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OPTIMUM CURRENCY AREAS: THEORY AND APPLICATIONS

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INTRODUCTION

“...the issue of optimum currency areas, or, more broadly, that of choosing an exchange rate regime, should be regarded as the central intellectual question of international monetary economics”.

Paul Krugman

As it was stated by Bayoumi and Eichengreen¹:

“... the theory of optimum currency areas remains the workhorse for analyses of monetary unification”.

Without doubt, OCA theory developed significantly since then. Nonetheless, words of these scientists are still true. There exists neither a measure which will definitely indicate whether countries should or should not form a monetary union nor even a unique definition for the concept of the Optimum Currency Area. Nonetheless, the interest in this branch of the economy has been continuously increasing, especially since the Eurozone creation. Furthermore, globalization and technological progress is making countries across the globe more and more integrated: bivariate trade, capital flows and migration has

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¹ T. Bayoumi, B. Eichengreen, *Shocking Aspects of Monetary Unification*. Cambridge: NBER, 1992.

increased significantly. This prompted the reevaluation of the importance of the currency's strength. Therefore, a number of regions (African Community, Asian Monetary Union etc.) have started to consider monetary union formation. Most empirical studies indicate that members of almost all of the potential currency unions are not sufficiently synchronized yet in order to fix their exchange rates². Thus, understanding of the economic factors which can increase the synchronization is crucial for the policy makers.

The empirical part of the present study is mainly aimed to test the number of Optimum Currency Area determinants appearing in the literature, namely, bivariate trade, openness, size, asymmetric movement of output, GDP per capita distance, and gravity variables. Given the substantial critique of each of the known methodologies, the paper presents several techniques for analytical work on exchange rate regimes which should complement each other, namely, Bayoumi and Eichengreen's OCA indexes, correlation analysis, and gravity model of trade.

The second goal of the work is to find country pairs which could form a potential optimum currency area. Two out of three methodologies mentioned above are used for this purpose as well. The rest of the paper is organized as follows.

1. THE OCA THEORY

Before any research takes place, it is necessary to present theoretical background and existing literature in the discussed field. In case of the Optimum Currency Area Theory, these two notions are strongly linked to each other. The main objective of this literature review is to figure out the most essential determinants of the OCA.

1.1. Traditional Optimum Currency Area Theory

In the past the notion of the currency area was strongly linked to state borders and such approach was considered as the only correct one. The first who referred to question the idea of "one country, one currency" was Robert Mundell³ in his *A Theory of Optimum Currency Area*. Despite the fact that

² H.K. Chow, K. Yoobai, A Common Currency Peg in East Asia? Perspectives from Western Europe, *Journal of Macroeconomics* 2003, vol 25, pp. 331–350.

³ R.A. Mundell, A Theory of Optimum Currency Areas, *American Economic Review* 1961, vol. 51, pp. 657–665.

some papers about exchange rate regimes existed even earlier⁴, R. Mundell⁵ was the first to use the Optimum Currency Area (OCA) term, and, eventually, was named the father of the idea. From Mundell's definition, the Optimum Currency Area is a region where no fiscal or monetary intervention is needed to bring the economy back to its equilibrium. He tried to find an answer to the question of whether economies should have their own currencies or whether a monetary union would be more beneficial to the regions. This was the main difference to literature developed earlier in so far as previous researchers mostly debated on the exchange rate regimes.

Mundell introduced a simple example of two regions facing exogenous country-specific shocks and illustrated that flexible exchange rate regimes, which allow for different monetary policies in these regions, are effective tools which are used to restore the equilibrium in both of them in such case. However, he noticed that "another adjustment mechanism" should be developed for the same regions provided that they use a single currency. It should be noticed that this theory was developed in the world not only under Bretton Woods system of fixed, explicitly adjusted exchange rates, but also with restricted capital mobility. Consequently, economic shocks were one of the core topics disputed in academic papers.

Mundell believed that a currency area cannot be optimal if high unemployment or inflation is the result of a fixed exchange rate. Because of this, Mundell suggested that labour mobility across the region is one of the most essential factors for currency area to be optimal. He argued that in order to provide external and internal adjustment labour mobility is an effective substitute for a flexible exchange rate. In other words, high labour mobility allows two regions to be economically efficient under the common monetary policy. Thus, it is considered by Mundell that two regions with high labour mobility should have a fixed exchange rate. The second criterion highlighted by Mundell is price and wage flexibility. Mundell believed it will help to allocate financial flows where they are needed most.

Finally, Mundell emphasized that in the absence of the two above-mentioned criteria, two regions should form one currency area if they do not suffer from asymmetric shocks. The explanation lies in the fact that two regions with asymmetric demand shocks experience the inverse problem of unemployment and inflation under both fixed and flexible exchange rates.

⁴ See also: M. Friedman, *The Case for Flexible Exchange Rates*. Chicago: University of Chicago Press, 1953.

⁵ R.A. Mundell, *A Theory...*, *op. cit.*

Mundell also provided several valuable arguments for large currency areas. Firstly, transaction and information costs increase with a number of currencies; therefore:

“...money in its role of medium of exchange is less useful if there are many currencies”⁶.

Secondly, a huge number of small currency areas makes foreign exchange market too thin, which, in turn, allows to speculate on the market and makes it easier to affect the prices on the foreign exchange. Hence, it becomes more difficult to conduct monetary policy.

Another pioneering contributor to the optimum currency area theory was Ronald McKinnon⁷. He has complemented Mundell’s theory with dividing factors, such as capital and labour mobility. The latter was presented in two distinct senses: geographical factor mobility among regions and factor mobility among industries. McKinnon mentioned that in the presence of the second one, there would not be much need for the first factor. However, he agreed with Mundell’s assumption that two regions with high mobility of factors should form a currency union.

McKinnon also mentioned the openness of the economy, defined as a ratio of tradable and non-tradable goods, as a key economic criterion to assess optimality. He argued that it is more beneficial for the country to join a monetary union if the degree of openness is high, since:

“... if we move across the spectrum from closed to open economies flexible exchange rate became both less effective as a control device for external balance and more damaging for internal price level stability”⁸.

The size of the economy also plays an important role in the McKinnon’s theory. He stressed that small economies are more suitable for currency union than large ones.

Peter Kenen⁹ further broadened the theory by putting emphasis on the importance of the diversified economy. His argumentation starts from the belief that: “... perfect labour mobility rarely exists”¹⁰. Thus, a new criterion

⁶ *Ibidem*.

⁷ R.I. McKinnon, *Optimum Currency Areas*. *American Economic Review* 1963, vol. 53, pp. 717–725.

⁸ *Ibidem*.

⁹ P. Kenen, *Theory of Optimum Currency Areas: An Eclectic View*, R. Mundell, A. Swoboda (eds.), Chicago: University of Chicago Press, 1969.

¹⁰ *Ibidem*.

for determination of optimality should be developed. He stated that product diversification may be more valid for this purpose and explained it as follows.

Assume that a country produces only one good which is also its export. Then, if negative demand shock affects the latter, it leads to a fall in export revenue. This, in turn, decreases demand for the domestic currency and causes depreciation. In case of fixed exchange rate regime, adjustment should be achieved by the decrease in price level and wages. As a result, the unemployment rate in the region increases. Thus, such an area cannot be considered an optimum. In addition, a highly diversified economy with highly diversified exports is less likely to suffer from shocks, since the shock in one industry tends to be compensated by the opposite in another. Therefore, a well-diversified economy will rarely experience changes in trade patterns in comparison to single-product one. Kenen mentioned, however, that product differentiation may not help in case of macroeconomic disturbances, since its export sector will be affected as a whole. Additionally, he admitted that diversified economies are likely to have relatively small marginal propensity to import. Furthermore, Kenen highlighted the importance of a similar production structure explaining it by the high probability of the sector-specific shocks symmetrically affecting the mentioned regions.

The author has also introduced the idea of regional fiscal integration as a crucial condition for a monetary union. Kenen argued that fiscal integration can work as an efficient tool to decrease the asymmetry of the shocks. Therefore, fiscally integrated regions are highly suitable for a fixed exchange rate regime or a monetary union.

Three authors mentioned above are usually considered as most crucial and cited. However, there is a number of other researchers who also deserve to be mentioned. The new “generation” of the OCA theory was inspired by the contradictions and lack of practical implementation of the traditional theory. A lot of debates were held on Kenen’s diversification criteria. On the one hand, two single-product economies should keep their exchange rate flexible. On the other, these two economies combined in a monetary union will be more diversified. As a result, they will become more suitable for adoption of the fixed exchange rate.

One can say that McKinnon’s product diversification criterion contradicts Kenen’s openness criteria to some extent. In general, large economies are more likely to be well diversified and more independent in trade. Therefore, their export sector is relatively small and only a small part of the economy is affected by changes in the exchange rates. It can be concluded that, from Kenen’s point of view, such (large) economies are suitable for

a fixed exchange rate. McKinnon, however, argued that it is beneficial for rather small economies. Mundell's point of view does, indeed, contradict itself. He believed that "The Optimum Currency Area is not the world"¹¹. Giercsh¹², however, proved that Mundell's labour mobility means that, in the long run, the optimal currency area is the world.

