.439***
	(18.248)	(5.760)	(21.521)	(7.454)	(8.608)
Denmark	0.873***	0.653***	0.580***	0.320***	0.375***
	(17.614)	(5.422)	(18.114)	(6.423)	(7.284)
UK	0.791***	0.580***	0.508***	0.257***	0.304***
	(15.758)	(4.868)	(16.329)	(5.284)	(6.276)
Sweden	0.935***	0.717***	0.643***	0.378***	0.434***
	(18.903)	(5.945)	(20.186)	(7.912)	(8.659)
Norway	0.532***	0.290**	0.136***	-0.052	-0.005
	(9.584)	(2.335)	(3.880)	(-1.118)	(-0.099)
Czech Republic	0.671***	0.434***	0.401***	0.144**	0.199***
	(13.195)	(3.635)	(12.592)	(2.652)	(3.631)
Hungary	0.942***	0.711***	0.665***	0.407***	0.457***
	(18.446)	(5.956)	(20.888)	(7.473)	(8.351)
Poland	0.672***	0.442***	0.395***	0.137**	0.188***
	(13.169)	(3.701)	(12.420)	(2.525)	(3.430)
Slovakia	0.620***	0.377***	0.374***	0.126**	0.169***
	(12.434)	(3.159)	(11.535)	(2.451)	(3.148)
Slovenia	0.876***	0.629***	0.633***	0.390***	0.430***
	(17.933)	(5.282)	(19.701)	(7.711)	(7.868)
Estonia	0.755***	0.513***	0.546***	0.284***	0.323***
	(15.711)	(4.320)	(17.129)	(5.639)	(5.886)
Latvia	0.763***	0.536***	0.564***	0.297***	0.337***

Table 4: Meta-regression

	(1) publication	(2) ref_country	(3) variable	(4) method	(5) preferred
Romania	(15.698)	(4.510)	(16.785)	(5.784)	(6.156)
	0.499***	0.299**	0.255***	-0.037	0.000
	(9.602)	(2.509)	(8.181)	(-0.672)	(0.002)
Observations	1,911	1,911	1,911	1,911	1,911
R-squared	0.761	0.707	0.740	0.756	0.769

Note: *, **, and *** stand for significance at the 10%, 5%, and 1% level, respectively.

Robust t-statistics in parentheses.

Conclusion

We have reviewed recent literature on European business cycles synchronization. The results of these studies were not always in consensus because authors used different methods, variables and data. With use of meta-analysis we provide a quantitative summary of this literature.

We found that the results are mostly influenced by year of the publication, annual frequency of data, GDP as indicator of economic activity, Blanchar-Quah decomposition and various filters as methodology. Only Blanchar-Quah decomposition has negative effect on reported degree of business cycle synchronization, while all the others have positive.

With the help of funnel plots and funnel asymmetry test we have found strong evidence of publication bias. Moreover, the publication bias is confirmed by meta-regression with only publication-related variables included, where all countries report a relatively high levels of business cycle synchronization. It means that authors report rather positive than negative or inconclusive results.

We found that almost all countries report positive level of business cycle synchronization. However, it is hard to determine which of them could be considered as optimum currency area due to missing benchmark (what is the exact degree of business cycle synchronization to indicate the OCA). The highest results are reported for countries which business cycles have been already integrated before establishing EMU (Germany, France, etc.). All CEECs countries, both EMU and non-EMU members, report lower results. Also Greece and Finland, as a long-time members, still present the low level of business cycle synchronization. After more than fifteen years of EMU some members are not integrated enough, what does not indicate the fulfillment of OCA criteria *ex-post*. Thus, we cannot confirm the endogeneity hypothesis.

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Appendix A

Table 5: List of surveyed studies sorted by year

Authors	Title	Year
Robert Inklaar, Jakob De Haan	Is There Really A European Business Cycle?	2000
Anna-Maria Agresti, Benoît Mojon	Some Stylised Facts On The Euro Area Business Cycle	2001
Frederico Belo	Some Facts About The Cyclical Convergence In The Euro Zone	2001
Joao Valle E Azevedo	Business Cycles: Cyclical Comovement Within The European Union In The Period 1960-1999. A Frequency Domain Approach	2002
Michael Artis	Is There A European Business Cycle?	2003
Jarko Fidrmuc, Iikka Korhonen	Similarity Of Supply And Demand Shocks Between The Euro Area And The Ceecs	2003
Bastiaan A. Verhoef	The (A)Symmetry Of Shocks In The Emu	2003
Dmitri Boreiko	Emu And Accession Countries: Fuzzy Cluster Analysis Of Membership	2003
Jarko Fidrmuc	The Endogeneity Of The Optimum Currency Area Criteria	2004
Yuliya Demyanyk, Vadym Volosovych	Asymmetry Of Output Shocks In The European Union: The Difference Between Acceding And Current Members.	2004

Appendix A

Authors	Title	Year
Michael Frenkel, Christiane Nickel	How Symmetric Are The Shocks And The Shock Adjustment Dynamics Between The Euro Area And Central And Eastern European Countries?	2005
Ian Babetskii	Trade Integration And Synchronization Of Shocks	2005
Davide Furceri, Georgios Karras	Are The New Eu Members Ready For The Euro? A Comparison Of Costs And Benefits	2006
Linda L. Tesar	Production Sharing And Business Cycle Synchronization In The Accession Countries	2008
Patrick M Crowley	One Money, Several Cycles? Evaluation Of European Business Cycles Using Model-Based Cluster Analysis	2008
Sofia Gouveia, Leonida Correia	Business Cycle Synchronisation In The Euro Area: The Case Of Small Countries	2008
António Afonso, Davide Furceri	Sectoral Business Cycle Synchronization In The European Union	2009
Christos S. Savva, Kyriakos C. Neanidis, Denise R. Osborn	Business Cycle Synchronization Of The Euro Area With The New And Negotiating Member Countries	2009
Periklis Gogas, Georgios Kothroulas	Two Speed Europe And Business Cycle Synchronization In The European Union: The Effect Of The Common Currency	2009

