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THE "IMPOSSIBLE TRILEMMA" AND THE ANALYSIS OF ITS VALIDITY BY VISUALIZATION THROUGH THE USE OF ARTIFICIAL INTELLIGENCE SOFTWARE

This research aims to visualize the "impossible trilemma", i.e. the impossibility of simultaneously having a fixed exchange rate, free movement of capital and an independent monetary policy, for every economy through the application of artificial intelligence software. The advantages of visualization techniques are revealed. The explored countries are divided into the following panels: the Eurozone countries, the developed European countries (DEC), the developed non-European countries (DNEC), the BRICS countries (Brazil, Russia, India, China and South Africa), the developing European countries and the Organization of the Petroleum Exporting Countries (OPEC). The results of the research show a great level of confirmation of the trilemma for the developing economies and the developed non-European countries. This implies that there is a compromise between exchange rate stability, monetary independence, and free capital mobility.

JEL: F15; F31; F41; E42

Keywords: trilemma; Mundell-Fleming; visualization; artificial intelligence

After the global financial crisis of 2008-2009, many economists and politicians engaged in an in-depth study of the current macroeconomic policies, in an attempt to reduce fluctuations in the business cycle and to evaluate the applied measures in order to stabilize the national economies. The international monetary and financial system is characterised by managed floating exchange rates and a national choice of exchange rate regime, which in turn helps to increase fluctuations in international capital flows. Exchange rate fluctuations affect the dynamics of foreign trade, capital movements, and macroeconomic policies. On the other hand, the stability of the exchange rate imposes serious constraints on the effectiveness of the monetary policy.

The purpose of the present research is to *investigate and explore the validity of the trilemma (the theoretical impossibility of the simultaneous application of a fixed exchange rate, free movement of capital and an autonomous monetary policy) by applying artificial intelligence to the research of a large-scale database.* In order to

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assess the degree of dependency between the individual elements of the trilemma, both within the panel of countries and between the individual countries, different visualization techniques with elements of artificial intelligence were brought into play.

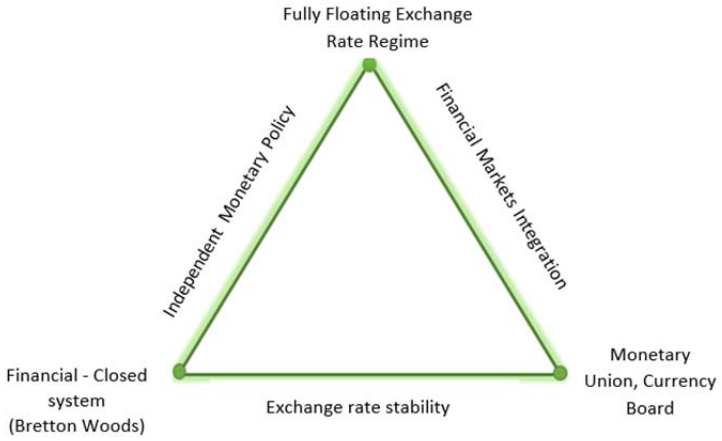
Theoretical and literature review

The idea that fixed exchange rate regimes, free movement of capital and an autonomous monetary policy cannot coexist is originally linked to the classical works of Robert Mundell (1960) and Marcus Fleming (1961). The trilemma is a consequence of the Mundell-Fleming model, which is an extension ofthe classic neo-Keynesian IS-LM model. The trilemma is important for the functioning of national economies not only in the era of floating exchange rates but also during the period of the gold standard (Obstfeld, Shambaugh and Taylor, 2003). Failure to take into account the constraints imposed by the trilemma leads to the formation of pro-cyclicality in the economic policy (Patnaik and Shah, 2010).

The so-called suggests that only two of the above three goals can be achieved simultaneously (Fleming, 1962; Mundell, 1963). The trilemma is illustrated in Figure 1.

Figure 1

Visualization of the “impossible trilemma”



Each of the three sides of the triangle – monetary independence, exchange rate stability and financial integration (the free movement of capital) – depicts a potentially desired aim. The impossibility of the respective economy to be located on all three sides of the triangle is visualized in Figure 1. For example, the peak designated as a “floating exchange rate” is associated with a full degree of monetary policy autonomy and financial liberalization, but not with the stability of the exchange rate.

Aizemman (2010) also proceeds from the thesis that the trilemma is an extension of the neo-Keynesian IS-LM model. One of the basic rules of monetary

policy in small countries with open economies is the so-called Mundell-Fleming theorem. According to it, three possible combinations of economic policies are applicable: the first is a combination of free movement of capital and a fixed exchange rate, but without an independent monetary policy; the second is a combination of free movement of capital and an independent monetary policy, but in a floating exchange rate regime; the third is a combination of a fixed exchange rate and an independent monetary policy, but without the free movement of capital.

Ganchev (2010) specifies that, according to the Mundell-Fleming theorem, it is not possible to pursue an autonomous monetary policy under a fixed exchange rate and a free movement of capital, under the conditions of a currency board. With the abolition of the free movement of capital, the rule which states that it is impossible to pursue an autonomous monetary policy in the presence of a fixed exchange rate and free movement of capital is no longer in force. According to Ganchev, the attempt to slow down credit growth through the use of the obligatory minimum reserve mechanism is an attempt to introduce elements of autonomous monetary policy. He argues that, despite the fact that the credit is increasing slower after the implementation of the restrictions, the realisation of the objective of the policy (external equilibrium), is impossible with the tool used (required reserves). More specifically, he concludes that both the monetary and the fiscal restrictions hinder the implementation of the Maastricht requirements, which, in their entirety, are an attempt at a compromise in relation to the trilemma, i.e. a combination of requirements that imply the conduct of monetary policy, the free movement of capital and the limiting of exchange rate fluctuations.