A number of inconsistencies were found in factor mobility criteria. Corden¹³ does not agree that labour mobility can deal with asymmetric shocks, especially in the long run. In his own words:

"...labor mobility is an inadequate substitute for exchange-rate flexibility, though it certainly reduces the costs, possibly substantially so, of exchange-rate inflexibility, and even yields gains of its own"¹⁴.

At the same time, labour mobility is likely to be lower in small countries, while McKinnon highlighted that large countries are less suitable for pegged exchange rates.

To sum up, seminal literature on the topic states that each group of countries could be at the same time considered feasible and not to form the OCA¹⁵. Tavlas¹⁶ termed this as a 'problem of inconclusiveness'. As a result, a "new wave" of OCA researches started with the aim to deal with existing contradictions and paradoxes.

Corden¹⁷ came up with obvious, to some extent, conclusion that a monetary union eliminates region's direct ability to influence monetary policy and exchange rate's fluctuations. This made him agree with Mundell's argument that price and wage flexibility are the most essential criteria, since they are responsible for the adjustment in absence of monetary policy.

¹¹ R.A. Mundell, *A Theory...*, *op. cit.*

¹² H. Giersch, On the Desirable Degree of Flexibility of Exchange Rates. *Weltwirtschaftliches Archiv* 1973, vol. 109, pp. 191–213

¹³ W. Corden, *The adjustment problem*. L. Krause & W. Salant (Eds). Washington, DC: Brookings, 1973.

¹⁴ *Ibidem*.

¹⁵ P. Krugman, *Lessons of Massachusetts for EMU*, F. Torres, F. Giavazzi (eds.), New York: Cambridge University Press, 1993.

¹⁶ G.S. Tavlas, The New Theory of Optimum Currency Areas. *The World Economy* 1993, vol. 16, pp. 663–685.

¹⁷ W. Corden, *Monetary Integration, Essays in International Finance*, Princeton: Princeton University, 1972.

Besides, Corden¹⁸ considered that countries which want to fix their exchange rate should also have a similar inflation level. In other case, a lot of additional funds would be required for this purpose of the OCA creation. This finding was mentioned by Fleming¹⁹ as well.

In addition, Fleming concluded that the currency peg will be costly in case of different growth rates of productivity. De Grauwe²⁰ initially agreed with this, but changed his mind in later paper. Importance of inflation was also mentioned by Magnifico²¹. He introduced a new economic concept of “national propensity to inflation” (NPI). This variable is a function of inflation-unemployment trade-off in each economy. The author argued that NPI should be similar in both regions. Otherwise, both countries would have to choose the less-advantageous point on their Phillips curves. This concept, however, is rarely mentioned in the OCA literature. Gandolfo²² pointed that similarities in the rates of inflation can be obtained *after* countries will form a monetary union.

Mundell²³ in his second paper on the Optimum Currency Area known as Mundell II or new Mundell, advocated the importance of assets’ differentiation as another adjustment mechanism to be used for international risk sharing. A similar criterion was stressed by Obstfeld and Rogoff²⁴.

Also, early Mundell²⁵, as almost all economists at that time, believed that a flexible exchange rate is a good instrument for stabilizing economy after asymmetric shocks. New

Mundell’s paper, however, was written at the time when the capital mobility was observed. Therefore, he changed his view to considering the exchange rate a source of large asymmetric shocks. In other words, new Mundell’s view proposes that the consequence of monetary union (loss

¹⁸ *Ibidem*.

¹⁹ J.M. Fleming, On exchange rate unification. *The Economic Journal* 1971, vol. 81, no. 323, pp. 467–488.

²⁰ P. De Grauwe, The interaction of monetary policies in a group of European countries, *Journal of International Economics* 1975, vol. 5, no. 3, pp. 207–228.

²¹ G. Magnifico, European Monetary Unification for Balanced Growth: A New Approach, Princeton: Princeton University Press, 1971.

²² G. Gandolfo, *Monetary unions*, P. Newman, M. Milgate, J. Eatwell (eds), London: MacMillan, 1992.

²³ R. Mundell, *Uncommon Arguments for Common Currencies*, H.G. Johnson, A.K. Swoboda (eds.), London: George Allen and Unwin Ltd., 1973.

²⁴ M. Obstfeld, K. Roggoff, *Foundations of International Macroeconomics*, Cambridge: MIT Press 1996.

²⁵ R. Mundell, *Uncommon... , op. cit.*

of exchange rate as an effective adjustment tool) is no more the cost, but rather a benefit to regions, since the probability of asymmetric shocks in the economy is reduced. This Mundell's finding is one of the examples of what will be later named by Frankel and Rose²⁶.

The Endogeneity of the Optimum Currency Area Criteria. This theory implies that regions which form a monetary union without **prior fulfillment of** criteria proposed by the theory can meet them **after** they will peg their currency. In Frankel and Rose's²⁷ words:

“Countries which join EMU, no matter what their motivation may be, may satisfy the OCA properties ex-post even if they do not ex-ante”.

This, however, works in the opposite direction as well. One of the examples for the reverse situation is Krugman's specialization effect, which is going to be discussed later. Vaubel²⁸ stressed that a real exchange rate is one of the most appropriate OCA criteria.

As stated in his paper:

“real exchange rate changes are clearly measurable and automatically give the appropriate weights to the economic forces of which they are the result”.²⁹

Later, Gros and Hobza³⁰ agreed with the statement. Mintz³¹ listed political factors among other conditions for the monetary union. Additionally, Haberler³² emphasized that similar attitude to the policies among regions

²⁶ J. Frankel, A. Rose, A Panel Project on Purchasing Power Parity: Mean Reversion Within and Between Countries, *Journal of International Economics* 1996, vol. 40, pp. 209–224.

²⁷ *Ibidem*.

²⁸ R. Vaubel, Real Exchange Rate Changes in the European Community – The Empirical Evidence and its Implications for European Currency Unification, *Review of World Economics* 1976, vol. 112, no. 3, pp. 429–470.

²⁹ *Ibidem*.

³⁰ D. Gros, A. Hobza, *Exchange Rate Variability as an OCA Criterion: Are the Candidates Ripe for the Euro?*, Brighton: International Center for Economic Growth European Center, 2003.

³¹ N. Mintz, *Monetary union and economic integration*, New York: New York University Press, 1970.

³² G. Haberler, *The international monetary system: Some recent developments and discussions*, G.N. Halm (ed.), Princeton, NJ: Princeton University Press, 1970.

should be a criterion. Tower and Willett³³ noticed that preferences towards growth, inflation, and unemployment should be on the same level to form a flourishing currency area. Furthermore, policy makers should have a noteworthy capacity for trade-off among targets.

The significant part of Tower and Willett's paper was devoted to the factors influencing relative costs and benefits of the OCA. They argued that an individual approach to each country, rather than single criterion for all, will help to assess optimality.

However, the first to introduce the idea of measuring the cost and benefit of the currency area and noticed that each region should estimate cost and benefit from its own perspective was Ishayama³⁴. Moreover, Ishayama highlighted that differences in social preferences may cause "harm" for currency area in the form of different inflation rates and wage increases.

1.2. New theory of optimum currency areas

The fact that optimum currency area theory was not complete, alongside with a number of new macroeconomic developments, gave the birth to "new theory of Optimum Currency Areas"³⁵. One modern OCA researcher, Tavlas³⁶, wrote the following in the first sentence of his paper:

"The theory of optimum currency area is back. Once dismissed as 'something of a dead-end problem'³⁷, and derided it as 'primarily a scholastic discussion which contributes little to practical problems of exchange rate policy and monetary reform'³⁸.

Other authors, Emerson et al.³⁹, mentioned that:

³³ E. Tower, T. Willett, *The Theory of Optimum Currency Areas and Exchange Rate Flexibility. A More General Framework*. Princeton: Princeton University Press, 1976.

³⁴ Y. Ishiyama, The Theory of Optimum Currency Areaspp. A Survey. *IMF Staff Papers* 1975, vol. 22, pp. 344–383.

³⁵ P. De Grauwe, German Monetary Unification. *European Economic Review* 1992, vol. 36, pp. 445–453.

³⁶ G.S. Tavlas, The New Theory..., *op. cit.*, pp. 663–685.

³⁷ H.G. Johnson, The case for flexible exchange rates. *Federal Reserve Bank of St. Louis Review* 1969, vol. 51, no. 6, pp. 12–24.

³⁸ Y. Ishiyama, *The theory...*, *op. cit.*

³⁹ M. Emerson, D. Gros, A. Italianer, G. Pisani-Ferry, H. Reichenbach, *One Market, One Money. An Evaluation of the Potential Benefits and Costs of Forming Economic and Monetary Union*, Oxford–New York: Oxford University Press, 1992.

“...there is still no ready-to-use theory for assessing the costs and benefits of economic and monetary union”.

Furthermore, a slowdown in the optimum currency area research was commonly explained by the lack of real world examples. With the appearance of European Monetary Union, however, more and more researchers became interested in the topic. The “new” Optimum Currency Area theory took into consideration recent (for that time) macroeconomic findings such as expectation formulation, the ineffectiveness of monetary policy, time inconsistency, credibility, the character of shocks, business cycle synchronization, specialization issues etc.⁴⁰. In general, a shift from more economic criteria to more policy-oriented ones has been seen in the OCA theory papers since 1990s. Political reasons have been also mentioned among important issues in the modern optimum currency area theory. Another difference between traditional and new theories is that the new theory focuses more on benefits, while the traditional one mostly highlights costs of a fixed exchange rate regime.