Appendix A

Authors	Title	Year
António Afonso, Ana Sequeira	Revisiting Business Cycle Synchronisation In The European Union	2010
Michael Artis, George Chouliarakis, P. K. G. Harischandra	Business Cycle Synchronization Since 1880	2011
Klaus Weyerstrass, Bas Van Aarle, Marcus Kappler, Atilim Seymen	Business Cycle Synchronisation With(In) The Euro Area: In Search Of A 'Euro Effect'	2011
Jean-Sébastien Pentecôte, Marilyne Huchet-Bourdon	Revisiting The Core-Periphery View Of Emu	2012
Çigdem Akin	Multiple Determinants Of Business Cycle Synchronization	2012
Mark Mink, Jan P.A.M. Jacobs, Jakob De Haan	Measuring Synchronicity And Comovement Of Business Cycles With An Application To The Euro Area	2012
Marinaş Marius-Corneliu	Business Cycles Synchronization With The Euro Area. The Case Of Cee Countries	2013
Mustapha Djennas, Mohamed Benbouziane, Meriem Djennas	Business Cycle Synchronization In Euro Area And Gcc Countries: A Wavelets-Gaapproach	2013
Stelios Bekiros, Duc Khuong Nguyen, Gazi Salah Uddin, Bo Sjo	Business Cycle (De)Synchronization In The Aftermath Of The Global Financial Crisis: Implications For The Euro Area	2014
Ioanna Konstantakopouloua, Efthymios G. Tsionasb	Sciencedirecthalf A Century Of Empirical Evidence Of Business Cyclesin Oecd Countries	2014

Appendix B

Table 6: Funnel asymmetry test

	(1) OLS	(2) WLS
1/T	10.409***	10.618***
	(1.272)	(1.136)
se_Germany	-6.690**	-9.105***
	(2.847)	(2.556)
se_Austria	-2.377	-5.005**
	(2.255)	(1.983)
se_Belgium	1.235	-0.359
	(1.741)	(2.035)
se_Greece	-0.692	-6.034***
	(2.170)	(2.039)
se_Spain	4.159**	0.799
	(1.836)	(2.037)
se_Finland	4.784*	-5.688
	(2.726)	(3.939)
se_France	1.230	0.419
	(1.823)	(2.279)
se_Ireland	2.261	-1.643
	(1.896)	(2.235)
se_Italy	2.766	-0.458
	(2.231)	(2.833)
se_Netherlands	0.169	-2.393
	(2.262)	(2.310)
se_Portugal	0.621	0.701
	(1.980)	(1.813)
se_Denmark	0.584	-6.782***
	(1.979)	(2.299)

Table 6: Funnel asymmetry test

	(1) OLS	(2) WLS
se_UK	0.784	-4.993**
	(1.776)	(2.239)
se_Sweden	0.874	-6.740*
	(2.161)	(3.963)
se_Norway	-15.601***	-16.657***
	(4.047)	(4.410)
se_Czech Republic	-1.861	-6.305**
	(2.604)	(2.709)
se_Hungary	-1.336	-0.660
	(2.606)	(2.285)
se_Poland	-5.237**	-4.440**
	(2.137)	(1.945)
se_Slovakia	-2.800	-5.912**
	(2.324)	(2.573)
se_Slovenia	-0.689	-5.835**
	(2.326)	(2.876)
se_Estonia	-2.344	-3.619*
	(1.861)	(1.888)
o.se_Latvia	-	-
	(omitted)	(omitted)
se_Romania	-4.277**	-2.920*
	(1.986)	(1.671)
Germany	1.026***	1.114***
	(0.091)	(.0731)
Austria	0.619***	0.705***
	(0.063)	(.035)
Belgium	0.628***	0.677***
	(0.066)	(.054)

Table 6: Funnel asymmetry test

	(1) OLS	(2) WLS
Greece	0.144**	0.327***
	(0.067)	(.043)
Spain	0.416***	0.525***
	(0.062)	(.050)
Finland	0.091	0.454***
	(0.088)	(.131)
France	0.706***	0.727***
	(0.060)	(.067)
Ireland	0.209***	0.342***
	(0.072)	(.073)
Italy	0.498***	0.603***
	(0.078)	(.096)
Netherlands	0.506***	0.590***
	(0.077)	(.064)
Portugal	0.302***	0.291***
	(0.058)	(.040)
Denmark	0.209***	0.482***
	(0.072)	(.067)
UK	0.137**	0.344***
	(0.063)	(.068)
Sweden	0.255***	0.535***
	(0.081)	(.152)
Norway	0.223***	0.238***
	(0.065)	(.066)
Czech Republic	0.108	0.285***
	(0.097)	(.084)
Hungary	0.359***	0.323***
	(0.097)	(.065)

Table 6: Funnel asymmetry test

	(1) OLS	(2) WLS
Poland	0.251***	0.209***
	(0.072)	(.052)
Slovakia	0.105	0.223***
	(0.093)	(.083)
Slovenia	0.266***	0.473***
	(0.090)	(.102)
Estonia	0.224***	0.270***
	(0.078)	(.051)
Latvia	0.120	0.111*
	(0.093)	(.058)
Romania	0.062	-0.010
	(0.095)	(.050)
Observations	1,911	1,911
R-squared	0.768	0.747

Note: *, **, and *** stand for significance at the 10%, 5%, and 1% level, respectively. Robust standard errors in parentheses.