A number of studies exist, which prove the trilemma hypothesis: Shambaugh (2004), Obstfeld et al (2005), Miniane and Rogers (2007), Hsing (2012a, b), and Capraru and Ihnatov (2012).

Nenovski (1993) examines the macro equilibrium in an open economy. The properties of the Mundell-Fleming model allow him to compare the effectiveness of the fiscal and the monetary policy in an economy with a fixed exchange rate. He concludes that under a than the monetary policy. According to him, the difficulty of the implementation of the monetary policy is due to its opposing effect on income and reserves. According to him, by applying a new qualification of government economic policy (financial and price control), Mundell and Fleming are searching for new options for affecting internal and external imbalances.

Spasova (2016) scrutinises the role of exchange rate regimes in achieving sustainable growth in Central and Eastern Europe over the period 2002-2014. In her research, she applies a descriptive analysis of the macroeconomic status of 14 economies: Albania, Bulgaria, Estonia, Latvia, Lithuania, Macedonia, Poland, Romania, Slovenia, Slovakia, Croatia, Serbia, Hungary, and the Czech Republic, through the prism of the Mundell-Fleming model. The volatility and instability of the economic growth under fixed exchange rate regimes are verified.

Zlatinov (2018) assesses the validity of the Mundell-Fleming model via studying the mechanisms of transmission and the effectiveness of fiscal and monetary policy

under different exchange rate regimes. He concludes that the Mundel-Fleming model is suitable for analyzing the transmission mechanisms of macroeconomic policies. He argues that in the case of a fixed exchange rate and imperfect capital mobility, the fiscal stimulus should be paired with monetary expansion.

Simeonov (2018) believes that the “impossible trilemma” is similar to the concept of optimal currency zones and the theory of exchange rate regime polarization. According to the theory of optimal currency areas and the “impossible trilemma,” it is feasible and optimal to apply monetary union in the presence of capital mobility. According to the theory of exchange rate polarization, in the presence of capital mobility on the world markets, it is less effective for countries to apply intermediate exchange rate regimes (which are related to neither the fixed nor the free-floating exchange rate).

Hsing (2012a) conducts an empirical analysis based on multiple regressions which confirms that the trilemma is valid in the particular case of Bulgaria. The author demonstrates that the real policy objectives in Bulgaria are a combination of exchange rate stability and monetary independence. In particular, the results prove that an increase in exchange rate stability increases the real GDP growth rate, while greater monetary policy autonomy combined with free capital mobility slows down economic growth under the constraints of the currency board. The level of inflation, the volatility of price level dynamics and the volatility of production, are not affected by any of the three basic elements of the trilemma. Based on these findings, the study recommends that restrictions be placed on the monetary policy, because greater monetary autonomy corresponds to a reduction in growth. It should be noted, however, that in the case of Bulgaria, Hsing measures monetary policy autonomy by the deviations of the basic interest rate in BGN from the US interest rate. Therefore, he takes into account the autonomy of the European Central Bank’s policy and not that of the BNB. This calls into question some of his conclusions.

Hsing (2012b) confirms the trilemma in the case of the Czech Republic. The results show that a stable exchange rate increases GDP growth and that greater monetary independence increases inflation, which is also fueled by the increased international financial integration.

Ihnatov and Căpraru (2014) investigate the effects of the trilemma hypothesis on the instability of the macroeconomic variables in selected countries of Central and Eastern Europe (CEE) which are EU Member States. The indicators used by the authors to study the trilemma are those constructed by Aizenman, Chinn and Ito (2011). The approach is applied in the context of multiple regressions aiming to test the effects of capital mobility, monetary policy and exchange rate regimes on inflation and production volatility. Capital mobility is proven to have a positive impact on reducing macroeconomic instability in Central and Eastern Europe. The study reveals also that the trilemma improves the opportunities for stable production growth.

Davis (2015) describes the trilemma of international finance as the most important concept in international financial theory, which remains a constraint on monetary policymaking in an open economic environment. He also reveals that,

according to the trilemma, if a central bank allows the exchange rate to “float”, it must have full monetary autonomy.

Asogwa et al. (2016) examine whether the trilemma hypothesis is valid and applicable to the Nigerian economy in the period 1970-2012 by applying the Vector Autoregressive (VAR) model and the Granger Causality test. The results of the applied econometric methodology prove that there is a Granger Causality test relationship between the net exports and the foreign direct investments. The research reveals evidence of the validity of the Mundel-Fleming theorem in the case of the Nigerian economy.