First of all, modern authors in the OCA field argued about the loss of monetary policy as a huge cost for individual country. Unlike Corden⁴¹, Alesina, Barro and Tenreyero⁴², who believed that:

“The costs of giving up monetary independence are lower the higher the association of shocks between the client and the anchor”.

Méltiz⁴³ stressed **that** economies may need a different monetary policy even in case of symmetric shocks if their starting economic positions are different. Calvo and Reinhart⁴⁴ in *Fear of Floating* emphasized that in case of inadequate usage of monetary policy, the cost of monetary independence loss will not be substantial. This founding is known as rules vs. discretion literature. The pioneering literature in rules vs. discretion topic was written

⁴⁰ For more on the subject see: K. Beck, *Akcesja Polski do strefy euro w świetle teorii optymalnych obszarów walutowych – weryfikacja empiryczna*, [w:] S. Lis (red.), „Kontrowersje wokół akcesji Polski do Unii Gospodarczej i Walutowej”, Wydawnictwo Uniwersytetu Ekonomicznego w Krakowie, Kraków 2011, pp. 224–238.

⁴¹ W. Corden, *Monetary Integration*, *op. cit.*, 1972.

⁴² A. Alesina, R. Barro, S. Tenreyero, *Optimal currency areas*, Cambridge: NBER, 2002.

⁴³ J. Méltiz, Brussels on a Single Money, *Open Economies Review* 1991, vol. 2, pp. 323–336.

⁴⁴ G. Calvo, C. Reinhart, Fear of Floating, *The Quarterly Journal of Economics* 2002, vol. 117, no. 2, pp. 379–408.

earlier⁴⁵. The literature pointed to the following idea: Policy makers may offer prospects of low inflation in the next period in order to manipulate private agent's expectations and force them to conduct wage contracts under wrong expectations. This will allow to increase inflation unexpectedly and, therefore, to lower unemployment along a short-run Philips curve. However, this can happen only once, because cheated agents will distrust promises and adjust their expectations. As a result, such an economy will receive higher inflation alongside with the same level of unemployment. In this situation the government will need to find a way of dealing with continuously increasing inflation. Alesina, Barro and Tenreyero⁴⁶ proposed adopting credible currency as a solution.

Already mentioned endogeneity of the optimum currency area criteria, firstly intuitively created by Mundell⁴⁷, was a hot issue for discussion in the new theory. It is commonly said that a currency union eliminates "borders" between participating regions. It means that countries within a monetary union experience a decrease in transaction costs, and, therefore, they are forced to increase trade volumes between each other⁴⁸. Since single currency also leads to the absence of market segmentation and exchange rate volatility, trade between countries increases even further. This allowed De Grauwe and Mongelli⁴⁹ to make a general conclusion that a currency union forces trade in regions to increase significantly. The presence of high trade between countries leads to two possible outcomes: either an increased specialization in the industry with the comparative advantage or rise in business cycle correlation in case of common demand shock's predominance. Frankel and Rose⁵⁰ believed that the second is true. Based on this finding, Frankel and Rose⁵¹ have explicitly introduced the concept of endogeneity of the optimum currency area criteria. This idea contradicts the traditional theory, which states that symmetric shocks are precondition for a currency union. The new

⁴⁵ F. Kydland, E. Prescott, Rules Rather than Discretion: The Inconsistency of Optimal Plans, *Journal of Political Economy* 1977, vol. 85, pp. 473–491.

⁴⁶ A. Alesina, R. Barro, S. Tenreyero, *Optimal currency...*, *op. cit.*

⁴⁷ R.A. Mundell, *A Theory...*, *op. cit.*

⁴⁸ J. McCallum, National borders matter: Canada-US regional trade Patterns, *American Economic Review* 1995, vol. 85, no. 3, pp. 615–623.

⁴⁹ P. De Grauwe, F. Mongelli, *Endogeneities of Optimum Currency Areas*, Frankfurt am Main: European Central Bank, 2004.

⁵⁰ J. Frankel, A. Rose, Is EMU More Justifiable Ex Post Than Ex Ante?, *European Economic Review* 1997, vol. 41, pp. 753–760.

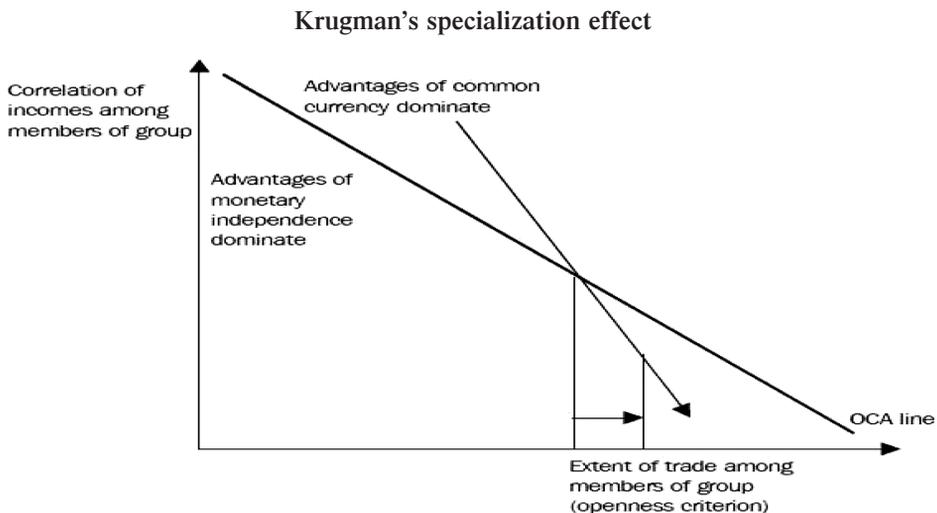
⁵¹ *Ibidem.*

theory emphasizes that the criterion will be fulfilled ex-post. However, the opposite direction of the endogeneity should be considered as well.

The reverse situation, that is one when countries are not fulfilling the OCA after the creation of the monetary union, is clearly illustrated using the OCA line by Broz⁵². Figure 1 illustrates a positive correlation between benefits of monetary union for regions and both correlation of incomes and openness of the economies. Countries for which it is beneficial to form monetary union will be placed above the line on Figure 1. Countries which will found it costly will be placed below it.

The notion shown on the graph is known as Krugman's specialization effect⁵³. He considers that countries experiencing the increase in trade are more likely to specialize in production. Therefore, their income correlation decreases. The final result is shown in the figure: Region will move down and to the right, shifting from the advantageous to the disadvantageous position on the diagram.

Figure 1



Source: T. Broz, *The theory...*, *op. cit.*

One of the leading roles in the modern OCA theory is devoted to business cycles synchronization (BCS) criterion. It is commonly believed that the higher correlation of business cycles, the lower the cost of leaving off the

⁵² T. Broz, *The theory of optimum currency areas: A literature review*, *Privredna Kretanja I Ekonomska Politika*, 2005, vol. 104, pp. 53–78.

⁵³ P. Krugman, *Lessons of...*, *op. cit.*

independent monetary policy. Frankel and Rose⁵⁴ stressed that business cycle correlation is likely to be endogenous. This was also proved empirically. Frankel and Rose⁵⁵ also argued that there is a significant impact of trade on business cycles synchronization. The former, as it was mentioned, is affected by monetary union membership. Additionally, Frankel and Rose⁵⁶ highlighted gravity variables among other determinants of BSC. Imbs⁵⁷ tested the influence of intra-industry trade on BSC and showed the existence of a positive relationship among them.

Frankel⁵⁸ highlighted the importance of dominated trading partners and income convergence between potential currency union members. He emphasized that the correlation of income might cause similarities in production and consumption as well as reduction of the possibility of asymmetric shocks.

De Grauwe⁵⁹ indicated that different labour market institutions may cause difficulties for currency area members. Dellas and Tavlas⁶⁰ pointed out to the importance of countries' real convergence for the OCA theory. They considered two countries at a different level of economic development. The first one is a developed country with a relatively high income, while the second one is a developing country with the low level of income. The authors have predicted possible outcomes for the developing country in case of common monetary policy with the price stability as an objective. These were low interest rate, too optimistic income expectations, "wrong" incentive structure of investment, and excessive domestic demand. As a result:

"...the economy concerned may eventually be faced with the need to undergo a prolonged deflation in order to regain competitiveness"⁶¹.

⁵⁴ J. Frankel, A. Rose, A Panel Project on Purchasing Power Parity: Mean Reversion Within and Between Countries, *Journal of International Economics* 1996, vol. 40, pp. 209–224.

⁵⁵ *Ibidem*.

⁵⁶ *Ibidem*.

⁵⁷ J. Imbs, *Trade, Finance, Specialization and Synchronization*, London: CERP, 2003.

⁵⁸ J. Frankel, *No Single Currency Regime is Right for All Countries or at All Times*, Cambridge: NBER, 1999.

⁵⁹ P. De Grauwe, The euro at stake? The monetary union in an enlarged Europe, *CESifo Economic Studies* 2003, vol. 49, no. 1, pp. 103–121.

⁶⁰ H. Dellas, G.S. Tavlas, An optimum-currency-area odyssey, *Journal of International Money and Finance* 2009, vol. 28, no. 7, pp. 1117–1137.

⁶¹ *Ibidem*.

