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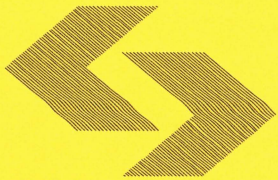

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Abstract

The presented study leads to an analysis of mutual interactions of the monetary and fiscal policies in the case of Poland. The historical policies carried on in different periods of time and their economic effects are compared with possible strategies obtained from analysis of the proposed monetary-fiscal game. In the paper methods of the noncooperative game theory are combined with macroeconomic modeling. A noncooperative monetary-fiscal game (MFG) has been formulated for players – namely monetary and fiscal authorities. Strategies of the players are defined as instruments of their policies: the real interest rate and the budget deficit in relation to GDP. Payoffs include inflation and GDP growth respectively. The payoffs are calculated using a specially elaborated recursive macroeconomic model based on the New Neoclassical Synthesis concept. The macroeconomic model describes influences of the instruments of the monetary and fiscal policies on the state of the economy. In comparison to the basic NNS model, this model describes not only a transmission of the monetary policy impulses but also influences of the fiscal policy. It takes into account the budget expenditure gap. The best response strategies and the Nash equilibria have been analyzed. It has been made for different time periods in which changes of the policies to more restrictive or more expansive to the historical ones have been assumed.

Keywords: game theory, economic modeling, policy mix, decision analysis, Nash equilibrium, Pareto optimality

JEL codes: E61, E63, C61, C72, E17

1. Introduction

The paper deals with analysis of alternative monetary-fiscal policies for Poland. The analysis is made with the use of noncooperative game describing mutual interactions of policies carried on by the monetary authority (the central bank) and the fiscal authority (the government). In the paper a respective monetary-fiscal game is formulated. A recursive dynamic econometric model for Poland is proposed. It is used to calculate payoffs of the monetary authority and the fiscal authority treated as players in the game. The model is

constructed using ideas of the New Neoclassical Synthesis (NNS) modeling including extensions describing influences of the fiscal policy. The model has been estimated using time series 2000-2014 for Poland. The paper presents simulation experiments in which results of the game are compared to the real historical policies and results of the policies in two time periods for Poland: 2004-2005 and 2008-2009.

The experiments include calculation of the best response strategies for different targets assumed by the fiscal and monetary authorities, analysis of the Nash equilibria and Pareto-optimality.

Interactions of fiscal and monetary policies are analyzed and discussed in many papers. Only selected papers dealing with monetary-fiscal games and the policy mix problems are referred here. Blinder (1983), Bennett & Loayza (2001) present prisoners-dilemma problem in simple monetary-fiscal games with 2x2 strategies and formulate arguments for coordination of the policies. Nordhaus (1994) analyzes the problem of independence versus coordination of fiscal and monetary policies using a fiscal monetary game. The game is based on a simple macroeconomic model. Starting point for further research. Dixit & Lambertini (2001), Lambertini & Rovelli (2003) – discuss problems of players' credibility and fiscal discipline. The monograph (Marszałek 2009) includes a list of selected game models describing relations between the government and the central bank. The game models are described and characterized. Wojtyna (1996), Darnault, Kutos (2005), (Stawska 2014) analyze the policy mix problem using statistical data. Libich, Nguyen & Stehlik (2014) present analysis and comparison of selected countries in so called monetary versus fiscal leadership space. Poland is located in the central part of the space.

In the case of Poland there were no publications dealing with interactions of the fiscal and monetary policies analyzed with the use of computational game models. It was a motivation to start the respective study by the authors. This paper continues the research direction presented in the previous papers: (Kruś, Woroniecka-Leciejewicz, 2015, 2016, 2017; Woroniecka-Leciejewicz, 2016, 2015a, b, 2010, 2008, 2007). This paper is organized as follows. The next section 2 presents formulation of the propose noncooperative monetary fiscal game. The proposed recursive macroeconomic model is described in section 3. Section 4 presents results of the model estimation. Simulation experiments for Poland in periods 2004-2005 and 2008-2009 are presented in Section 5. It includes examples of simulation runs and analysis of the proposed monetary-fiscal game. Section 6 concludes the obtained results.