Methodology

The research aims to reveal dependencies that support the basic trilemma hypothesis through the application of visualization techniques. It covers the period 1960-2017 with an annual frequency of the used data. The examined countries are divided into the following groups:

Table 1

Grouping of the explored countries

Eurozone	BRICS	Developed European countries	Developed non-European countries	Developing European countries	OPEC
Austria	Brazil	Denmark	Canada	Albania	Algeria
Belgium	Russia	Norway	Japan	Georgia	Angola
France	China	Sweden	New Zealand	Bulgaria	Venezuela
Germany	India	Switzerland	Australia	Turkey	Ecuador
Italy	South Africa	Iceland		Moldova	Iraq
Luxembourg		Czech Republic		Ukraine	Iran
Netherlands				Serbia	Qatar
Finland				Hungary	Kuwait
Greece				Croatia	Libya
Ireland				Macedonia	Nigeria
Malta				Bosnia and Herzegovina	Saudi Arabia
Portugal				Poland	United Arab Emirates
Spain				Belarus	
Cyprus				Montenegro	
Slovakia				Romania	
Estonia					
Latvia					
Lithuania					
Slovenia					

In order to visualize the trilemma, indexes that quantify the degree of attainment across the three dimensions of the trilemma hypothesis are used, namely: monetary independence, exchange rate stability and financial liberalization. These indices are introduced for the first time by Aizenman, Chinn & Ito (2008). The data on them are

periodically updated and can be found at http://web.pdx.edu/~ito/trilemma_indexes.htm. The Monetary Independence Index (MI) is measured as the reciprocal of the annual correlation between the monthly interest rates of the home country and the benchmark country.

(1) $MI = 1 - \frac{corr(i_i, i_j) - (-1)}{1 - (-1)}$, where:

i_i- the interest rate of the home country;
i_j- the interest rate of the benchmark country.

The minimum value of the Monetary Independence Index is 0 and the maximum value is equivalent to 1. Higher values of the index correspond to a more independent monetary policy.

The Exchange Rate Stability Index (ERS) is calculated as the annual standard deviations of the monthly exchange rate between the home country and the benchmark country. If the rate of the monthly change in the exchange rate remains within +/-0.33 percent bands, the exchange rate is considered as “fixed”. Higher index values indicate a more stable exchange rate movement against the currency of the benchmark country.

(2) $ERS = \frac{0.01}{0.01 + stdev(\Delta \log(exch\_rate))}$

Higher exchange rate stability reduces uncertainty and can stimulate capital inflows, investment, and economic growth. At the same time, the emergence of external shocks can reverse capital flows and affect economic growth significantly, as was the case with the Baltic countries during the financial crisis. In this way, the stability of the exchange rate can cause higher volatility of economic growth.

The KAOPEN Index, which was introduced by Chinn & Ito (2006, 2008), is used to meaure financial openness (integration). It represents the capital account openness. The Chinn-Ito Index is normalized between zero and one, where higher values of this index indicate that one country is more open to cross-border capital transactions. It is based on information reflecting the restrictions in the International Monetary Fund’s Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).

IBM® Watson ™ Studio was used to construct the visualizations[1] between the abovementioned indices in the panels of the explored economies, as well as all the necessary tasks of the present research. The IBM® Watson ™ Studio guidelines

[1] Visualization is a technique of creating images, charts, or animations to convey a message. It has been an effective way of communicating through abstract and concrete ideas since the ancient history of humanity. Examples include cave paintings, Egyptian hieroglyphics and Greek geometry. The application of visualization today has expanded to science, education, engineering (e.g. product visualization), interactive multimedia, medicine and more. The area of Computer Figureics is a form of representative visualization application. The invention of Computer Figureics may be the most important development in visualization after the discovery of central perspective during the Renaissance. The development of animation also helps for better visualization.

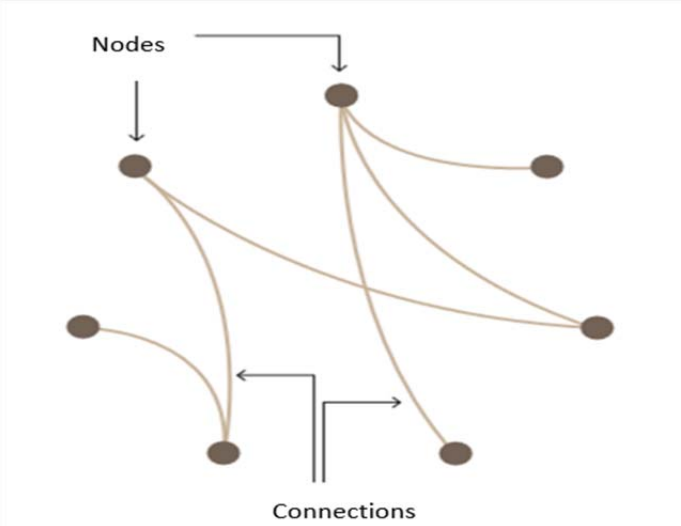
explain the different ways in which the software can be used for prediction and analysis[2]. IBM® Watson ™ Studio provides an environment and tools for problem-solving through data collaboration. The software makes it possible to select the tools needed to analyze and visualize data; to clear and shape data; to absorb streaming data, or to create, train and implement machine-learning models.

Chord Diagram

A Chord Diagram is a Figureical method for displaying data relationships in a matrix. Chord charting is a relatively new form of information visualization. This is a type of diagram that visualizes the relationships between objects. Object links are used to show that they share something in common. This makes Chord Diagrams ideal for comparing similarities in a dataset or between different data sets (Figure 2).

Figure 2

Structure of Chord Diagrams



Source. Authors' interpretation.