1.3. How to test the OCA criteria. Evidence from the literature

Indeed, empirical research in the Optimum Currency Area theory is a very complicated issue. There exists no mechanism accounting for all potential cost and benefits. That is why researchers use approaches that analyse the OCA criteria through measurements which are strongly linked to the OCA theory (Exchange Rate, Business Cycles, Economic Shocks etc.).

There are several key methods used in literature for “operationalizing” the OCA theory. The first, developed by Bayoumi and Eichengreen⁶², is responsible for a significant progress in the empirical OCA methodology. This technique tries to relate the variability of exchange rates with the main OCA criteria highlighted in the literature. In more formal way, Bayoumi and Eichengreen propose to construct a so-called OCA index based on the estimation of the following equation:

$$SD(e_{ij}) = \alpha + \beta_1 SD(\Delta y_i + \Delta y_j) + \beta_2 DISSIM_{ij} + \beta_3 TRADE_{ij} + \beta_4 SIZE_{ij} \quad (1)$$

$SD(e_{ij})$ – the standard deviation of the change in the logarithm of the end-year bilateral exchange rate between countries i and j ,

$SD(\Delta y_i + \Delta y_j)$ – the standard deviation of the difference in the logarithm of real output between i and j ,

$DISSIM_{ij}$ – the sum of the absolute differences in the shares of agricultural, mineral, and manufacturing trade in total merchandize trade,

$TRADE_{ij}$ – the mean off the ratio of bilateral exports to domestic GDP for the two countries,

$SIZE_{ij}$ – the mean of the logarithm of the two GDPs measured in U.S. dollars
 α is an intercept term.

On the basis of the result, the dependent variable, which is named Optimum Currency Area index, is estimated for pairs of countries. Low OCA index indicates that countries will find it beneficial to create a monetary union.

The second method, which is sometimes called correlation and cluster analysis, is aimed to find regions with similarities in OCA criteria. The degree of business cycles synchronization has proven to be a useful measure for this purpose. The most common method employs pairwise correlation coefficient of detrended GDP, also known as Business Cycle Synchronization Index (Rose, 1998) as a measure of BSC.

⁶² T. Bayoumi, B. Eichengreen, *Shocking...*, *op. cit.*

$$cor_{ij} = cor(y_i, y_j) = \frac{cov(y_i, y_j)}{\sqrt{var(y_i) \times var(y_j)}} \quad (2)$$

y_i, y_j – cyclical components of real GDPs measured in US \$ for countries i and j respectively

In order to obtain cyclical component of GDP, different filters (Hodrick – Prescott, Baxter – King band – pass etc.) are used⁶³.

Another technique is called Generalized Purchasing Power Parity (G-PPP) theory. The approach was introduced by Enders and Hurn⁶⁴. The general concept is based on the following fact.

It can happen that macroeconomic determinants of real exchange rate for a group of countries are non-stationary. It causes real exchange rate for these economies to be non-stationary as well. However, if the determinants are sufficiently integrated, the real exchange rate will present similar trends. Mundell⁶⁵ argued that such economies (which share common real disturbances) form an optimum currency area.

G-PPP method can be presented in the form of the following regression:

$$r_{12t} = \beta_0 + \beta_{13t} r_{13t} + \beta_{14t} r_{14t} + \dots + \beta_{1mt} r_{1mt} + \varepsilon_t \quad (3)$$

r – the bilateral real exchange rates between country 1 (the base country) and country i in the time period of t . β is an intercept term.

β – the parameters of the co-integrating vector, and

ε – a stationary stochastic disturbance term.

The higher cointegration between real exchange rate, the lower the cost of monetary union's creation for these economies. This method, nonetheless, is the least commonly used among introduced.

Despite the fact that the next approach analyses the OCA criteria indirectly, it is very often met in the related literature. This approach is

⁶³ For details see: K. Beck, *Spectral Analysis and Application of filters in the examination of business cycles*, „Myśl Ekonomiczna i Polityczna”, 3(58), 2017, pp. 40–65 and K. Beck, *Zastosowanie filtrów do analizy cykli koniunkturalnych i synchronizacji cyklu koniunkturalnego Polski z krajami europejskimi*, „Wiadomości Statystyczne”, 10(677), 2017, pp. 5–18.

⁶⁴ W. Enders, S. Hurn, Theory and tests of generalized purchasing-power parity. Common trends and real exchange rates in the Pacific Rim. *Review of International Economics* 1994, vol. 2, pp. 179–190.

⁶⁵ R. Mundell, *A Theory...*, *op. cit.*

based on the classical and developed gravity models of trade. The main idea is to separate trade creation effect of a monetary union from other macroeconomic variables that may have an effect on bilateral trade. This method is mainly used by the supporters of The Endogeneity of the Optimum Currency Area Criteria theory. While analyzing monetary union effect on trade, researchers believe that regions may fulfil OCA criteria ex-post. Rose (2002) was the first who introduced monetary union dummy to the classical gravity model. His regression (below) is one of the possible ways to follow this technique.

$$\begin{aligned} \ln(x_{ijt}) = & \beta_0 + \beta_1 \ln(y_i y_j)_t + \beta_2 \ln\left(\frac{y_i y_j}{Pop_i Pop_j}\right)_t + \beta_3 \ln D_{ij} + \\ & + \beta_4 cont_{ij} + \beta_5 lang_{ij} + \beta_6 FTA_{ij} + \beta_7 ComNat_{ij} + \\ & + \beta_8 ComCol_{ij} + \beta_9 Colony_{ij} + \gamma CU_{ijt} + \delta V(e_{ij})_t + \varepsilon_{ijt} \end{aligned} \quad (4)$$

x_{ij} – value of bilateral trade between i and j ,

$y_i y_j$ – real GDP for county i and j ,

Pop – population for county i and j ,

D_{ij} – the distance between countries,

$cont_{ij}$ – a common border dummy,

$lang_{ij}$ – a common official language dummy,

FTA_{ij} – a dummy variable for shared regional trade agreement,

$ComNat_{ij}$ – a dummy variable for shared nationality,

$ComCol_{ij}$ – a dummy variable for shared colonizer,

$Colony_{ij}$ – a dummy variable for colonial relation,

CU_{ijt} – a dummy for shared currency at time t ,

$V(e_{ij})_t$ – the volatility of the nominal exchange rate in the period before t .

Obviously, a CU dummy, variable of main interest, is expected to have positive sign.

This paper is going to employ all, but G-PPP methodology. The G-PPP technique can be used, however, for further research.

2. DATA AND METHODOLOGY

2.1. Bayoumi and Eichengreen's model

Initially, the data for 173 countries was collected. However, part of these were dropped due to the lack of some bivariate data (trade mainly). Moreover, the model employed is not able to conduct a valid estimation for the countries with exchange rates are already pegged to any other currency (the variation of exchange rate equals to zero), since the exchange rate of this countries is not determined by themselves. Such countries were excluded from the observations as well. Finally, the sample was reduced to 3187 observations. The aim followed during construction of such a sample was to keep the balance between number of variables and a number of observations in order to obtain the highest possible combination of both.

The model constructed to calculate an OCA index is a developed version of Bayoumi and Eichengreen's (1997) equation (see previous chapter). The dependable variable, variation of exchange rate, is measured as a standard deviation of log for the bivariate exchange rate for 21 years analogically to how it is done in the pioneering work.

An asymmetric movement of output is determined as a pair-wise correlation coefficient of detrended GDP.

$$cor_{ij} = cor(y_i, y_j) = \frac{cov(y_i, y_j)}{\sqrt{var(y_i) \times var(y_j)}} \quad (5)$$

y_i, y_j – cyclical components of real GDPs, obtained with Hodrick-Prescott filter ($\lambda = 6.25$), and measured in US \$ for countries i and j respectively. The low value of the coefficient indicates divergent business cycles. The trade relation is measured by the ratio of bilateral trade to real GDP.

$$Trade(i, j) = \frac{X_{ij}}{Y_i} + \frac{M_{ij}}{Y_j} \quad (6)$$

x_{ij} – an average of bilateral export between country i and country j .

M_{ij} – an average of bilateral import between country i and country j .

Y_i – an average of real GDP of country i .

Y_j – an average of real GDP of country j .

The variable which is called **SIZE** in the pioneering regression was calculated by summarizing GDPs of two countries.

The classical regression also includes the variable which measures trade composition (**DISSIM**). Because of the lack of data for major part of the studied sample, it was decided to eliminate this variable from the regression. Otherwise, it would dramatically reduce the number of observations. Additionally, it was decided to include openness, measured as a sum of trade value to GDP ratios, GDP per capita distance, which is the difference between natural logarithms of countries GDPs per capita, as well as gravity variables.

Table 1. presents all variables included in regression as well as their sources and brief explanation.

Table 1

Definitions and sources of data

Abbreviation	Explanation	Source
Cor	Pair-wise correlation coefficient	Penn World Table, version 8.0, July 2013
E	Exchange rate	Euromonitor Passport Database, 2017
Trade	Bivariate trade	IMF from IMF Direction of Trade data set, 2017
SameCountry	Dummy which indicates whether countries were part of one country or a common colonial system	CEPII from CEPII gravity data set, February 2017
Size	Sum of GDPs of two countries	Penn World Table, version 8.0, July 2013
Openness	Openness for trade	Penn World Table, version 8.0, July 2013
ComLang	Dummy for shared language	CEPII GRAVITY data set, February 2017
Borders	Dummy for shared borders	CEPII GRAVITY data set, February 2017
Dist	Physical distance	CEPII GRAVITY data set, February 2017
GDPpercapdist	GDP per capita distance	World Bank from World Bank Development Indicators data set, 2017

Source: own elaborations.