2. Noncooperative monetary fiscal game

Relations between the fiscal authority and the monetary authority can be described by a noncooperative, static, deterministic game. It is a single stage, deterministic, non-zero sum, perfect information game played by the central bank and the government. Each player takes decision independently taking into account possible reaction of the counter player. The game is defined in the strategic form as follows:

(i) There are two players i=1, 2: the fiscal authority (the government) and the monetary authority (the central bank).

(ii) For each player a set Ω^i of pure strategies is defined. The strategies of the fiscal authority are those of the budgetary policy – from the extremely restrictive to the extremely expansive. The measure, denoted by b, of the degree of restrictiveness/expansiveness of the fiscal policy is constituted here by the level of budget deficit in relation to GDP. The strategies of the monetary authority range from the extremely restrictive one to the extremely expansive. The degree of restrictiveness/expansiveness is equivalent simply to the value of the real interest rate and denoted by r. Let Ω denote the Cartesian product of the sets of the strategies $\Omega = \Omega^1 \times \Omega^2$.

(iii) For each player i=1, 2, a function h^i: $\Omega \rightarrow \boldsymbol{R}$ is given defining outcome of the player i for given strategies undertaken by the both players. The outcome of the fiscal authority is measured by the GDP growth rate, denoted by y, where $y=h^1(b, r)$. In the case of the monetary authority it is the inflation value, denoted by p, where $p=h^2(b, r)$. The functions h^i, i=1, 2, are defined by the model relations.

(iv) For each player i=1, 2, a preference relation is given in the set of the attainable outcomes. It is assumed here that each authority tries to achieve a given goal: the fiscal authority – a desired value of GDP growth, the monetary authority – a desired value of inflation.

Outcomes of the game in the discrete form are presented in table 1. Payoffs in the table are denoted in the following manner: y_{ij} – payoff of the fiscal authorities (GDP growth rate) in the case where the government applies the fiscal strategy F_i and the central bank applies the monetary strategy M_j; p_{ij} – cost to the monetary authorities (inflation) for the same pair of policies. The symbol b_i denotes the budgetary deficit in relation to GDP, corresponding to the i-th fiscal strategy, while r_j denotes the real interest rate, ascribed to the j-th monetary strategy.

It is assumed that the fiscal and monetary authorities take decisions independently, and the Nash equilibrium state in such a game is identified with the choice of a given combination of the budgetary and monetary policies.

Table 1. The monetary-fiscal game – table of payoffs

		Central bank – the monetary policy ← restrictive … expansive →			
	Strategies	Monetary strategy M_1 (interest rate r_1)	Monetary strategy M_2 (interest rate r_2)	…	Monetary strategy M_n (interest rate r_n)
Government – fiscal policy ← expansive restrictive →	Fiscal strategy F_1 (budgetary deficit b_1)	p_{11} / y_{11}	p_{12} / y_{12}	… / …	p_{1n} / y_{1n}
	Fiscal strategy F_2 (budgetary deficit b_2)	p_{21} / y_{21}	p_{22} / y_{22}	… / …	p_{2n} / y_{2n}
	…			…	
	Fiscal strategy F_m (budgetary deficit b_m)	p_{m1} / y_{m1}	p_{m2} / y_{m2}	… / …	p_{mn} / y_{mn}

3. Recursive econometric model

The presented model, used to analyze the discussed monetary-fiscal game is a recursive macroeconomic model based on the New Neoclassical Synthesis (NNS) concept. In comparison to the basic NNS model (compare Gali, 2009) the proposed model takes additionally into account effects of the fiscal policy – influence of the real budget expenditures. An equation of the output gap is introduced. The equation of the interest rate (Taylor rule) is removed but an additional equation describing expected inflation is introduced. The interest rate is a decision variable in this model, changed in simulations.