The Chord Diagram is made up of nodes and links. The nodes are arranged in a circle and the connections between the points are connected using arcs or curves. Values are assigned to each connection, which is represented in proportion to the size of each arc. Color can be used to group data into different categories, which helps to compare and differentiate groups. The Non-Ribbon Chord Diagram derives its name from the terminology in geometry. A circle chord is a segment of a geometric line

[2] They range from a semi-automated approach, using the AutoAI Experiment tool via a schematic approach based on SPSS Modeler Flows, to a fully programmed style applying Jupyter notebooks for Python.

whose endpoints lie on the circle. Non-Ribbon Chord Diagrams are also known as radial network diagrams. While a small amount of data can be represented in a pie chart using straight lines to show the relationships, a multiple line chart will quickly become illegible. To reduce visual complexity, Chord Diagrams use a technique called hierarchical edge binding. Each node must be represented with a width proportional to its total flow. Each edge must be represented by two arcs which connect the start and endpoints of the two-node wedges. Relationship diagrams show how the data columns connect and what the strength of this connection is through the use of different types of lines.

3D Diagrams

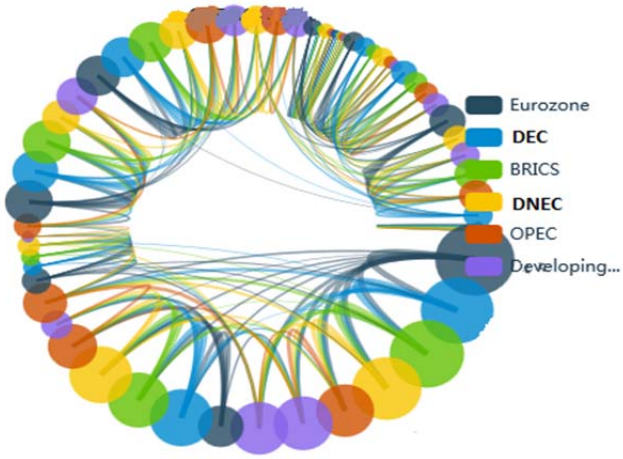
3D diagrams show data in a 3D coordinate system by plotting each column as a cuboid in order to create a 3D effect.

Results

The results shown in Figure 3 include individual countries from the Eurozone group, the developed European coutnries (DEC) group, the developed non-European countries group, the BRICS group, the developing European countries group and the OPEC group, as well as the said groups in their entirity.

Figure 3

Visualization of the interconnections between the exchange rate stability indices of the explored panels of countries



Source. Authors’ calculations.

The USA is included indirectly because currency fluctuations are set to the dollar. Regarding the dependencies between the exchange rate stability indices, we find that the Eurozone countries are most strongly dependent on the developed

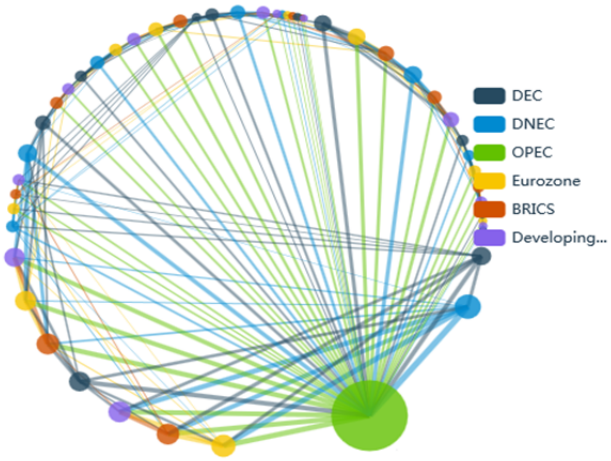
European economies, followed by the BRICS countries, the developed non-European countries, the OPEC and the developing European countries. Individual Eurozone, OPEC and BRICS countries also have an impact on the stability of currency rates. Since exchange rate fluctuations are relative to the dollar, Figure 3 also reflects the strong influence of the dollar on the exchange rate system.

The high levels of financial openness of the OPEC panel correspond to the strong relations with the Eurozone countries and the developed non-European economies.

Figures 4 and 5 visualize the links between the degree of financial integration and independent monetary policy. The central position of the OPEC group in both charts is interesting. This link is most likely due to the fact that the movement of capital is strongly influenced by OPEC's active trade balance, and respectively by the problem of recycling petroleum surpluses, i.e. the international capital movement has been genetically linked to the market for energy petroleum products in recent years. Monetary policy autonomy also appears to be a consequence of the combination of floating exchange rates, the transformation of central bank policy into the only nominal anchor of the world monetary and financial system, and the recycling of petroleum dollars. In other words, the objective result of the central banks' stabilization policy is to maintain a relatively stable price ratio between 'black gold' and other commodities. Therefore, the final result of inflation targeting, which is applied almost universally by central banks, aims to guarantee the purchasing power of petrodollars. Interestingly, this conclusion can hardly be drawn without the use of visualization.

Figure 4

Visualization of the interconnections between the financial openness of the explored panels of countries



Source. Authors' calculations.

It is noteworthy that there is no direct link between the financial integration in the OPEC and the DNEC groups, such as the one that can be observed for all of the other segments (see Figure 4). The DNEC have a direct impact on the OPEC, however, this connection is not reciprocated. The DNEC node determines all the other segments – the Eurozone, the BRICS countries and the developing European countries – with the exception of the DEC. The thickness of the connecting lines, which indicates the significance of the connection, is commensurate with that of the influence of the OPEC. This marks a certain correlation between DEC and DNEC, represented not only by the registered direct impact on the DNEC by the DEC, but also by the fact that only the DEC have a direct connection with all other segments, followed by the DNEC, which do not affect only the DEC.