Finally, the estimated equation is as follows:

$$SD(e_{ij}) = \alpha + \beta_1 COR_{ij} + \beta_2 TRADE_{ij} + \beta_3 SIZE_{ij} + \\ + \beta_4 OPENNESS_{ij} + \beta_5 BORDERS_{ij} + \beta_6 SAMECOUNTRY_{ij} + \\ + \beta_7 COMLANG_{ij} + \beta_8 DISTANCE_{ij} + \beta_9 GDPERCAPDIST_{ij} + \varepsilon_{ij}$$

The estimation was performed using the simple OLS method.

2.2. Correlation analysis and trade model

The data for the following models was calculated and collected in the same way as in the previous case.

Additionally, fixed exchange rate, or currency union dummy, was personally constructed based on the data from Euromonitor Database. The sample, however, is somewhat larger in this case, since there is no need to exclude already existing monetary unions. Thus, these regressions were run for 5782 country pairs. The variables used in the model were taken from the past research into the determinants of business cycle synchronization⁶⁶.

The estimated equation for correlation analysis takes the following form.

$$COR_{ij} = \beta_1 + \beta_2 TRADE_{ij} + \beta_3 SIZE_{ij} + \beta_4 OPENNESS_{ij} + \\ + \beta_5 BORDERS_{ij} + \beta_6 SAMECOUNTRY_{ij} + \beta_7 COMLANG_{ij} + \\ + \beta_8 DISTANCE_{ij} + \beta_9 GDPERCAPDIST_{ij} + \varepsilon_{ij}$$

⁶⁶ K. Beck, *Determinants of Business Cycles Synchronization in the European Union and the Euro Area*, "Equilibrium. Quarterly Journal of Economics and Economic Policy", vol. 8, No. 4, 2013, pp. 25–48; K. Beck, *Structural Similarity as a Determinant of Business Cycles Synchronization in the European Union: a Robust Analysis*, "Research in Economics and Business: Central and Eastern Europe", vol. 5, No. 2, 2013, pp. 31–54; K. Beck, *Determinanty synchronizacji cykli koniunkturalnych w krajach Unii Europejskiej w latach 1990–2007*, „Gospodarka w Teorii i Praktyce”, 1(34), 2014, pp. 5–20; K. Beck, M. Grodzicki, *Konwergencja realna i synchronizacja cykli koniunkturalnych w Unii Europejskiej. Wymiar strukturalny*, Wydawnictwo Naukowe SCHOLAR, Warszawa 2014; K. Beck, *Model dwóch gospodarek a wyniki badań nad synchronizacją cykli koniunkturalnych. Weryfikacja teoretyczna i empiryczna*, „Myśl Ekonomiczna i Polityczna”, 3(46), 2014, pp. 17–47; K. Beck, *Determinanty synchronizacji cykli koniunkturalnych: analiza z wykorzystaniem BMA i miar łączności. Część 1, Metodyka badania*,

The trade model employed in the paper is presented below⁶⁷.

$$\begin{aligned} TRADE_{ij} = & \beta_0 + \beta_1 FIXEDEXRATEORCU + \beta_2 COR_{ij} + \beta_3 SIZE_{ij} + \\ & + \beta_4 OPENNESS_{ij} + \beta_5 BORDERS_{ij} + \beta_6 SAMECOUNTRY_{ij} + \\ & + \beta_7 COMLANG_{ij} + \beta_8 DISTANCE_{ij} + \beta_9 GDPERCAPDIST_{ij} + \varepsilon_{ij} \end{aligned}$$

The OLS method was employed for both regressions.

3. RESULTS

This section describes the empirical results that have been obtained using the approaches discussed in the previous section.

3.1. Bayoumi and Eichengreen's model

As it can be seen from the results presented in Table 2, not all of the newly added to the classical regression variables coincide with the theoretical hypothesis. Common language, GDP per capita distance, borders and same country variables came out with expected sign the last two, however, are not significant. The positive sign of openness variable contradicts McKinnon's openness criteria, but to some extent confirms Kenen's diversification hypothesis. Surprisingly, the result indicates the negative relationship between distance and exchange rate deviation. The explanation or proof of such a relation, unsurprisingly, was not found in the literature. At the same time, Bayoumi and Eichengreen's outcome is similar with the one received here. Only size appeared to be insignificant and with different from Bayoumi and Eichengreen's sign. However, the Optimum Currency Area theory admits that both a positive and negative relationship between size and exchange rate variation are possible.

Rather low R^2 indicates low consistency in the predictive power of the model, as pioneering work has reported 51% of explanatory power. This can

„Myśl Ekonomiczna i Polityczna”, 4(59), 2017, pp. 19–46; K. Beck, *Determinanty synchronizacji cykli koniunkturalnych: analiza z wykorzystaniem BMA i miar łączności. Część 1, Wyniki estymacji*, „Myśl Ekonomiczna i Polityczna”, 1(60), 2018, pp. 19–46;

⁶⁷ More on gravity model of trade can be found in: K. Beck, *Bayesian Model Averaging and Jointness Measures: Theoretical Framework and Application to the Gravity Model of Trade*, “Statistics in Transition”, vol. 18, No. 3, 2017, pp. 393–412.

be explained by the highly heterogeneous sample, compared to Bayoumi and Eichengreen's and other similar models

presented in the literature. Another reason can lie in the fact that most of the research in this

area was conducted for Europe, with Bayoumi and Eichengreen's model being no exception. In the used sample, most of the European countries are excluded, since the variation of their exchange rates is equal to zero. Following the results, one can say that the traditional OCA theory is applicable to the lower extent on the different than European sample.

Table 2

Regression results. Bayoumi and Eichengreen's model

Dependent variable	Standard deviation of exchange rate	Consistent with theory
Independent variables:		
Borders dummy	-0.028118 (0.0433831)	+
Log of distance	-0.0592108*** (0.0008967)	-
Openness	0.4833699*** (0.0741683)	+/-
Size	-0.0061971 (0.0049037)	+/-
GDP per capita distance	6.77e-07* (4.39e-07)	+
Common language dummy	-0.059365*** (0.016492)	+
Same country	-0.0121666 (0.0209529)	+
Correlation coefficient	-0.1490031*** (0.0173251)	+
Trade	-3.555345* (2.234632)	+
Adjusted R ²	0.0457	
Number of observations	3187	

Standard errors are given in parentheses.

*** – indicates significance at the 1% level, ** – at the 5% level, * – at the 10%.

Source: own elaborations based on World Bank, n.d.; Penn World Table 8.0, n.d.; IMF, n.d., Euromonitor, n.d., CEPII, n.d.. Performed in Stata/MP.

3.2. The correlation analysis

The result of the correlation analysis was depicted in Table 3. Given relatively high R^2 of the model, one can say that the correlation analysis is more suitable for the countries under inquiry. The fact that this model was regressed for the larger sample due to the shortcomings of the previous model makes such a conclusion even more notional. Nonetheless, significance of variables indicates roughly the same explanatory power of the models.

Table 3

Regression results. Business cycles synchronization

Dependent variable	Pair-wise correlation coefficient of detrended GDP	Consistent with theory
Independent variables:		
Borders dummy	0.0274294 (0.0374294)	+
Log of distance	-0.0131299**	+
Openness	0.4627889*** (0.0512742)	+/-
Size	0.0119655*** (0.0032159)	+/-
GDP per capita distance	1.75e-07*** (3.08e-07)	-
Common language dummy	-0.0563661 (0.0118117)	-
Same country	0.0107888 (0.0136923)	+
Trade	5.270093*** (1.273145)	+
Adjusted R^2	0.0952	
Number of observations	5782	

Standard errors are given in parentheses.

*** – indicates significance at the 1% level, ** – at the 5% level, * – at the 10%.

Source: own elaborations based on World Bank, n.d.; Penn World Table 8.0, n.d.; IMF, n.d., Euromonitor, n.d., CEPII, n.d.. Performed in Stata/MP.

Three out of eight variables appear to be insignificant, namely, the same country, borders and common language dummy. All variables except for the common language were also insignificant in the Bayoumi and Eichengreen's model. Nowadays, it is common to hear that the world has turned out to be smaller and more open due to the continuously increasing integration and globalization. This can be one of the reasons for insignificance of borders dummy. One can say that different trade and economic agreements have made a border effect almost negligible. The low significance of common language dummy can be as well explained by the increasing level of education and globalization. The effect of one country dummy can be offset by the gravity variables included in the model. In addition, manual inspection of the data for the mentioned dummies indicated that these variables rarely take on the value of 1. This can be considered as a statistical reason for such result. The sign of the GDP per capita distance, in fact, defies logic and contradicts the result obtained in the previous model as well. However, the coefficient of the mentioned regressor can be roughly considered a zero. Therefore, one can say that GDP per capita distance has no effect on business cycles synchronization and variation of exchange rates for the analyzed sample.

3.3. Potential OCA of the world

In so far as most of the variable in Bayoumi and Eichengreen's model are significant, it still makes sense to calculate the Optimum Currency Area indexes, even though some variables showed unexpected signs. The indexes were constructed based on all significant variables in the model. Table 4. presents top 5 countries with lowest OCA indexes.