3.1 Equation of the output gap (dynamic, inter-period version of the IS curve)

The equation describes an aggregated demand as the result of the optimal decisions made by a representative consumer.

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \alpha_2 (r_t - \pi_t^e - r_t^n) + \alpha_3 g_t + \varepsilon_{1t}, \qquad (1)$$

where:

$x_t = y_t - y_t^n$ - production gap x_t defined as a difference of the current real production y_t and its natural level $y^n{}_t$ in the equilibrium state with the perfectly elastic prices,

$r_t - \pi_t^e - r_t^n$ - interest rate gap i.e. deviation of the real interest rate from its natural value r_t^n; real interest rate is calculated as the difference: the nominal interest rate r_t (WIBOR 1M) minus the expected inflation π_t^e

$g_t = G_t - G_t^n$ - gap of the budget expenditures, deviation of the real budget expenditures G_t from its natural value $G^n{}_t$.

The production is measured by the real Gross Domestic Product (GDP). A current value of the production gap depends on its delayed value and on the interest rate gap, where the interest rate gap is defined as the difference of the real interest rate and its natural level r_t^n.

The natural level of the product as well as the natural interest rate r_t^n and the expenditures $G^n{}_t$ have been calculated using the Hodrick–Prescott filter.

3.2. Inflation equation

The equation is known as the New Keynesian version of the Phillips curve. It presents a function of the aggregated supply based on price decisions of firms in the conditions of imperfect competition (Calvo, 1983). Inflation depends on the expected inflation π_t^e and on the output gap x_t. The equation has the form:

$$\pi_t = \beta_0 + \beta_1 \pi_{t-1}^e + \beta_2 x_t . \tag{1}$$

3.3. Equation of the expected inflation

The expected inflation is explained by its delayed value and by the current inflation. The equation has the form:

$$\pi_t^e = \delta_0 + \delta_1 \pi_{t-1}^e + \delta_2 \pi_t . \tag{2}$$

4. Model estimation

Time series for the Polish economy from the period of years 2000-2014 (quarterly data) have been used in estimation.

Table 2. The variables used in the model estimation

Variable	Description
output_gap	The output gap is defined as the difference between the real GDP and the natural level of output presented by the Central Statistical Office in time series according to the principles of the "European System of National and Regional Accounts" (ESA); GDP in constant prices. The natural level is calculated using the Hodrick–Prescott filter.
output_gap_1	The output gap, one period delayed
inflation	Inflation calculated on the basis of the consumer price index
expected_infl	Expected inflation measured as the average inflation level expected in the next year (NBP, Ipsos data)
expected_infl_1	Expected inflation, one period delayed
WIBOR_gap	The interest rate gap measured on the basis of WIBOR 1M. The interest rate WIBOR 1M, nominal, at the beginning of each period (data from Money.pl (http://www.money.pl/))
expend_gap	The gap of the expenditure of the public sector

The statistical data have been collected from the following sources: Central Statistical Office of Poland, National Bank of Poland (NBP), Ipsos group. The NNS-MFG model has been estimated as a system of simultaneous equations using the Three-Stage Least Squares Method (3SLS) in the econometric GRETL package.

The estimation results show an acceptable goodness of fit. All the variables are statistically significant. The results are presented in the following tables and in figure 1.

Equation 1: Estimation 3SLS, observations 2001:1-2014:4 (N = 56)
output_gap = 0.0274 + 0.6853 output_gap_1 - 0.4343 WIBOR_gap + 0.1353 expend_gap
(0.1195) (0.0841) (0.1241) (0.0622)
R-squared 0.647118 Adjusted R-squared 0.624743

	coefficient	std. error	z	p-value	
const	0.0272869	0.119475	0.2284	0.8193	
output_gap_1	0.693819	0.0840444	8.255	1.51e-016	***
WIBOR_gap	-0.424272	0.124742	-3,401	0.0007	***
expend_gap	0.137646	0.0620940	2.217	0.0266	**