It should be noted that the OPEC segment, although it has significant influence, judging from the size of the sphere with which it is depicted, affect all other segments, except for the DEC and the DNEC. Placing the last two segments in relative proximity in terms of meaning and determinants of all the other segments requires consideration of these two factors precisely in the context of promoting the financial integration of the surveyed countries as a whole.

With this in mind, the analysis should begin by outlining the interaction and the leading principle between the two main factors – the DEC and the DNEC. It is clear that only the DEC have a deterministic impact on the DNEC. In addition, the DEC group affects all other segments like as does the DNEC, the size of the links is weaker, which can also be interpreted as evidence of the DNEC’s leading influence over all of the other segments as compared to that of the DEC. However, it should not be forgotten that only a one-way effect link exists from the DEC to the DNEC. Therefore, we can conclude that DEC and DNEC are of similar importance to the global financial integration of the explored countries, and that both segments reveal their leading importance for the OPEC’s financial integration. This gives some reason to argue that the OPEC’s established significant position as a mediator of financial integration can be considered as a very important, but lateral, consequential and additional result of established financial integration between the surveyed countries, which has become a channel of incluence of the general financial policies pursued, which are centered around the DEC and the DNEC.

It can be said that the graphical representation of financial integration shows how the periphery follows the core and thus contributes to the attainment of its goals, regardless of whether those goals are aligned to the specific needs of the periphery – i.e. there is a spillover effect of the “one medicine for all patients” type. The predisposition of the periphery to be influenced by the core is also evidenced by the graphical representations with the use of 3D graphics.

Relatively low levels of monetary independence are recorded for the BRICS, OPEC and developing European countries. The same is valid for one of the groups of countries in the core – the DNEC – which predetermines the predisposition of the core countries to external influences from countries that are not included in this study.

The question naturally arises, since we have a process of financial integration that starts from the core and moves towards the periphery, why does the figureic study of artificial intelligence present us with two centers of influence – those of the DEC and the DNEC – instead of a single one? The explanation may come from accepting the DNEC's actions as a "proxy" of US financial policy. This US channel of influence over the DNEC, including Japan, Canada, Australia and New Zealand, can be explained by the very low coefficient of monetary independence (see Figure 9).The monetary openness of the DNEC, combined with the complex trade and financial relations with the United States, leads to a strong alignment of monetary policy with the measures applied in the United States with regard to the Federal Reserve's interest rate policy. On the other end of the spectrum, the DEC have a high degree of monetary independence (see Figure 7 and Figure 8), which is also characteristic of the Eurozone countries (see Figure 11 and Figure 12). It is this monetary independence, which stems from the European countries, combined with the retransmission effect of the US monetary signals through the DNEC that forms a strong channel for influencing the peripheral countries, which are predisposed to the impact of this monetary spillover effect due to their weak monetary independence.

It can be assumed that the petrodollar recycling hypothesis is valid, however, the deciding factor is rather the synchronous policy of leading central banks, which is expressed through common policies (inflation targeting) that balance the attempts to promote economic growth with taking into account the dynamics of oil prices. In other words, it is not the OPEC that determine the financial policies and the integrity of the DEC and the DNEC, but their monetary policy affects the financial integrity of the OPEC, expressed through the oil prices.

Using the visual language of the Figures, it should be noted that neither of the two groups of countries (DNEC and DEC) are subject to the OPEC's influence. On the contrary, all of the impacts are directed towards the OPEC (see Figure 4). It can be concluded that the synchronous policy of the central banks, which use the same methodology to maintain the upward trend and combat the downturn in the economic cycle, a) leads to the clear impact of the DEC and the DNEC on all the other explored panels of countries; and, (b) as a side but not insignificant result of this synchronized policy, guarantees the purchasing power of petrodollars. Additional evidence of this can be observed in Figure 5, where the monetary policies of the DEC and the DNEC influence all the other segments, while only the OPEC affects their monetary policy. This reveals the role of the instruments of the monetary policy, ensuring monetary stability in relation to the price of oil.

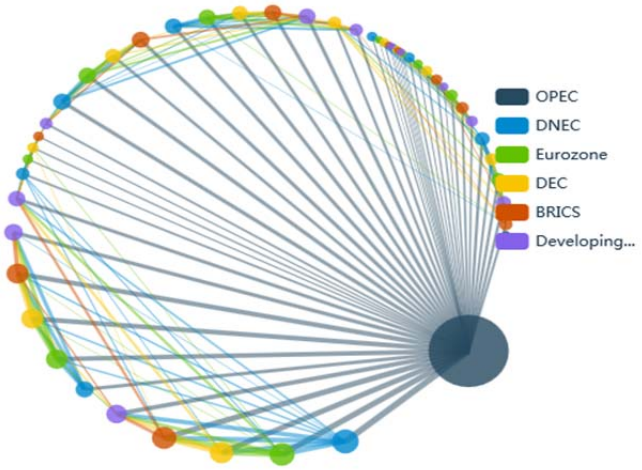
Interestingly, what is missing is the determinant impact of financial integration, namely the impact of the Eurozone factor. This is a surprising result because among the countries that form this panel there are leading G8 economies that can be assumed to be more important to the global economy than the countries, represented in the two major segments – the DEC and the DNEC. The explanation can be seen as a direct confirmation of the constrains, imposed by the trilemma. Since the countries in this group share a common currency the exchange rate is not controlled at a national

level and thus the trilemma enables them to operate only via financial flows, but not with an autonomous monetary policy.