Table 4

Top 5 countries with lowest Optimum Currency Area indices

Country pair	OCA index
Ghana and Pakistan	0,792996666
Ghana and India	0,814221011
Gambia and Kenya	0,850011842
Kenya and Zimbabwe	0,894306889
Sudan and Yemen	0,894335551

Source: based on World Bank, n.d.; Penn World Table 8.0, n.d.; IMF, n.d., CEPII, n.d., Euromonitor, n.d.. Performed in Stata/MP.

One can say that these counties can create a monetary union with minimum loses.

Another way to find the most suitable countries for OCA is to employ Business Cycles Synchronization Index. Table 5. Illustrates top 5 (excluding countries which are already in the MU) of the highest correlation coefficient of GDP.

Table 5

Top 5 countries with highest correlation coefficients

Country pair	Correlation coefficient
Armenia and Lithuania	0,924924944
Honduras and Lithuania	0,914918610
Armenia and Latvia	0,907679563
Canada and Sweden	0,897141486
Cambodia and Nicaragua	0,896540816

Source: based on World Bank, n.d; Penn World Table 8.0, n.d.; IMF, n.d., CEPII, n.d., Euromonitor, n.d.. Performed in Stata/MP.

The historical, political and geographical reasons most probably will overpower pure statistical results in both cases. The most likely integration seems to be between Lithuania, Latvia and Albania. However, since Lithuania and Latvia are newcomers in the Eurozone and their target is to converge with the rest of Europe, this correlation result may be spoiled. As far as Albania is the official candidate for accession to the European Union since 2014, and, perhaps, in the future, it may also join the Eurozone, it can make sense to take obtained results into account for policy making.

According to Spearman rank, correlation coefficient value between OCA and BCS indexes equals -0.19 . Considering low R^2 of both models, the negative correlation is a kind of expected result. Considering this, it was decided to find out county pairs which have appeared in top 10% of both measures, since such a methodology will provide a more accurate result. Outcomes are presented in the table below. The last column of the table roughly indicates the possibility of common currency in the states. The decision was mainly made based on geographical location and historical reasons. In other words, closed location, and/or existing plans for monetary unification alongside with a good historical relation between countries allowed to say that there is high possibility of the OCA in countries.

What is interesting is that one of presented country pairs (Ghana and Guinea) already tried to form currency union together with Mali. The co-called Union of African States was created in 1958, but was disbanded in 1963. The main target of the Union was to form the currency area and develop a common foreign policy.

Some countries are part of the planned African monetary union (Ghana and Guinea, Kenya and Mauritania). Cambodia, Laos and Bangladesh seem to be good candidates for the currency area as well. Indeed, there are some ideas about a so-called Asian Monetary Union and these countries are potential members (Malone, 2002). Another extremely possible trio is

Argentina, Chile and Uruguay. Deeper analysis concerning the mentioned countries and Latin American countries in total, however, indicates that "...union in Latin America should stay as a long-term project" (Hallwood at al. 2004)

Table 6

**Coincidences in top 10% of Optimum Currency Area
and Business Cycles Synchronization indices**

Country pair	OCA index	BCS index
Sudan and Yemen	0,894335551	0,58719406
Bolivia and Honduras	0,90851844	0,584991094
Bangladesh and Cambodia	1,07694961	0,818981436
Bangladesh and Benin	1,163726657	0,573661527
Honduras and Philippines	1,387660586	0,660459135
Malawi and Rwanda	1,449025446	0,658075009
Honduras and Sri Lanka	1,461904537	0,590243703
Mauritania and Pakistan	1,475226421	0,704917782
Cambodia and Laos	1,491314084	0,584994751
Australia and United Kingdom	1,504531703	0,607154522
Bangladesh and Laos	1,547371959	0,619702071
Costa Rica and Grenada	1,898498186	0,608946954
Bangladesh and Madagascar	2,037965871	0,67872679
Malaysia and Russia	2,062759786	0,58335814

Table 6 (cont.)

Country pair	OCA index	BCS index
Cambodia and Madagascar	2,12091212	0,613942533
Myanmar and Yemen	2,131963324	0,701804125
Moldova and Uzbekistan	2,137460896	0,589701908
Kenya and Mauritania	2,139831003	0,624814511
Cambodia and Pakistan	2,161610052	0,695764434
Honduras and Nicaragua	2,304641024	0,731007745
Argentina and Chile	2,323362989	0,590602126
Argentina and Uruguay	2,340555471	0,840756128
Kyrgyzstan and Uzbekistan	2,465480716	0,773480559
Tanzania and Vietnam	2,687301498	0,612775096
Nicaragua and Philippines	2,699375721	0,594857105
Ghana and Guinea	2,751678742	0,646829897
Nicaragua and Sri Lanka	2,79694081	0,680210747
Costa Rica and Panama	2,923853828	0,800812493
Bolivia and Côte d'Ivoire	3,063383423	0,625053019
Iceland and USA	3,228514399	0,62594657
Bangladesh and Cameroon	3,45527242	0,631364941

Source: own elaborations based on World Bank, n.d.; Penn World Table 8.0, n.d.; IMF, n.d., Euromonitor, n.d., CEPII, n.d.. Performed in Stata/MP.

3.4. Gravity model

This section is going to check the effect of monetary union on trade. A huge number of theoretical and empirical studies have shown that trade is one of the main driving forces for countries' economic integration. The previous section also proved these results. Therefore, the positive sign of currency union or fixed exchange rate dummy will indicate that countries can satisfy OCA requirements ex-post.

As it can be observed from Table 7., all significant control variables appeared to be with expected signs. The dummy variable which indicates

whether countries were part of the same country or the colonial system is insignificant. One can say that distance, borders and common language dummy may offset the effect of the mentioned variable. The results confirm the theoretical assumption of the positive effect of the monetary union on trade. This means that the endogeneity of OCA criteria appears to take place in the real life.

Table 7

Regression results. Gravity model of trade

Dependent variable	Trade	Consistent with theory
Independent variables:		
Borders dummy	0.0004996* (0.0002802)	+
Log of distance	-0.0005717*** (000000589)	+
Openness	0.007606*** (0.0004831)	+
Size	0.0001469*** (0.0000315)	+
GDP per capita distance	-1.33e-09 (2.94e-09)	+
Common language dummy	0.0005667*** (0.00001128)	+
Same country	-0.0000494 (0.0001308)	-
Correlation coefficient	0.0004795*** (0.0001245)	+
Fixed exchange rate or currency union dummy	0.0015726*** (0.0002301)	+
Adjusted R ²	0.0904	
Number of observation	5782	

Standard errors are given in parentheses.

*** – indicates significance at the 1% level, ** – at the 5% level, * – at the 10%.

Source: own elaborations based on World Bank, n.d.; Penn World Table 8.0, n.d.; IMF, n.d., Euromonitor, n.d., CEPII, n.d.. Performed in Stata/MP.

CONCLUSION

This study has aimed to test the hypothesis of OCA theory on a quite broad sample of countries, which can roughly be considered as a whole world. Generally, the paper is divided into two parts. Part 1 presents an analysis of existing literature in the field. The OCA literature is commonly divided into two sections. The first one is a traditional OCA theory, which is mainly discussed by Mundell⁶⁸, McKinnon⁶⁹ and Kenen⁷⁰. Despite the fact that these three papers gave birth to a number of paradoxes, one can say that these studies developed the most essential insights that remain as such up until now. The second which is the 'new' OCA theory, was fuelled by the creation of the European Monetary Union and inconsistency in the previous findings. Compared with the earlier literature, the modern one is mostly concentrated on the endogeneity, specialization, and business cycles synchronization issues. Furthermore, new contributions shifted the OCA criteria from purely economic towards more policy oriented one. The complexity and ambiguity of the theory, however, makes it more difficult to apply the criteria developed during more than half of a century in practice. Several tools used for empirical analysis in this branch of economics are also presented in this section. Three of them were used in the second empirical part of the paper.

The obtained results do not always coincide with existing research. It was concluded that Bayoumi and Eichengreen's method is less applicable on the scope of the whole world. The correlation analysis appears to be more suitable, even though the predictable power of the model is still low. Trade, GDP per capita distance, openness, and physical distance have the significant effect on dependent variables in both regressions. However, the signs of the variables are not always in line with theoretical assumptions and previous empirical results. The significance of monetary union dummy in gravity trade model proved the existence of endogeneity of the OCA criteria. The positive sign of the variable is consistent with the theory and previously conducted empirical studies. However, the possible Krugman's specialization effect should be taken into account while considering this result. The most promising country pairs out of those discovered as potential monetary union members are as follows: Sudan and Yemen, Bolivia and Honduras, Uzbekistan

⁶⁸ R.A. Mundell, *A Theory...*, *op. cit.*

⁶⁹ R.I. McKinnon, *Optimum...*, *op. cit.*

⁷⁰ P. Kenen, *Theory of...*, *op. cit.*

and Kyrgyzstan, Argentina and Uruguay, Ghana and Guinea, Bangladesh and Laos, Bangladesh and Cambodia, Cambodia and Laos,

Argentina and Chile as well as Argentina and Uruguay. In addition, it was determined that Albania is ready for monetary integration with Lithuania and Latvia.