Equation 2: Estimation 3SLS, observations 2001:1-2014:4 (N = 56)
inflation = 0.5510 + 0.7670 expected_infl_1+ 0.3755 output_gap
(0.1908) (0.0584) (0.0937)
R-squared 0.759751 Adjusted R-squared 0.750686

	coefficient	std. error	z	p-value	
const	0.520982	0.190795	2.731	0.0063	***
expected_infl_1	0.766939	0.0583543	13.14	1.87e-039	***
output_gap	0.375516	0.0936751	4.009	6.11e-05	***

Equation 3: Estimation 3SLS, observations 2001:1-2014:4 (N = 56)
expected_infl = - 0.1994 + 0.1748 expected_infl_1 + 0.8673 inflation
(0.1026) (0.0607) (0.0773)
R-squared 0.941506 Adjusted R-squared 0.939298

	coefficient	std. error	z	p-value	
const	-0.159371	0.102611	-1.553	0.1204	
expected_infl_1	0.174756	0.0607436	2.877	0.0040	***
inflation	0.867254	0.0773378	11.21	3.49e-029	***

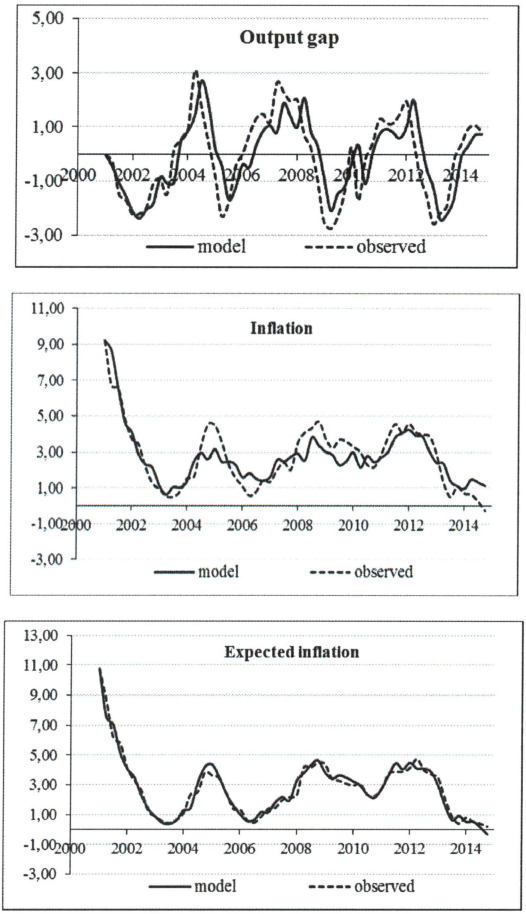

Figure 1. Estimation results

5. Simulation experiments

5.1. Simulation assumptions

The output variables are calculated using the proposed model since 2001 according to statistical data for Poland.

In a selected period an impulse changing the policy mix is introduced. The instruments of the policy mix, i.e. real interest rate and the budget deficit in relation to GDP are assumed as a given deviation in % points from the historical levels in this period of time. Effects of the

changed policy mix are measured by average annual production growth and average annual inflation in the period of 8 quarters since the introduced changes in the policy mix.
Payoffs of players have been calculated for different values of the strategies changed in assumed intervals: the interest rate has been changed in the interval [2%, -2%] points and the budget deficit in relation to GDP – also in the interval [-2%, 2%] points in comparison to the historical ones.

The simulation analysis of results have been made for two different periods: 2004-2005 – period of prosperity and for the recession period 2008 – 2009.
The period 2004- 2005 has been assumed in the simulations as an example of the time of economic recovery in Poland. The GDP growth rate in 2004 was 5.4%. The Polish economy developed more than 2 times faster than EU-25 countries. The GDP growth rate, very high 7% in the first quarter decreased in the last quarter to ca 4%. The growth noted in the first and second quarter of the year was effect of the accession of Poland to EU and the associating increase of demand.