As the data from Figure 11 and Figure 12 show, the varying degree of autonomy reflects the imperfections of ECB’s common monetary policy. All this brings financial integration to the forefront, as this indicator registers the highest values compared to the other two that make up the trinity of the tirlema. This is where the Eurozone and the DNEC and DEC groups can be compared. If the Eurozone countries have only one of the trilemma tools at their disposal, the DNEC and DEC panels, in contrast, may use both the independent monetary policy and the “channel” of financial integration to spread spillover effects from the core to the periphery. The individual Eurozone countries can only receive and relay these signals, but they cannot produce them and, as a result, the latter also does not affect the levels of financial integration of the periphery.

Figure 5

Visualization of the interconnections between the independent monetary policies of the explored panels of countries



Source. Authors’ calculations.

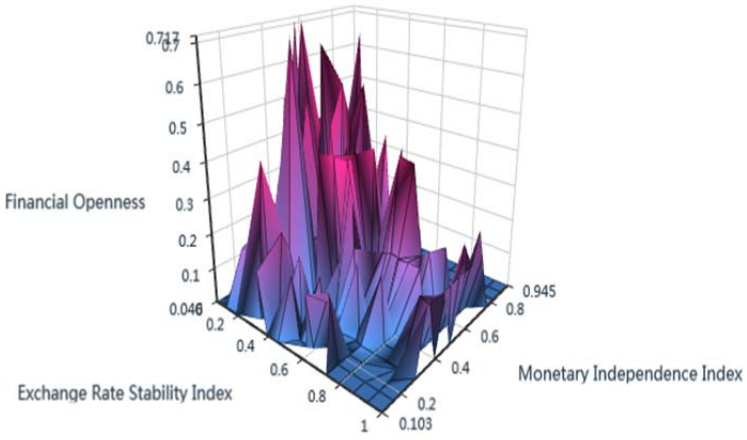
This effect of transmission is also visible in terms of the financial integration. The DEC, DNEC, and OPEC influence the Eurozone nodes, however, the impact is then sequentially transmitted from the Eurozone, only to the neighboring nodes of the BRICS and the developing European countries (see Figure 4). This effect of the retransmission of impulses by the Eurozone is revealed in Figure 5, which shows

the interconnections between the independent monetary policies of the explored countries. A confirmation of this finding is clearly evident between the DNEC nodes, which have a direct impact on the Eurozone node, which in turn transmits and relays the impact on to the DEC, which then further retransmit it to the nodes of the BRICS and the developing European countries. The relatively large number of impacts of the Eurozone's monetary policy on the nodes of the developing European countries should also be noted. These impacts can be considered not only in terms of the monetary policy transmission mechanism, in which the Eurozone is only an intermediate unit, but also from the point of view that the impact of the ECB's monetary policy affects only the periphery and not the core, as this peripheral impact is limited only to the developing European countries

In most of the BRICS countries, the trilemma is realized through a combination of high levels of financial liberalization, an autonomous monetary policy, and a floating exchange rate.

Figure 6

The "impossible trilemma" for the BRICS countries



Source. Authors' calculations using IBM® Watson ™ Studio.

A characteristic feature of the developed European countries is the combination of maximum financial liberalization, an autonomous monetary policy, and a predominantly moderately stable exchange rate. This reflects the impact of the integration processes in the Eurozone, both directly, through participation in European monetary integration, and indirectly along the lines of maintaining relatively stable exchange rates.

Figure 7

The “impossible trilemma” for the developed European countries

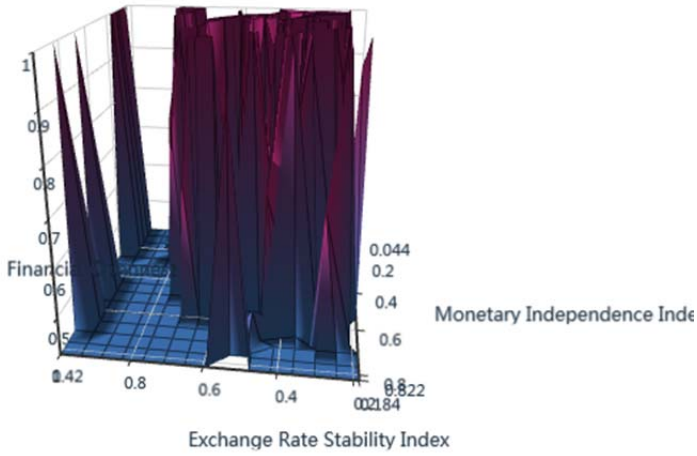
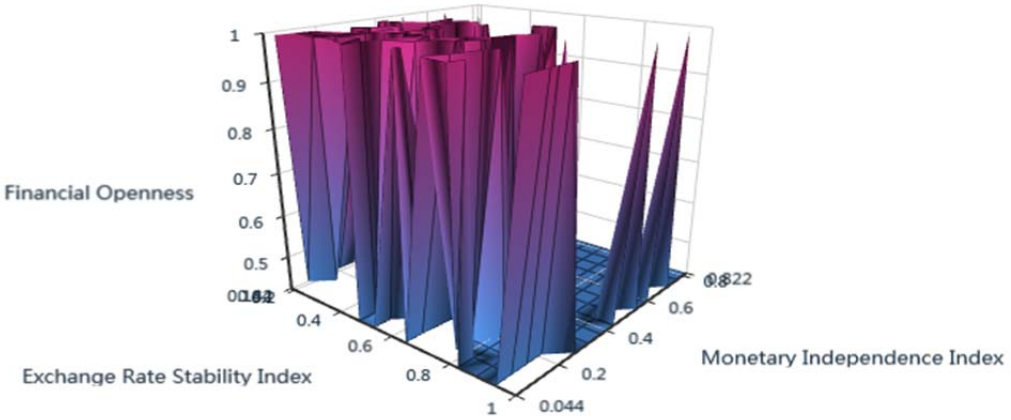


