THE IMPACT OF POLICY MIX INSTRUMENTS ON THE EURO AREA ECONOMY IN LOW INTEREST RATES ENVIRONMENT

[a]JOANNA STAWSKA

University of Lodz, 39 Rewolucji 1905 Street, Lodz, 90-214, Poland

email: [a]joanna.stawska@uni.lodz.pl

Abstract: The aim of the article is to examine the relationship between instruments of policy mix and selected economic variables in the euro area economy with regard to low interest rates. Moreover, the article verifies the hypothesis that policy mix instruments exerted a statistically significant impact on the euro area economy between 1999-2016. The research methods include a review of the relevant scientific literature and statistical analysis methods. The analysis is original as it emphasizes the importance of proper monetary and fiscal policies and reveals their growing significance for economic processes.

Keywords: policy mix, euro area, interest rate, monetary policy, fiscal policy.

1 Introduction

Monetary and fiscal policy to a great extent affect the economy of a given country. Decisions made by economic authorities influence each other, which is also reflected in the values of macroeconomic ratios, Economic literature defines a notion of *policy mix* as a combination of fiscal and monetary policy. A significant impact of *policy mix* on the economy was described, among others, by M. Buti and A. Sapir[1] as well as by R. Clarida, J. Gali, M. Gertler[2] or D.K. Foley, K. Shell, M. Sidrauski.[3] Furthermore, the issue of policy-mix was discussed by R. Beetsma and X. Debrun[4], L. Onorante[5], A. Hughes Hallet, P. Mooslechner, M. Schuerz[6] and others.

For central banks, interest rates are an instrument with which they shape the behavior of economic agents and consumers and regulate money supply, the supply and demand for loans, and the general economic situation. The extent to which interest rates can influence the economy depends on many factors, mainly on the lag with which the economy reacts to interest rate adjustments, economic slowdowns and financial crises. The recent financial crisis has had a particularly strong effect on economic variables, reflected in the levels of variables determined by monetary policy. In turn, an instrument of government fiscal policy that is the most frequently mentioned is budget deficit that to some extent affects, among others, GDP growth and inflation. Hence, while talking about the economic policy. coordination of central bank and government activities is connected with consistent application of instruments of monetary and fiscal policy so that assumed objectives could be met. According to that approach a notion of coordination was formulated by W. Nordhaus[7] who claimed that coordinated macroeconomic policy is observed when central banks interest rates adjust appropriately so that effects of fiscal policy can be neutralized. Therefore, the aim of the paper is to examine the relationship between policy mix instruments and selected economic variables in the euro area economy with regard to low interest rates. Moreover, the article verifies the hypothesis that policy mix instruments exerted a statistically significant impact on the euro area economy between 1999-2016.

2 Monetary and fiscal policy in low interest rates environment and the Eurozone economy

According to J. Skrzypczynska, the core of the coordination of monetary and fiscal policy (policy mix) is based on the combination of the both policies to enable to achieve goals related to price stability and economic growth and employment.[8] P. Jacquet, J. Pisani-Ferry emphasize the importance of coordination of monetary and fiscal policies exemplifying the Eurozone. They claim that in reality a national fiscal policy and structural policy influence an average level of inflation in a given country and thus the decisions of fiscal authorities of the member states may affect the decision of a central bank related to common monetary policy in the euro area.[9] It should be stressed that the liberty of national authorities at conducting fiscal policy was limited by the rules of the Maastricht Treaty. Hence it seems that desirable coordination of fiscal and monetary policy is not easy achievable in the process of pursuing financial stability.[10]

I. Woroniecka – Leciejewicz conducted an analysis of balance in the monetary-fiscal game emphasizing priorities of the central bank and government in conducting macroeconomic policy. It has been assumed that central bank strives to minimize inflation, whereas government wants to maximize a real economic growth while taking into consideration an impact of budget deficit on GDP growth. These studies indicated that economic authorities try to implement their dominant strategies i.e. to choose a restrictive monetary policy and expansive fiscal policy or both restrictive policies.[11]

Woroniecka –Leciejewicz expanded the research by studying the interactions between the decisions of the monetary and fiscal authorities and their mutual conditioning using a simulation study based on a fiscal-monetary game, in which fiscal and monetary policy strategies varied regarding restrictiveness and expansionism. The game was carried out assuming that an increasing interest rate slows down, *ceteris paribus*, the rate of economic growth and reduces inflation, and that an expanding budget deficit pushes, *ceteris paribus*, inflation upwards. It was also assumed that an expanding budget deficit improves, *ceteris paribus*, the rate of GDP growth. Two cases were considered, in one of which the monetary authorities sought to minimize inflation and the fiscal authorities maximize GDP growth, and in the other the monetary and fiscal authorities pursued their own goals defined, respectively, by the inflation target and the GDP growth rate. A logistic function used to determine how economic growth and inflation were related to the fiscal and monetary policy instruments showed an increasingly restrictive monetary policy to have a limited potential for reducing inflation, likewise increasingly expansionary fiscal policy for stimulating economic growth. The study showed that the contribution of a fiscal instrument (budget deficit) to a higher rate of GDP growth represented by an increasing logarithmic function grows until the instrument reaches a certain level. Like an increasingly expansionary fiscal policy has a dampening effect on the simulation of economic growth, an increasingly restrictive fiscal policy has limited potential for improving the production growth rate. A similar situation is observed regarding the impact of the budget deficit on inflation. Moreover, as the interest rate increases the rate of GDP growth decreases from maximal when the monetary policy is extremely expansionary to minimal when