Inflation in Poland in 2004 was under influence of prices related to the accession to EU as well as to the prices' of raw materials, growing on the word markets. Especially the growth of prices of food and crude oil had been observed. In June 2004 inflation exceeded the upper limit of the inflation target. The increase of inflation was accompanied by inflation expectation. It was a risk that the budget deficit can exceed the 2-nd save limit (55% of GDP). The Council of Monetary Policy at the National Bank of Poland (NBP) had decided in 2004 to pursue a more restrictive monetary policy.

Average inflation in 2005 was 2.1%. It was lower than it was assumed in all internal forecasts previously prepared in 2004 and 2005. It was effect of the decrease of inflation temporary raised after accession of Poland to EU and of strong appreciation of polish currency (PLN) in 2004. Additionally the real budget deficit of public finance was lower than previously forecasted. Finally the interest rates could be decreased to the level assumed before the increase undertaken in 2004. While in the first part of 2015 the economic recovery was lower than expected, in the last months of the year a distinct recovery was observed and inflation was lower than expected. It allowed to pursue a soften monetary policy.

In 2008 the Polish economy was under high perturbation observed on the world markets. A global financial crisis revealed in this year initiated by the subprime mortgage crisis in US. In the first half of the year the Polish economy was in a high growth. A dynamic growth of consumption and investments was observed. In the second part of the year the increasing

word crisis had effected limitation of investments in Poland. The recession in EU, especially in Germany which is the most important trade partner for Poland, resulted in a decrease of the GDP growth in Poland. The inflation processes in Poland were determined mainly by the world factors. A growth of food prices and prices of energy was observed. In 2009 the monetary policy in Poland was pursued in the conditions of recession of the world economy. Since the second quarter of the year an improvement of the economic situation curbing the recession on the world financial markets was observed.

The Polish economy was relatively resistant on the world economic crisis. Poland was a unique EU country having positive GDP growth in 2009, however the growth decreased to 1.8% from 5.0% in 2008. The slowdown of economic processes was accompanied by a decrease of employment. The slowdown made worse the situation of public finance sector. The budget deficit in relation to GDP increased two times reaching 7.1% in 2009. The Consumer Price Index in this year was 3.5%, i.e. 0.7 % point lower than in 2008. It was on the upper level of deviations from the inflation target of NBP. The raised CPI in 2009 was an effect of increasing VAT rates and administrative prices as well as the depreciation of PLN in the period July 2008 till February 2009.

5.2. Alternative variants to the historical policy mix: more expansive and more restrictive

Three variants (changes of the policies: during 2 years (8 quarters) starting from the first quarter of 2008 are considered:

1. A policy more expansive than the policy historically implemented. Real interest rate was assumed 1 percent point lower and the budget deficit in relation to GDP – 1 percent point greater than the historical values.
2. A policy more restrictive than the historical policy. Real interest rate was assumed 1 percent point grater and the budget deficit in relation to GDP – 1 percent point lower than the historical values.
3. A neutral policy, when the instruments were assumed on the historical level.