Figure 8

The “impossible trilemma” for the developed European countries

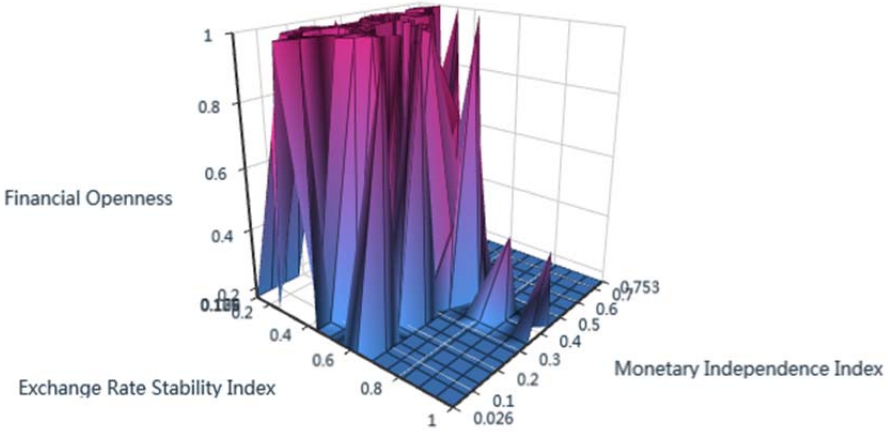


Source. Authors’ calculations using IBM® Watson ™ Studio.

In the case of the developed non-European countries, a high degree of capital account liberalization, moderate exchange rate fluctuations and a combination of independent and dependent central banks are observed.

Figure 9

The “impossible trilemma” for the developed non-European countries

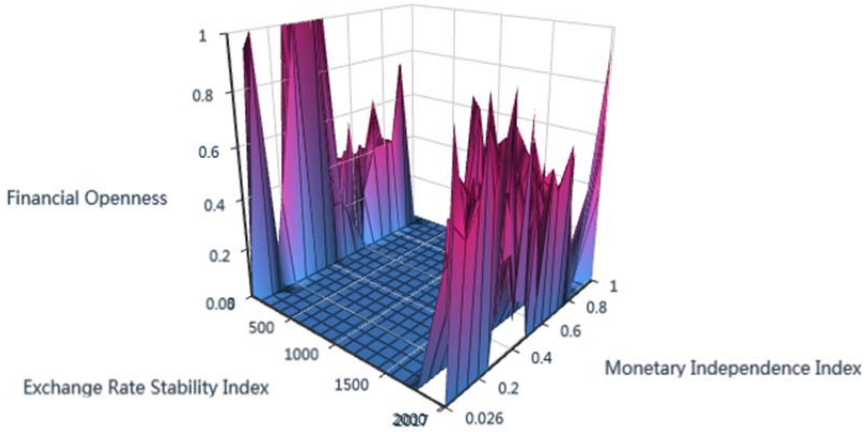


Source. Authors’ calculations using IBM® Watson ™ Studio.

In the panel of the developing European countries there is a clear distinction between a group of countries with stable exchange rates and a group of countries with floating exchange rates. The capital account liberalization is high, but there is both a combination of inflexible exchange rates, financial liberalization, and an autonomous monetary policy and a combination of more limited liberalization with inflexible exchange rates and a relatively autonomous monetary policy.

Figure 10

The “impossible trilemma” for the developing European countries



Source. Authors’ calculations using IBM® Watson ™ Studio.

Figure 11 and Figure 12 illustrate that there is a high level of financial liberalization in the Eurozone countries. How the monetary policy autonomy is measured through interest rate correlation shows a different degree of autonomy which reflects the imperfections of the ECB’s common monetary policy. The exchange rate is uniform, which is reflected in the grouping by this indicator of all countries in one location. The link between the autonomous anti-inflation policy of the major central banks in the world and the maintenance of a relatively constant price of energy, which is a factor that has dominated global economic development over the last 50 years, is of particular importance.