[1] BUTI M., SAPIR A.: Economic Policy in EMU, Clarendon Press-Oxford, 1998.
[2] CLARIDA R., GALÍ J., GERTLER M.: Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory, "Quarterly Journal of Economics", 2000.
[3] FOLEY D.K., SHELL K., SIDRAUSKI M.: Optimal Fiscal and Monetary Policy and Economic Growth, "Journal of Political Economy" vol. 77/4, 1969.
[4] BEETSMA R., DEBRUN X.: The Interaction between Monetary and Fiscal Policies in Monetary Union: A Review of Recent Literature, [in:] R. BEETSMA et. al., Monetary Policy, Cambridge, 2004.
[5] ONORANTE L.: Interaction of Fiscal Policies in the Euro Area: How Much Pressure on the EBC? [in:] R. BEETSMA et. al., Monetary Policy, Cambridge, 2004.
[6] HUGHES HALLET A., MOOSLECHNER P., SCHUERZ M.: eds. Challenges of Economic Policy Coordination within European Monetary Union, Dordrecht, 2001.
[7] NORDHAUS W.: Policy Games: Coordination and Independence in Monetary and Fiscal Policies, "Brooking Paper on Economic Activity", 1994, No.2, 194 p.

[8] SKRZYPCZYŃSKA J.: Koordynacja polityki fiskalnej I pieniężnej strefy euro w obliczu kryzysu finansowego, „Rocznik Integracji Europejskiej" 6/2012, 289 p.
[9] JACQUET P., PISANI-FERRY J.: Economic policy co-ordination in the euro-zone. What has been achieved?, What should be done?, :Sussex European Institute Working Paper" 40/2001, 7 p.
[10] SKRZYPCZYŃSKA J.: Koordynacja …, op. cit.
[11] WORONIECKA – LECIEJEWICZ I.: Analiza policy-mix z uwzględnieniem interakcji decyzyjnych między bankiem centralnym a rządem i ich priorytetów, Zeszyty Naukowe Wydziału Informatycznych Technik Zarządzania Wyższej Szkoły Informatyki Stosowanej i Zarządzania „Współczesne Problemy Zarządzania" No. 1, 2011, 39 – 60 pp.

the interest rate becomes extremely high. Analogously, as the interest rate increases, inflation falls from extremely high when the monetary policy is extremely expansionary to extremely low when the policy becomes extremely restrictive.[12]

In the euro area policy-mix is based on the common monetary policy for all members of the Monetary and Economic Union (EMU) and national fiscal policies. Here, we should refer to the results of analyses conducted by C. Badarau and G. Levieuge who concentrated on studies of policy-mix suitable to the monetary union in a context of financial heterogeneity. Using dynamic, stochastic general equilibrium model (DSGE), they came to several conclusions. First of all, they have ascertained that centralized monetary policy was more advantageous for the monetary union than alternative national monetary policies. Also, they have found that national budget policies can mitigate cyclical divergences. Nevertheless, the analysis of various cases of policy-mix shows the certain advantage of the common budget and it allows better stability of price divergence in EMU.[13]

In the case when the economic authorities are unwilling to cooperate with each other, the Nash equation generates higher levels of inflation and lower levels of production compared with the best solution achievable under the given circumstances (but still not optimal, because of the disturbances caused by the fiscal policy). The reason for this is a mismatch between the central bank seeking to reduce production and inflation below levels set by the government and the government pursuing a fiscal policy increasing inflation and production above levels defined by the central bank. This is a case of an inflationary fiscal policy partly offset by the monetary policy.[14]

A fiscal policy may influence inflation (based on the Fiscal Theory of the Price Level (FTPL) developed by Woodford[15] and modified by other authors), because when the debt is high a temptation arises to reduce its real value by increasing inflation rather than taxes. In the case of the aforementioned 'fiscal domination', a disparity between the monetary and fiscal policy goals may significantly weaken the central bank's position thus leading to higher inflation.[16]

From the perspective of the monetary and fiscal game, inflation and economic growth are the lowest in an environment characterized by a combination of extremely restrictive monetary and fiscal policies. A monetary policy that is becoming more and more expansionary (successive cuts in interest rates) increases inflation and the rate of GDP growth. On the other hand, an increasingly expansionary fiscal policy (expanding the budget deficit) pushes up inflation and the rate of GDP growth. The highest rates of inflation and GDP growth are observed in countries the economic authorities of which have chosen extremely expansionary monetary and fiscal policies. I. Woroniecka-Leciejewicz noted that the restrictiveness of a monetary policy depends on the government's fiscal policy. To prevent inflation from rising too high, the central bank tightens up monetary policy as the government makes its fiscal policy more expansionary. On the other hand, the central bank's monetary policy has influence on how restrictive or expansionary policy will be pursued by the fiscal authorities. An increasingly restrictive monetary policy leads to a more expansionary fiscal policy, because a higher interest rate

environment requires a more pro-growth fiscal policy to boost economic growth, which usually increases the budget deficit.[17]

In considering the issue of coordination between monetary policy and fiscal policy, or a lack of it, one has to take account of the so-called zero lower bound on nominal interest rates, also known as a zero-bound (ZLB) problem. The problem basically is that nominal interest rates cannot drop below zero. Many economists argue that a near-zero interest rate encourages fiscal stimulation that certainly has influence on the type of decisions made by the central bank.