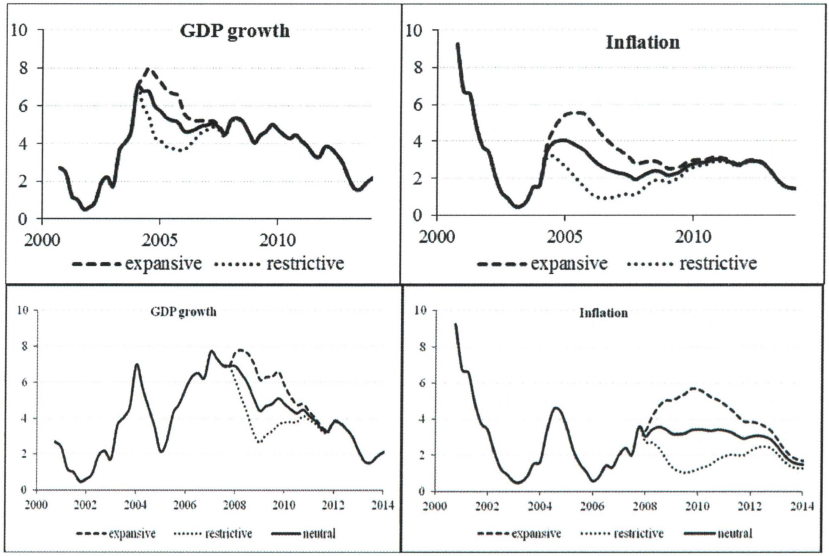

Figure 2. Alternative variants to the historical policy mix in 2004-2005 (upper) and 2008-2009 (lower): more expansive and more restrictive

It can be observed that effects of the introduced changes of the policies are temporary, shorter in the case of the GDP growth and longer in the case of inflation. The more expansive policy mix results in a greater GDP growth and in a greater inflation in comparison to the neutral path. The effects of the more restrictive policy are reverse.

5.3. Game payoffs dependent on the strategies

Figures 3 and 4 present the outcomes of the authorities, as dependent on assumed changes of strategies for the period 2008-2009. Inflation (figure 3) can be obtained on a low level when a restrictive monetary policy and a restrictive fiscal policy are applied. More expansive monetary and fiscal policies lead to an increase of inflation and of the economic growth. On the other hand more restrictive monetary and restrictive fiscal policies lead to a decrease of inflation and of the economic growth (figure 4).

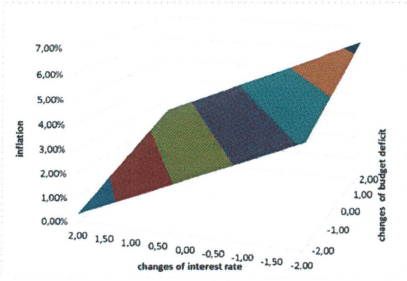

Figure 3. Outcomes of the monetary authority

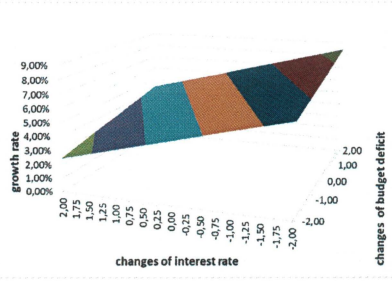

Figure 4. Outcomes of the fiscal authority

5.4. The optimal (best response) strategies

Let the fiscal authority try to achieve the GDP growth rate on the level y^g, and let the monetary authority assume the inflation goal on the level p^g.

Let Ω denote the set of admissible pairs (b, r) of strategies.

The respective best response strategies can be obtained as solutions of the optimization problems:

$$\text{Min } |h^1(b, r) - y^g|$$

with respect to the budget deficit $b \in \Omega^1$ solved for all the interest rates $r \in \Omega^2$, in the case of the fiscal authority and

$$\text{Min } |h^2(b, r) - p^g|$$

with respect to $r \in \Omega^2$, solved for all $b \in \Omega^1$, in the case of the monetary authority.

Examples of the best response strategies derived for different targets of the authorities are presented in the following figures for two analyzed periods: 2004-2005 (figure 5) and 2008-2009 (figures 6 and 7) . Figure 5, the left part (case a) presents the best response strategies of the fiscal authority for the three different targets: GDP growth = 4.5%, 4.75%, 5%, and the best response strategy of the monetary authority for the target: inflation = 2.5%. Figure 5, the right part (case b) presents the best response strategies of the monetary authority for the three different targets: inflation = 2%, 2.5%, 3% and the best response strategies of the monetary authority for the targets: GDP growth = 4.75% and 5.5%. The Nash equilibria which are Pareto optimal in the assumed interval of the policies' instruments are shown.