Figure 11

The “impossible trilemma” for the Eurozone countries

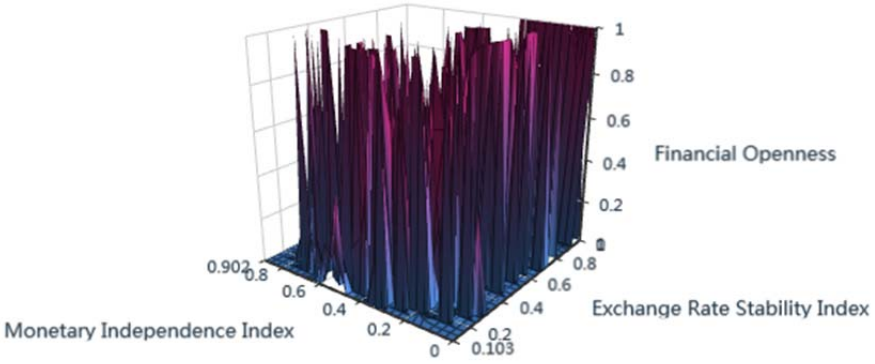
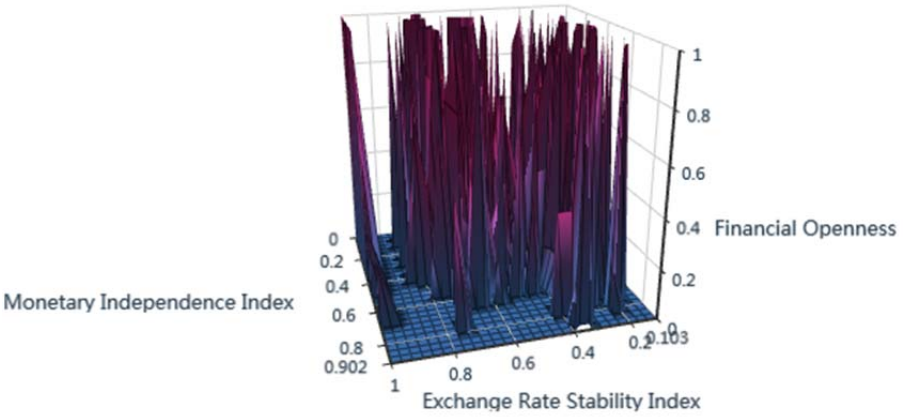


Figure 12

The “impossible trilemma” for the the Eurozone countries



Source. Authors’ calculations using IBM® Watson ™ Studio.

For the Eurozone countries, the strongest interconnections can be observed between the three elements of the trilemma.

In this group, there is a high degree of financial liberalization, which corresponds to a high degree of monetary independence and a stable exchange rate. There are similarities with the BRICS countries, i.e. the trilemma is realized through the combination of a high degree of financial liberalization, an autonomous monetary policy, and a floating exchange rate.

Figure 13

The “impossible trilemma” for the OPEC panel

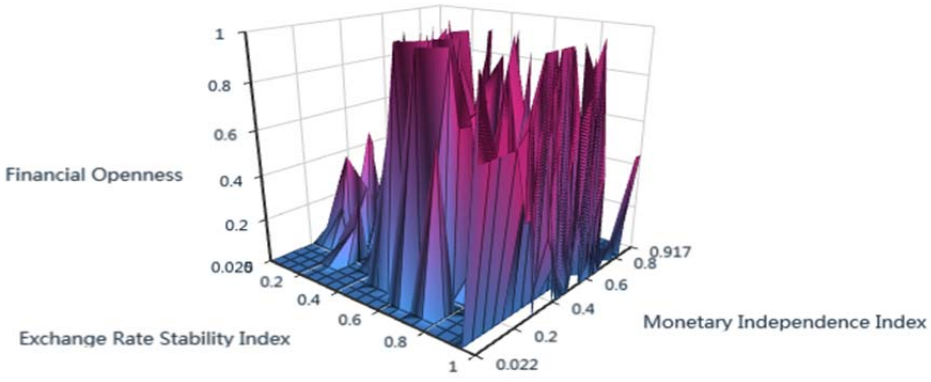
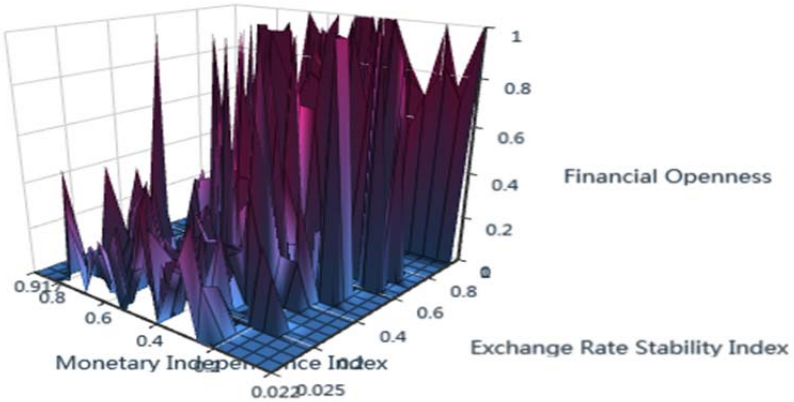


Figure 14

The “impossible trilemma” for the OPEC panel



Source. Authors’ calculations using IBM® Watson ™ Studio.

Conclusion

The visualizations of the “impossible trilemma” shown above illustrate that there is a high degree of validation of the trilemma, in the case of both the developing economies and the developed non-European countries. This implies that a compromise exists between exchange rate stability, monetary independence, and free capital mobility. In examining the interrelationships between the various elements of the trilemma on a global level, an emphasis is placed on the central role of the OPEC. The upholding of a relatively stable price ratio between ‘black gold’ and other commodities is the objective result of the central bank’s stabilization policy. The Eurozone countries have a common currency and exchange rates that cannot be controlled by national economies, and thus, the trilemma allows them to operate only with financial integration, but without an autonomous monetary policy. The Eurozone is in need of a centralized political identification.

The EU’s green policy, which is aimed at reducing the dependence of economies on traditional energy sources, including oil, gas and coal, will be of great importance in terms of capital mobility and central bank policy targeting. The link between the monetary policies and the price of energy should weaken in the future. The stabilization of the purchasing power of the leading currencies within the global monetary system would be inevitably oriented towards limiting price fluctuations between a wider range of industries and sectors of the economy. This will lead to a new structuring of economic and political interdependencies within the world system.

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http://web.pdx.edu/~ito/trilemma_indexes.htm

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