In an economy with zero-bound interest rates, the monetary policy effectiveness can be blunted by the liquidity trap, which emerges when the monetary policy is unable to stimulate demand because interest rates cannot be reduced any lower.[18] Studies on fiscal policy effectiveness under zero-bound interest rates conducted in many countries show that the zero-lower bound interest rates make fiscal expansion more effective, particularly in economies pursuing an accommodative monetary policy (maintaining low interest rates). A. Szymańska argues that fiscal policy is more effective during recession that in a period of stable growth, because recession tends to be accompanied by low interest rates.[19] According to L.H. Summers, the main reason why fiscal policy outperforms monetary policy during a crisis is that its instruments stimulate the economy faster and more efficiently.[20] The most recent crisis of 2008 caused many national governments to relax fiscal discipline, as the monetary policy they had pursued so far failed to deliver the desired results in a low-interest rate environment. The discretionary fiscal policies they formulated to handle the crisis impacts included fiscal packages, which were designed to rebalance financial systems and increase total demand in the economy.[21]

A.Rzońca has stated that a zero-bound interest rate is supportive of fiscal stimulation[22], because it creates conditions for the government to run a substantial budget deficit by reducing the cost of borrowing, etc.[23] He also argues that a zero-bound interest rate policy can make production factors less productive and reduce total demand. Low interest rates have a negative effect on the rate of productivity growth in the long term, mainly because they contribute to a lower rate of economic restructuring and limit borrowing opportunities available to new organizations and new projects. The financial sector's uncertainty as to the likely course of events in an economy operating zero-bound interest rates also reduces total demand, discouraging the use of some entities' savings to fund the expenditures of others. A low rate of growth usually leads to problems with reducing the general government deficit, which frequently follows a financial crisis. In most cases, a zero-bound interest rate contributes to a larger deficit, because it makes the central bank appear not to be able to stimulate total demand and eliminates the risk of a crowding-out effect.[24] According to P. Ciżkowicz and A. Rzońca, a financial crisis lessens the influence of interest rate reduction on total demand, because it involves a falling natural interest rate and stronger frictions in financial markets. The authors also maintain that in the aftermath of the burst of the

[12] WORONIECKA – LECIEJEWICZ I.: Problem wyboru policy – mix w grze fiskalno-monetarnej z zastosowaniem funkcji logistycznej, „Studia i Materiały Informatyki Stosowanej", Vol. 4, No. 8, 2013, 29 – 38 pp.
[13] BADARAU C., LEVIEUGE G.: Which policy-mix to mitigate the effects of financial heterogeneity in a monetary union?, "LAREFI Working Paper" No. CR11-EFI/09, 2011, 2 – 3 pp.
[14] DIXIT A., LAMBERTINI L.: Interactions of Commitment and Discretion in Monetary and Fiscal Policies, Princeton University, 2003; KUTTNER K. N.: Kombinacja (policy mix) polityki pieniężnej i fiskalnej z perspektywy amerykańskiej, XXII Konferencja Naukowa NBP, Reformy strukturalne a polityka pieniężna" Falenty 2002.
[15] WOODFORD M.: Fiscal Requirements for Price Stability, Journal of Money, credit and Banking, Vol. 33, 2001, 669-728 pp.
[16] SARGENT T., WALLACE N.: Some Unpleasant Monetarist Arithmetic, Federal Reserve Bank of Minneapolis Quarterly Review, Vol. 5, 1981, 1-17 pp.

[17] WORONIECKA – LECIEJEWICZ I.: Problem …. op.cit.
[18] WOJTYNA A.: Skuteczność polityki pieniężnej w warunkach niskiej inflacji: problem zerowej granicy nominalnych stóp procentowych, „Bank i Kredyt" No. 7, 2001.
[19] SZYMAŃSKA A.: Efekty polityki fiskalnej w warunkach niskich stóp procentowych – przegląd literatury, „Studia Prawno-Ekonomiczne", Vol. XCIII, 2014, 347 p.
[20] SUMMERS L.H.: Fiscal Stimulus Issues, Testimony before the House Budget Committee, Washington, 2008: http://larrysummers.com/wp-content/uploads/2012/10/1-16-08_Fiscal_Stimulus_Issues.pdf, (access: 26.11.2017).
[21] SPILIMBERGO A., SYMANSKY S., BLANCHARD O., COTTARELLI C.: Fiscal Policy for the Crisis, IMF Staff Position Note, 2008/1, 2 p.
https://www.imf.org/external/pubs/ft/spn/2008/spn0801.pdf, (access: 26.11.2017).
[22] RZOŃCA A.: Kryzys banków centralnych. Skutki stopy procentowej bliskiej zera, C.H. Beck, Warsaw, 2014.
[23] ARELLANO C., CONESA J. C., KEHOE T. J: Chronic Sovereign Debt Crisis in the Eurozone, 2010-2012, "Federal Reserve Bank of Minneapolis Economic Policy Paper", No. 4., 2012; CONESA J.C., KEHOE T.: Gambling for redemption and self – fulling debt crises, Staff Report from Federal Reserve Bank of Minneapolis, no. 614, 2012.
[24] RZOŃCA A.: Kryzys …, op.cit.