To sum up, this research together with other existing works indicate that it is not easy to establish effects of macroeconomic factors on variables which are used to determine exchange rate regimes. Furthermore, the theory itself contains a lot of paradoxes and contradictory hypotheses. For this reason, it can be concluded that the OCA theory is still “a workhorse for analysis”, as more extensive theoretical development as well as further research are required.

REFERENCES

- Alesina A., Barro R., Tenreyero S., *Optimal currency areas*, Cambridge: NBER, 2002.
- Barro R., Gordon D., Rules, Discretion and Reputation in a Model of Monetary Policy, *Journal of Monetary Economics* 1983, vol. 12.
- Bayoumi T., Eichengreen B., *Shocking Aspects of Monetary Unification*. Cambridge: NBER, 1992.
- Bayoumi T., Eichengreen B., Ever Closer to Heaven? An Optimum-Currency-Area Index for European Countries. *European Economic Review* 1998, vol. 41.
- Beck K., *Akcesja Polski do strefy euro w świetle teorii optymalnych obszarów walutowych – weryfikacja empiryczna*, [w:] S. Lis (red.), *Kontrowersje wokół akcesji Polski do Unii Gospodarczej i Walutowej*, Wydawnictwo Uniwersytetu Ekonomicznego w Krakowie, Kraków 2011.
- Beck K., *Determinants of Business Cycles Synchronization in the European Union and the Euro Area*, “Equilibrium. Quarterly Journal of Economics and Economic Policy”, vol. 8, no. 4, 2013.
- Beck K., *Structural Similarity as a Determinant of Business Cycles Synchronization in the European Union: a Robust Analysis*, “Research in Economics and Business: Central and Eastern Europe”, vol. 5, no. 2, 2013.
- Beck K., *Determinanty synchronizacji cykli koniunkturalnych w krajach Unii Europejskiej w latach 1990–2007*, „Gospodarka w Teorii i Praktyce”, 1(34), 2014.

- Beck K., *Model dwóch gospodarek a wyniki badań nad synchronizacją cykli koniunkturalnych. Weryfikacja teoretyczna i empiryczna*, „Myśl Ekonomiczna i Polityczna”, 3(46), 2014.
- Beck K., *Spectral Analysis and Application of filters in the examination of business cycles*, „Myśl Ekonomiczna i Polityczna”, 3(58), 2017.
- Beck K., *Zastosowanie filtrów do analizy cykli koniunkturalnych I synchronizacji cyklu koniunkturalnego Polski z krajami europejskimi*, „Wiadomości Statystyczne”, 10(677), 2017.
- Beck K., *Bayesian Model Averaging and Jointness Measures: Theoretical Framework and Application to the Gravity Model of Trade*, „Statistics in Transition”, vol. 18, no. 3, 2017.
- Beck K., *Determinanty synchronizacji cykli koniunkturalnych: analiza z wykorzystaniem BMA i miar łączności. Część 1, Metodyka badania*, „Myśl Ekonomiczna i Polityczna”, 4(59), 2017.
- Beck K., *Determinanty synchronizacji cykli koniunkturalnych: analiza z wykorzystaniem BMA i miar łączności. Część 1, Wyniki estymacji*, „Myśl Ekonomiczna i Polityczna”, 1(60), 2018.
- Beck K., Grodzicki M., *Konwergencja realna i synchronizacja cykli koniunkturalnych w Unii Europejskiej. Wymiar strukturalny*, Wydawnictwo Naukowe SCHOLAR, Warszawa 2014.
- Berger H., Jensen H., Schjelderup G., To peg or not to peg? A simple model of exchange rate choice in small economies, *Economic Letters* 2001, vol. 73.
- Broz T., The theory of optimum currency areas: A literature review. *Privredna Kretanja i Ekonomska Politika* 2005, vol. 104, pp. 53–78.
- Buiter W.H., Optimal currency areas: why does the exchange rate regime matter? With an application to UK membership in EMU. *Scottish Journal of Political Economy* 2000, vol. 47, no. 3.
- Calvo G., Reinhart, C., Fear of Floating. *The Quarterly Journal of Economics* 2002, vol. 117, no. 2.
- CEPII, n.d. Gravity. CEPII, viewed 29 March 2018, <http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=8>.
- Chow H.K., Yoobai K., A Common Currency Peg in East Asia? Perspectives from Western Europe, *Journal of Macroeconomics* 2003, vol. 25.
- Corden W., *Monetary Integration, Essays in International Finance*, Princeton: Princeton University, 1972.
- Corden W., *The adjustment problem*. L. Krause, W. Salant (Eds). Washington, DC: Brookings, 1973.

- Corsetti G., Pesenti P., *Self-Validating Optimum Currency Areas*, New York: Federal Reserve Bank of New York 2002.
- De Grauwe P., The interaction of monetary policies in a group of European countries. *Journal of International Economics* 1975, vol. 5, no. 3.
- De Grauwe P., German Monetary Unification, *European Economic Review* 1992, vol. 36.
- De Grauwe P., The euro at stake? The monetary union in an enlarged Europe, *CESifo Economic Studies* 2003, vol. 49, no. 1.
- De Grauwe P., Mongelli, F., *Endogeneities of Optimum Currency Areas*, Frankfurt am Main: European Central Bank, 2004.
- Dellas H., Tavlas G.S., An optimum-currency-area odyssey, *Journal of International Money and Finance* 2009, vol. 28, no. 7.
- Emerson M., Gros D., Italianer A., Pisani-Ferry G., Reichenbach H., *One Market, One Money. An Evaluation of the Potential Bene-fits and Costs of Forming Economic and Monetary Union*, Oxford–New York: Oxford University Press, 1992.
- Enders W., Hurn S., Theory and tests of generalized purchasing-power parity. Common trends and real exchange rates in the Pacific Rim, *Review of International Economics* 1994, vol. 2.
- Euromonitor International, n. d. *Passport database*. Euromonitor International, viewed 18 March 2018 , < <http://go.euromonitor.com/passport.html>>.
- Feenstra R.C., Inklaar R., Timmer M.P., The Next Generation of the Penn World Table, *American Economic Review* 2015, vol. 105, no. 10, viewed 8 February 2018, <www.ggdc.net/pwt – <http://www.rug.nl/ggdc/productivity/pwt/>>.
- Fleming J.M., On exchange rate unification, *The Economic Journal* 1971, vol. 81, no. 323.
- Frankel J., *No Single Currency Regime is Right for All Countries or at All Times*, Cambridge: NBER, 1999.
- Frankel J., Rose A., A Panel Project on Purchasing Power Parity: Mean Reversion Within and Between Countries, *Journal of International Economics* 1996, vol. 40.
- Frankel J., Rose A., Is EMU More Justifiable Ex Post Than Ex Ante?, *European Economic Review* 1997, vol. 41.
- Frankel J., Rose A., Endogeneity of the Optimum Currency Criteria. *Economic Journal* 1998., vol. 108.
- Friedman M., *The Case for Flexible Exchange Rates*, Chicago: University of Chicago Press, 1953.

- Gandolfo G., *Monetary unions*, Newman P., Milgate M., Eatwell J. (eds), London: MacMillan, 1992.
- Giersch H., On the Desirable Degree of Flexibility of Exchange Rates, *Weltwirtschaftliches Archiv* 1973, vol. 109.
- Gros D., Hobza A., *Exchange Rate Variability as an OCA Criterion: Are the Candidates Ripe for the Euro?*, Brighton: International Center for Economic Growth European Center 2003.
- Haberler G., *The international monetary system: Some recent developments and discussions*, Halm G.N. (ed.), Princeton, NJ: Princeton University Press, 1970.
- Imbs J., *Trade, Finance, Specialization and Synchronization*, London: CERP 2003.
- International Monetary Fund, n.d. *Direction of Trade Statistics*. International Monetary Fund, viewed 21 March 2018, <<http://data.imf.org/?sk=9D6028D4-F14A-464C-A2F2-59B2CD424B85>>
- Ishiyama Y., The Theory of Optimum Currency Areas. A Survey, *IMF Staff Papers* 1975, vol. 22.
- Johnson H.G., The case for flexible exchange rates, *Federal Reserve Bank of St. Louis Review* 1969, vol. 51, no. 6.
- Kenen P., *Theory of Optimum Currency Areas: An Eclectic View*, Mundell R., Swoboda A. (eds.), Chicago: University of Chicago Press, 1969.
- Kiyotaka S., Zhaoyong Z., McAleer M., *Shocking Aspects of East Asian Monetary Integration: An Optimum Currency Area Approach*, Yokohama: Central for International Trade Studies, Faculty of Economics, Yokohama National University, 2003.
- Krugman P., *Lessons of Massachusetts for EMU*. Torres F., Giavazzi F. (eds.), New York: Cambridge University Press, 1993.
- Kydland F., Prescott E., Rules Rather than Discretion: The Inconsistency of Optimal Plans, *Journal of Political Economy* 1977, vol. 85.
- McCallum J., National borders matter: Canada-US regional trade Patterns, *American Economic Review* 1995, vol. 85, no. 3.
- Magnifico G., *European Monetary Unification for Balanced Growth: A New Approach*, Princeton: Princeton University Press, 1971.
- McKinnon R.I., Optimum Currency Areas, *American Economic Review* 1963, vol. 53.
- Meade J., The Balance of Payments Problems of a European Free Trade Area, *The Economic Journal* 1957, vol. 67.
- Méltiz J., Brussels on a Single Money, *Open Economies Review* 1991, vol. 2.