asset bubble that triggered the financial crisis of 2008 central banks took no account of the zero-bound interest rates' influence on the natural interest rate.[25]

The recent financial crisis showed many countries' preference to seek solutions to their problems in traditional Keynesian solutions designed to stimulate economies. Interestingly, despite the long-standing promotion of monetarist thought and new classical macroeconomics many governments still find interventionist tools, such as an expansionary fiscal policy, to be useful.[26] P. Krugman argues that a fiscal stimulus spurring the economy helps create new jobs and that the reduction of the budget deficit slows down economic growth in the short term. He also concludes that in the face of a financial crisis a government in charge of an economy with near-zero interest rates should increase public expenditures (to illustrate his point, P. Krugman refers to the Great Depression that was defused in the US by rapidly increasing government spending).[27]

According to J. Działo, a restrictive fiscal policy seems a better option, as it gives the monetary authorities more freedom in carrying out a loose monetary policy. In some cases, however, such as an economic crisis, an expansionary fiscal policy can prove useful. The discretionary, anti-cyclical measures of the fiscal authorities have the potential for mitigating the negative impacts of recession, such as mass bankruptcies and fast-rising unemployment (usually at the cost of higher public deficits and debts).[28]

3 Analysis of dependencies between instruments of policy mix and real economy

This part presents statistical data concerning instruments of monetary and fiscal policy e.g. the ECB official interest rate, a rate of inflation, money supply M3 in the euro area as well as deficit and debt of general government sector (GG) and GDP growth. Moreover, the results of regression between such variables as interest rate, inflation, GG deficit, GDP growth or a real GDP value were presented.

Table 1 shows the levels of the main (official) interest rates set by the central bank in the euro area (the main refinancing operation rate), between 1999 and 2016. Because the rates were frequently changed over a year, the table presents their annual arithmetic means. Moreover, table 1 shows HICP inflation rate as an annual average rate of change (2015=100) as well as Broad Money (M3) Index (2010=100) in the euro area between 1999-2016.

Table 1 Main interest rate of ECB, inflation (HICP) and Broad money index (M3) in euro area

Year	Main refinancing operation rate ECB (%)	Inflation (HICP) in euro area (%)	Money supply Index (M3) in euro area
1999	2,90	1,1	48,7
2000	4,04	2,1	51,5
2001	3,94	2,3	55,7
2002	2,75	2,2	59,7
2003	2,25	2,1	64,3
2004	2,00	2,1	68
2005	2,25	2,2	73,1
2006	3,00	2,2	79,4
2007	3,88	2,1	88,2
2008	3,44	3,3	97,4
2009	1,44	0,3	101,1
2010	1,00	1,6	100
2011	1,25	2,7	101
2012	0,75	2,5	103,7
2013	0,38	1,4	105,7
2014	0,10	0,4	107,5
2015	0,05	0	114
2016	0,00	0,2	119,6

Source: based on [Eurostat, OECD].

In the analysed period the ECB main interest rate was at a relatively low level. It increased only in more than 3% between 2000-2001 as well as 2007-2008, which mostly reflected an economic slowdown and the last financial crisis that also influenced a level of inflation. Inflation in the euro area between 1999-2016 only in 2008 exceeded 3.3%, whereas in other years a rate of inflation oscillated around 2% (inflation target in euro area is below 2%). It was observed that between 1999-2016 money supply M3 in the euro area was rising steadily (the lowest growth was noted between 2009-2011) .

Table 2 shows the 1999-2016 real GDP growth rate for the euro area (as percentage change on previous year), General Government (GG) deficit (as percentage of GDP) and debt (government consolidated gross debt percentage of GDP) in euro area.

Table 2 GDP growth, GG deficit and debt in Euro Area in the 1999-2016

Year	GDP growth rate in Eurozone	GG deficit in euro area (% GDP)	GG debt in euro area (% GDP)
1999	3	-1,5	70,6
2000	3,8	-0,3	68,1
2001	2,1	-2	67
2002	0,9	-2,7	66,9
2003	0,6	-3,2	68,1
2004	2,3	-3	68,4
2005	1,6	-2,6	69,2
2006	3,2	-1,5	67,3
2007	2,9	-0,6	64,9
2008	0,4	-2,2	68,6
2009	-4,4	-6,3	78,4
2010	2,1	-6,2	83,8
2011	1,6	-4,2	86,1
2012	-0,9	-3,6	89,4
2013	-0,3	-3	91,3
2014	1,3	-2,6	91,8
2015	2,1	-2,1	89,9
2016	1,8	-1,5	88,9

Source: based on [Eurostat, OECD].

Between 1999-2016 GDP in the euro area dropped significantly during the last financial crisis of 2008-2009 as well as in the period of so-called public debt crisis. As a result of the last financial crisis GG deficit and GG debt also increased, which affected GDP in the euro area.

Below, a regression analysis of the selected variables is presented. It aimed to find out which dependencies between instruments of policy mix and real economy indicators in euro area were statistically significant in the years 1999-2016 by testing a null hypothesis H_0 (the variables' parameters are not significant) and an alternative hypothesis H_1 (the parameters are significant). The variables were checked for stationarity with the use of the ADF test (the Dickey–Fuller test). Variables that were non-stationary at their levels were transformed into first differences, yielding stationary series. The necessary data were obtained from the Eurostat and OECD.[29]

Table 3 contains the regression results for the euro area. The independent variables were the nominal main ECB interest rate [IR_ECB] and the nominal main ECB interest rate lagged by one year [IR_ECB_1]; the dependent variable was the first differences of the inflation rate (HICP) in the euro area [d_INF_EUR].

Table 3 The dependent variable (Y): d_INF_EUR; independent variables (X) – IR_ECB and IR_ECB_1

Variable name	Coefficient	Standard error	t- Student	p-value	
Const	−0,123662	0,401645	−0,3079	0,7627	
IR_ECB	0,827430	0,301489	2,744	0,0158	**
IR_ECB_1	−0,725742	0,317381	−2,287	0,0383	**
Selected regression statistics and analysis of variance; n=17 observations from 2000-2016					

[25] CIŻKOWICZ P., RZOŃCA A.: Interest rates close to zero, post-crisis restructuring and natural interest rate, "Prague Economic Papers", No.3, 2014.
[26] KRYŃSKA E., KWIATKOWSKI E.: Polityka państwa wobec rynku pracy. Idee ekonomiczne i rzeczywistość, „Polityka Społeczna" No. 5-6/2010, 2010, 6 p.
[27]KRUGMAN P.: End the depression now!, 2012 [in:] http://natemat.pl/20625,noblista-paul-krugman-wzywa-zakonczcie-ten-kryzys-teraz (access: 19.11.2017).
[28] DZIAŁO J.: Dlaczego trudno jest prowadzić "dobrą" politykę fiskalną?, „Gospodarka Narodowa" No. 1 – 2, 2012, 36 p.

[29]http://ec.europa.eu/eurostat/web/national-accounts/data/main-tables;
http://stats.oecd.org/index.aspx?querytype=view&queryname=170#
(access: 10.11.2017).

SD of the dependent variable 1,025377; Standard error of residuals = 0,883530
R-square = 0,350343
F(2, 14) = 3,774922   p - value for F test = 0,048841

Source: own elaboration based on [Eurostat, OECD].

The data in the table 3 point out that the nominal main ECB interest rate and the nominal main ECB interest rate lagged by one year had a statistically significant effect on the first differences of the inflation rate (HICP) in the euro area in the sampled years. The t-Student statistics of 2.744 and -2,287 at p-values of 0.0158 (< p=0.05) and 0,0383 (< p=0.05) indicate that there is a 95% probability that in that period the first differences of the rate of inflation (HICP) was statistically significantly determined by the nominal main ECB interest rate and the nominal main ECB interest rate lagged by one year.

The value of the coefficient for variable IR_ECB_1 in table 3 is negative (−0.725742), meaning that the influence of ECB interest rates lagged by one year on the first differences of the inflation rate HICP in euro area is consistent with economic theory. Further, the coefficient for the nominal main ECB interest rate is positive (0.827430), indicating that the first differences in inflation rate in the euro area increase as the ECB raises the nominal main ECB interest rate. The last dependency could be a result of financial crisis and a very low inflation in spite of low interest rates. Na tę ostatnią zależność mógł mieć wpływ kryzys finansowy oraz bardzo niska inflacja pomimo niskich stóp procentowych.

In the table 4 the independent variables in the analysis were the real GG deficit in the euro area [DEF_real], real GG deficit in euro area lagged by one year [DEF_real_1] and the nominal ECB's main interest rate [IR_ECB]; the dependent variable was the first differences of the inflation rate (HICP) in the euro area [d_INF_EUR].

Table 4 The dependent variable (Y): d_INF_EUR; independent variables (X) – DEF_real, DEF_real_1 and IR_ECB

Variable name	Coefficient	Standard error	t-Student	p-value
Const	−1,30473	0,744109	−1,753	0,1031
DEF_real	3,64503e-06	1,62790e-06	2,239	0,0433**
DEF_real_1	−5,35224e-06	1,76779e-06	−3,028	0,0097***
IR_ECB	0,407635	0,176935	2,304	0,0384 **
Selected regression statistics and analysis of variance; n=17 observations from 2000-2016				
SD of the dependent variable 1,025377; Standard error of residuals = 0,812285				
R-square 0,490114				
F(3, 13) 4,165297 p-value for F test 0,028451				

Source: own elaboration based on [Eurostat, OECD].