- Mintz N., *Monetary union and economic integration*, New York: New York University Press, 1970.
- Mongelli F., *New Views on the Optimum Currency Area Theory: What is EMU Telling Us*, Frankfurt am Main: European Central Bank, 2002.
- Mundell R.A., A Theory of Optimum Currency Areas, *American Economic Review* 1961, vol. 51.
- Mundell R., *Uncommon Arguments for Common Currencie*, H.G. Johnson and A.K. Swoboda (eds.), London: George Allen and Unwin Ltd. 1973.
- Obstfeld M., Roggoff K., *Foundations of International Macroeconomics*, Cambridge: MIT Press, 1996.
- Scitovsky T., *Economic theory and western European integration*, London: Allen and Unwin, 1958.
- Tavlas G.S., The New Theory of Optimum Currency Areas, *The World Economy*, vol. 16, 1993.
- Tower E., Willett T., *The Theory of Optimum Currency Areas and Exchange Rate Flexibility. A More General Framework*, Princeton: Princeton University Press, 1976.
- Vaubel R., Real Exchange Rate Changes in the European Community – The Empirical Evidence and its Implications for European Currency Unification. *Review of World Economics*, 1976, vol. 112, no. 3.
- World Bank, n.d. *World Development Indicators*, viewed 15th March 2018, <<http://data.worldbank.org/data-catalog/world-development-indicators>>.

OPTIMUM CURRENCY AREAS: THEORY AND APPLICATION

Summary

The paper is aimed at providing an extensive analysis of the theory of an optimum currency area (OCA), one of the most controversial and incomplete topics in economics. Nonetheless, high possibility of practical implementation alongside with real world examples made it a popular topic for discussions among researchers and policy makers. Although early literature in the field was written in the 1950s, Robert Mundell was the first to use the term of an optimum currency area. Other pioneering authors who are considered to be founders of the theory are Peter Kenen and Robert McKinnon. Their works, however, have also established a number of paradoxes. This, in turn, gave birth to the “new OCA generation”. The main contributions to the

OCA theory at this stage were made by Giercsh, Corden, Magnifico. The previously mentioned authors belong to the traditional OCA researchers. The modern theory, which emerged after the eurozone creation, broadened classical literature by considering the recent macroeconomic developments of the times. The literature, which is discussed in the first chapter of the paper, highlights the following key determinants of the OCA: similarities in shocks, inflation, business cycles, attitudes to policy, high factors' mobility, trade integration, price and wage flexibility, openness, and political and historical reasons. Due to limited data availability, the empirical part of this paper tests only a portion of these factors. It is performed with the use of econometric techniques and in accordance with the methodology discussed in Chapters 2 and 3, respectively. Generally, the findings indicate that, although theoretical hypothesis and methodologies are true and applicable to European countries, to some extent unexpectedly, the results are obtained in a broader scope. This finding confirms the assumption of Tower and Willett, and Ishayama, who stressed that the OCA criteria are individual for each region. The empirical part also presents potential currency areas, which were determined with the use of OCA and BCS indexes. Although some of the currency areas seem to be achievable, low predictable power of the models should be taken into account while considering the findings.

Key words: optimum currency area, business cycles synchronization, bilateral trade, exchange rate volatility, Krugman specialization effect, optimum currency area index, correlation analysis, asymmetric shock, monetary union, exchange rate regime

OPTYMALNY OBSZAR WALUTOWY. TEORIA I ZASTOSOWANIE

Streszczenie

Celem niniejszej pracy jest przedstawienie obszernej analizy teorii optymalnego obszaru walutowego (OOW), jednego z najbardziej kontrowersyjnego i niekompletnego tematu w ekonomii. Niemniej jednak, duża możliwość praktycznej implementacji wraz z przykładami z rzeczywistości sprawiła, że był to popularny temat dyskusji wśród badaczy i decydentów. Pierwsza literatura w tej dziedzinie została napisana w latach 50. XX w., ale Robert Mundell był pierwszym, który użył terminu Optymalny Obszar Walutowy. Inni pionierscy autorzy, którzy są uważani za założycieli tej teorii to Peter

Kenen i Robert McKinnon. Prace wcześniej wspomnianych autorów ustaliły jednak dużo paradoksów. To z kolei dało początek „nowej generacji OCA”. Główny wkład w teorię Optymalnego Obszaru Walutowego na tym etapie złożyli: Giercsch, Corden, Magnifico, De Grauwe. Wszyscy wcześniej wspomniani autorzy należą do tradycyjnych badaczy Optimum Currency Area. Nowoczesna teoria, która powstała po stworzeniu strefy euro, poszerzyła literaturę klasyczną, biorąc pod uwagę ostatnie wydarzenia makroekonomiczne tych czasów. Literatura, która jest omówiona w pierwszym rozdziale pracy, podkreśla następujące kluczowe determinanty OOW: podobieństwa w szokach, inflacji, instytucjach rynku pracy, cyklach koniunkturalnych; wysoka mobilność czynników, integracja handlu, elastyczność cen i płac; polityczne i historyczne powody. Biorąc pod uwagę ograniczoną dostępność danych, część empiryczna tego artykułu testuje tylko część tych czynników. Odbывается to za pomocą technik ekonometrycznych i zgodnie z metodologią omówioną w rozdziałach 2 i 3. Wyniki pracy wskazują, że chociaż teoria i metodologia są prawdziwe i mają zastosowanie do krajów europejskich, nieoczekiwane do pewnego stopnia wyniki uzyskane są w szerszym zakresie. To odkrycie potwierdza założenie Tower and Willett i Ishayama, którzy podkreślili, że kryteria OCA są indywidualne dla różnych regionów. Część empiryczna przedstawia również potencjalne obszary walutowe, które zostały określone za pomocą teorii OOW i indeksów BCS. Chociaż niektóre obszary walutowe wydają się osiągalne, niska przewidywana moc modeli ekonometrycznej powinna być brana pod uwagę przy rozważaniu wyników.

Słowa kluczowe: optymalny obszar walutowy, synchronizacja cykli koniunkturalnych, handel dwustronny, zmienność kursu walutowego, efekt specjalizacji Krugmana, indeks optymalnych obszarów walutowych, analiza korelacji, szok asymetryczny, unia walutowa, reżim kursu walutowego

ОПТИМАЛЬНЫЕ ВАЛЮТНЫЕ ЗОНЫ: ТЕОРИЯ И ЭМПИРИКА

Резюме

Целью настоящей статьи является обширный анализ *Теории Оптимальных Валютных Зон (ОВЗ)*, одной из самых противоречивых и недостаточно исследованных в экономике. Тем не менее, большие возможности практического использования, эмпирически подкрепленные рядом фактов, имеющих место в действительности, стали причиной того, что *Теория Оптимальных*

Валютных Зон стала объектом пристального внимания со стороны специалистов и предметом многочисленных исследований и дискуссий. Несмотря на то, что данная проблематика освещалась в предметной литературе еще в 1950-х годах, Роберт Манделл первым использовал термин *Оптимальная Валютная Зона*. К другим авторам данной теории, которые считаются ее основоположниками, можно отнести Питера Кенена и Роберта Маккиннона. Работы вышеупомянутых авторов вызвали многочисленные споры в предметной литературе, что в свою очередь, стало причиной появления «нового поколения ОВЗ». Значительная роль в развитии *Теории Оптимальных Валютных Зон* на данном этапе принадлежит Гиршу, Кордену, Магнифико, Де Грауву. Упомянутые авторы относятся к числу традиционных исследователей *Теории Оптимальных Валютных Зон*. Современная теория, формирование которой происходило после образования Еврозоны, обогатила и углубила классические исследования в данной области, с учетом последних событий макроэкономических событий указанного периода. В предметной литературе, рассмотренной в первой главе настоящего исследования, освещены следующие ключевые детерминанты *Теории Оптимальных Валютных Зон*: сходства в сфере макроэкономических шоков, инфляции, институтов рынка занятости, бизнес-циклов, отношения к политике; высокая мобильность факторов, интеграция торговли, гибкость цен и заработной платы, открытость к торговле; обусловленности политического и исторического характера. В связи с отсутствием достаточного количества данных, эмпирический раздел настоящего исследования содержит попытку верификации только части вышеупомянутых факторов, что было достигнуто благодаря использованию эконометрических методов, описанных в главах 2 и 3. В целом, результаты статьи позволяют сформулировать вывод о том, что, хотя теоретические гипотезы и методологии достоверны и могут быть применимы в отношении европейских государств, неожиданные результаты, полученные уже на первом этапе, достигают более широкого диапазона значимости. Данный вывод подтверждает предположения Таувера и Уиллетта и Ишаямы, которые подчеркивали, что критерии ОСА являются индивидуальными для каждого отдельного региона. В эмпирической части исследования также представлены потенциальные валютные зоны, которые были определены благодаря использованию теории ОВЗ и индексов синхронизации бизнес-циклов. Следует, однако, учитывать низкую прогнозируемую мощность эконометрических моделей при использовании результатов работы.

Ключевые слова: оптимальная валютная зона, синхронизация бизнес-циклов, двусторонняя торговля, волатильность обменного курса, эффект специализации Кругмана, индекс оптимальных валютных зон, анализ корреляции, асимметричный шок, монетарный союз, режим обменного курса.

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