The above data indicate that independent variables – real GG deficit and real GG deficit lagged by one year and nominal ECB`s main interest rate statistically significantly influenced the first differences of the real inflation rate in the euro area in the analysed period. The t-Student statistics of 2,239, −3,028 and 2,304 at p-values of 0,0433 (< p=0.05), 0,0097 (< p=0.05) and 0,0384 (< p=0.05), respectively, indicate that there is a 95% probability that in that period the first differences of the inflation rate was statistically significantly determined by the real GG deficit, real GG deficit lagged by one year and ECB`s main interest rate in the euro area.

The value of the coefficient for variable DEF_real in table 4 is positive (3,64503e-06), meaning that the influence of real GG deficit on the first differences of the inflation rate HICP in euro area is consistent with economic theory. Further, the coefficient for the real GG deficit lagged by one year in euro area is negative (−5,35224e-06), indicating that the first differences in inflation rate in the euro area increase as the governments raise the real GG deficits (variable lagged by one year). The last dependency could have been affected by impact of turbulences in financial markets connected with the last financial crisis.

Table 5 shows the regression results for the euro area. In this case, the independent variables were the ECB's main refinancing operation rate [IR_ECB] and the ECB's main refinancing operation rate lagged by one year [IR_ECB_1]; the dependent variable was the first differences of the real GDP in the euro area [d_GDP_real].

Table 5 The dependent variable (Y): d_GDP_real; independent variables (X) – IR_ECB and IR_ECB_1

Variable name	Coefficient	Standard error	t-Student	p-value
Const	155466	66944,3	2,322	0,0358 **
IR_ECB	199173	50250,8	3,964	0,0014 ***
IR_ECB_1	−206394	52899,6	−3,902	0,0016 ***
Selected regression statistics and analysis of variance; n=17 observations from 2000-2016				
SD of the dependent variable 203853,9; Standard error of residuals = 147262,7				
R-square 0,543379				
F(2, 14) 8,330016 p-value for F test 0,004139				

Source: own elaboration based on [Eurostat, OECD].

An analysis of the data in table 5 leads to a conclusion that the ECB's nominal interest rate and the nominal ECB interest rate lagged by one year had a statistically significant influence on the first differences of the real GDP in the euro area. In this case, the t-Student statistics are 3,964 and -3,902 at p-values of 0.0014 (<p=0.05) and 0,0016 (<p=0.05), respectively, meaning that in the period under consideration the ECB's nominal interest rate and the nominal ECB interest rate lagged by one year rate had a statistically significant influence on the first differences of the real GDP. The numbers also indicate a probability of 95% that the ECB`s nominal interest rate and ECB`s nominal rate lagged by one year had a statistically significantly influence on the first differences of the real GDP in euro area in 1999 – 2016.

As in the previous case, in table 5 the coefficient is negative (−206394) only for the ECB's main rate lagged by one year, implying, again, that the effect of ECB interest rates lagged by one year on the first differences in real GDP in Poland was consistent with economic theory. The positive value of the coefficient for the ECB's nominal interest rate (199173) indicates that the raising of interest rates by the ECB stimulates growth of the first differences of the real GDP, which could be related to financial crisis, low interest rates and, first of all, to inflation expectations of market participants.

Table 6 also contains the regression results for the euro area. The independent variables were the nominal main ECB interest rate lagged by one year [IR_ECB_1] and the real GG deficit in the euro area [DEF_real]; the dependent variable was the first differences of the real GDP in the euro area [d_GDP_real].

Table 6 The dependent variable (Y): d_GDP_real; independent variables (X) – IR_ECB_1 and DEF_real

Variable name	Coefficient	Standard error	t- Student	p-value
Const	435728	94829,6	4,5949	0,0004***
IR_ECB_1	−36674,8	27008,1	−1,3579	0,1960
DEF_real	0,896843	0,221996	4,0399	0,0012***
Selected regression statistics and analysis of variance; n=17 observations from 2000-2016				
SD of the dependent variable 203853,9; Standard error of residuals = 145771,3				
R-square 0,552581				
F(2, 14) 8,645304 p-value for F test 0,003589				

Source: own elaboration based on [Eurostat, OECD].

An analysis of the data in table 6 leads to a conclusion that the real GG deficit had a statistically significant influence on the first differences of the real GDP in the euro area. In this case, the t-Student statistic is 4,0399 at p-value of 0,0012 (<p=0.05), meaning that in the period under consideration the real GG deficit in euro area had a statistically significant influence on the first differences of the real GDP. The numbers also indicate a

probability of 95% that the real GG deficit had a statistically significantly influence on the first differences of the real GDP in euro area in 1999 – 2016.

In the table 7 the independent variables in the analysis were the ECB's main interest rate [IR_ECB] and the nominal ECB main interest rate lagged by one year [IR_ECB_1]; the dependent variable was the GDP growth in the euro area [GDP_growth].

Table 7 The dependent variable (Y): GDP_growth; independent variables (X) – IR_ECB and IR_ECB_1

Variable name	Coefficient	Standard error	t- Student	p-value
Const	1,49188	0,472299	3,1588	0,0070***
IR_ECB	2,20163	0,354524	6,2101	<0,0001***
IR_ECB_1	−2,13887	0,373212	−5,7310	<0,0001***
Selected regression statistics and analysis of variance; n=17 observations from 2000-2016				
SD of the dependent variable 1,894109; Standard error of residuals = 1,038952				
R-square 0,736737				
F(2, 14) 19,58939 p-value for F test 0,000088				

Source: own elaboration based on [Eurostat, OECD].

An analysis of the data in table 7 leads to a conclusion that the ECB's nominal interest rate and the nominal ECB interest rate lagged by one year had a statistically significant influence on the GDP growth in the euro area. In this case, the t-Student statistics are 6,2101 and -5,7310 at the same p-values of 0.0001 (<p=0.05), meaning that in the period under consideration the ECB's nominal main interest rate and the ECB nominal main interest rate lagged by one year rate had a statistically significant influence on the GDP growth. The numbers also indicate a probability of 95% that the ECB`s nominal interest rate and ECB`s nominal rate lagged by one year had a statistically significantly influence on the GDP growth in euro area in 1999 – 2016.

The coefficient for the ECB nominal main interest rate is positive (2,20163), meaning that the Polish GDP increased following rises in the euro area's main nominal interest rate, which could have been affected by crisis phenomena and inflation expectations in the analysed period. The negative value of the coefficient (−2,13887) for the first rate indicates that the relationship between nominal interest rate of ECB lagged by one year and GDP growth was consistent with economic theory.

The results of the analysis indicate that in the sampled years instruments of monetary policy of the central bank and instruments of fiscal policy of governments in the euro area had a statistically significant   impact on basic macroeconomic variables in the euro area such as inflation, real GDP or GDP growth. As monetary policy and fiscal policy play a significant role in economies of euro area countries, the European Central Bank and governments of euro area countries need to be watched carefully for changes in their instruments.

4 Conclusions

The nominal main interest rates (as instrument of monetary policy) that in the years 1999-2016 were already relatively low in the euro area, after 2008, in the wake of the crisis, moved much closer to the zero bound (between 2009 and 2014 the main refinancing operation rate in the euro area decreased from 1.44% to 0.10%). Fiscal policy became more expansionary in that period, expanding GG deficit and debt (as instruments of fiscal policy). It seems that because of financial crisis an expansionary monetary policy was accompanied by an expansionary fiscal policy and that the economists may be right that fiscal expansion is greater during a crisis.

The analysis of interactions between the monetary authority and the fiscal authority performed in the context of low interest rates shows that the crisis caused the ECB to cut interest rates more frequently (i.e. to adopt an expansionary monetary policy) and the governments of many euro-area countries chose to stimulate

total demand using an expansionary fiscal policy that increased public deficit and debt (Stawska, 2017). The maintenance of near-zero nominal interest rates frequently prevents the use of measures counteracting deflationary shocks that affect price levels and production.

In conclusion, the objective of the article i.e. to examine the dependencies between policy mix instruments and selected economic variables in the euro area economy with regard to low interest rates, was accomplished. Furthermore, the hypothesis stating that policy mix instruments had a statistically significant impact on the euro area economy between 1999-2016, has been verified positively. The analyses confirmed that the ECB main refinancing rate (as an instrument of monetary policy) significantly statistically affected the inflation, real GDP and GDP growth in the euro area in the analysed period. In turn, real GDP deficit (as an instrument of fiscal policy) had a statistically significant impact on inflation as well as on the real GDP in the euro area between 1999-2016.

Literature:

1. ARELLANO C., CONESA J. C., KEHOE T. J.: *Chronic Sovereign Debt Crisis in the Eurozone*, 2010-2012, "Federal Reserve Bank of Minneapolis Economic Policy Paper", No. 4., 2012.
2. BADARAU C., LEVIEUGE G.: *Which policy-mix to mitigate the effects of financial heterogeneity in a monetary union*?, "LAREFI Working Paper" No. CR11-EFI/09, 2011, 2 – 3 pp.
3.BEETSMA R., DEBRUN X.: *The Interaction between Monetary and Fiscal Policies in Monetary Union: A Review of Recent Literature,* [in:] R. BEETSMA et. al., *Monetary Policy*, Cambridge, 2004. DOI 10.1017/CBO9780511492389.006.
4. BUTI M., SAPIR A.: *Economic Policy in EMU*, Clarendon Press-Oxford, 1998. ISBN 0-19-829478-6.
5. CIŻKOWICZ P., RZOŃCA A.: *Interest rates close to zero, post-crisis restructuring and natural interest rate*, "Prague Economic Papers", No.3, 2014. ISSN 1210-0455.
6.CLARIDA R., GALÍ J., GERTLER M.: *Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory*, "Quarterly Journal of Economics", 2000. ISSN 0033-5533.
7.CONESA J.C., KEHOE T.: *Gambling for redemption and self –fulling debt crises*, Staff Report from Federal Reserve Bank of Minneapolis, no. 614, 2012.
8. DIXIT A., LAMBERTINI L.: *Interactions of Commitment and Discretion in Monetary and Fiscal Policies*, Princeton University, 2003.
9. DZIAŁO J.: *Dlaczego trudno jest prowadzić "dobrą" politykę fiskalną?,* „Gospodarka Narodowa" No. 1 – 2, 2012, 36 p. ISSN 0867-0005.
10. EUROSTAT: http://ec.europa.eu/eurostat/web/national-accounts/data/main-tables; (access: 10.11.2017).
11.FOLEY D.K., SHELL K., SIDRAUSKI M.: *Optimal Fiscal and Monetary Policy and Economic Growth*, "Journal of Political Economy" vol. 77/4, 1969. ISSN 0022-3808.
12.HUGHES HALLET A., MOOSLECHNER P., SCHUERZ M.: eds. *Challenges of Economic Policy Coordination within European Monetary Union,* Dordrecht, 2001. ISBN 978-1-4757-4738-6.
13. JACQUET P., PISANI-FERRY J.: *Economic policy co-ordination in the euro-zone. What has been achieved?, What should be done?,* :Sussex European Institute Working Paper" 40/2001, 7 p.
14. KRUGMAN P.: *End the depression now!,* 2012 [in:] http://natemat.pl/20625,noblista-paul-krugman-wzywa-zakonczcie-ten-kryzys-teraz (access: 19.11.2017).
15. KUTTNER K. N.: *Kombinacja (policy mix) polityki pieniężnej i fiskalnej z perspektywy amerykańskiej*, XXII Konferencja Naukowa NBP, Reformy strukturalne a polityka pieniężna" Falenty 2002.
16. KRYŃSKA E., KWIATKOWSKI E.: *Polityka państwa wobec rynku pracy. Idee ekonomiczne i rzeczywistość,* „Polityka Społeczna" No. 5-6/2010, 2010, 6 p. ISSN 0137-4729.
17. NORDHAUS W.: *Policy Games: Coordination and Independence in Monetary and Fiscal Policies*, "Brooking Paper on Economic Activity", 1994, No.2. ISSN 0007-2303.

18. OECD: http://stats.oecd.org/index.aspx?querytype=view&queryname=170# (access: 10.11.2017).

19. ONORANTE L.: *Interaction of Fiscal Policies in the Euro Area: How Much Pressure on the EBC?* [in:] R. BEETSMA et. al., *Monetary Policy*, Cambridge, 2004.

20. RZOŃCA A.: *Kryzys banków centralnych. Skutki stopy procentowej bliskiej zera*, C.H. Beck, Warsaw, 2014. ISBN 978=83-255-5544-3.

21. SARGENT T., WALLACE N.: *Some Unpleasant Monetarist Arithmetic*, Federal Reserve Bank of Minneapolis Quarterly Review, Vol. 5, 1981, 1-17 pp.

22. SKRZYPCZYŃSKA J.: *Koordynacja polityki fiskalnej I pieniężnej strefy euro w obliczu kryzysu finansowego,* „Rocznik Integracji Europejskiej" 6/2012, p.289. ISSN 1899-6256.

23. SPILIMBERGO A., SYMANSKY S., BLANCHARD O., COTTARELLI C.: *Fiscal Policy for the Crisis*, IMF Staff Position Note, 2008/1, 2 p. https://www.imf.org/external/pubs/ft/spn/2008/spn0801.pdf, (access: 26.11.2017).

24. STAWSKA J.: *The phenomenon of low interest rates in the context of monetary and fiscal interaction (policy mix),* International Multidisciplinary Scientific Conference on Social Science & Arts 2017, Book 1: Modern Science, Economics & Tourism, Vol. IV, Bulgaria 2017, 777 – 784 pp. ISBN: 978-619-7408-16-4.

25. SUMMERS L.H.: *Fiscal Stimulus Issues, Testimony before the House Budget Committee*, Washington, 2008: http://larrysummers.com/wp-content/uploads/2012/10/1-16-08_Fiscal_Stimulus_Issues.pdf, (access: 26.11.2017).

26. SZYMAŃSKA A.: *Efekty polityki fiskalnej w warunkach niskich stóp procentowych – przegląd literatury*, „Studia Prawno-Ekonomiczne", Vol. XCIII, 2014. ISSN 0081-6841.

27. WOJTYNA A.: *Skuteczność polityki pieniężnej w warunkach niskiej inflacji: problem zerowej granicy nominalnych stóp procentowych*, „Bank i Kredyt" No. 7, 2001. ISSN 0137-5520.

28. WOODFORD M.: *Fiscal Requirements for Price Stability*, Journal of Money, credit and Banking, Vol. 33, 2001, 669-728 pp. ISSN 0022-2879.

29. WORONIECKA – LECIEJEWICZ I.: *Analiza policy-mix z uwzględnieniem interakcji decyzyjnych między bankiem centralnym a rządem i ich priorytetów*, Zeszyty Naukowe Wydziału Informatycznych Technik Zarządzania Wyższej Szkoły Informatyki Stosowanej i Zarządzania „Współczesne Problemy Zarządzania" No. 1, 2011, 39 – 60 pp. ISSN 1689-7293.

30. WORONIECKA – LECIEJEWICZ I.: *Problem wyboru policy – mix w grze fiskalno-monetarnej z zastosowaniem funkcji logistycznej*, „Studia i Materiały Informatyki Stosowanej", Vol. 4, No. 8, 2013, 29 – 38 pp. ISSN 1689-6300.

Primary Paper Section: A

Secondary Paper Section: AH