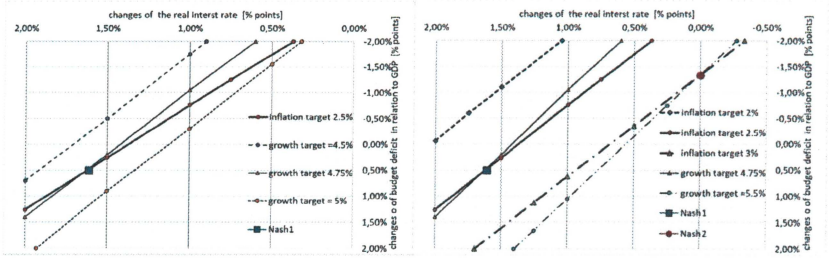

Figure 5. The best response strategies of the authorities (period: 2004-2005): (a - left) for different fiscal targets and the monetary target – inflation = 2.5%; (b - right) for different monetary and fiscal targets

It can be observed how the level of restrictiveness/expansiveness of the monetary policy depends on the level of restrictiveness/expansiveness of the fiscal policy. A more expansive fiscal policy leads to a more restrictive monetary policy taken by the central bank trying to limit inflation excessing the inflation target. If the budget deficit is higher, then the required inflation is obtained for respectively higher interest rates. Analogously, if the government carries out a more restrictive budget policy, then the central bank will apply a less restrictive (more expansive) monetary policy with relatively lower interest rates.

On the other hand a more restrictive monetary policy causes in reaction a more expansive budget policy. If the interest rate is higher, then the required growth rate can be achieved by applying a more expansive fiscal policy supporting a higher growth rate. That means the government should assume a relatively greater budget deficit. Inversely the government can implement more restrictive fiscal policy limiting the budget deficit in reaction on a more expansive monetary policy.

The simulation results show how changes of the targets of fiscal and monetary policies influence on the best response strategies and on the Nash equilibrium state, i.e. on the choice of the respective policy mix. More ambitious target of fiscal policy with a high required economic growth causes that the best response budget strategy moves into more expansive one and vice versa in the opposite case. The higher inflation targets assumed by the monetary authority cause that the best response strategies of the central bank move into more expansive monetary policies. In the opposite case, of the lower inflation target, the best response monetary policy moves into a more restrictive one. Changes of the targets assumed by the fiscal and monetary authorities result in respective positioning of the Nash equilibrium.

There are two cases of the best response strategies in the considered game. The first when the best response strategies cross in the set of admissible strategies, and the second when they do

not cross in this set. The cross point in the first case defines the Nash equilibrium. One can easily see that a deviation of any strategy from the point leads to a worse payoff of the respected player (Nash, 1951). The results at the Nash equilibrium (Nash1): inflation 2.5% and GDP growth 4.75% are better than the historical ones: inflation 2.8% and GDP growth 4.4%.

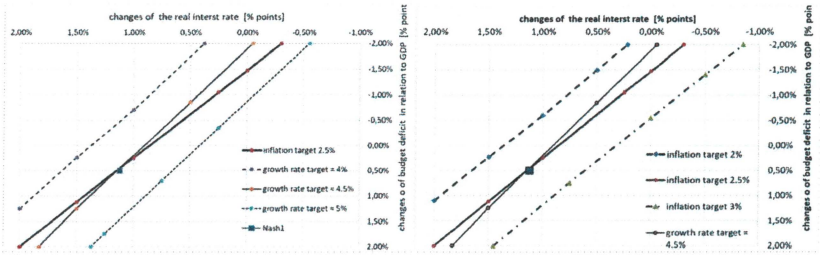

Figure 6. The best response strategies of the authorities (period: 2008-2009): (a - left) for different fiscal targets and the monetary target – inflation = 2.5%; (b - right) for different monetary targets and the fiscal target – growth rate = 4.5%

Similar observations can be find analysing the simulation resuts for the period 2008-2009.

The more expansive fiscal policy leads to the more restrictive monetary policy taken by the central bank trying to limit inflation excessing the inflation target. If the budget deficit is higher, then the required inflation is obtained for respectively higher interest rates. Analogously, if the government carries out the more restrictive budget policy, then the central bank will apply a less restrictive (more expansive) monetary policy with relatively lower interest rates. On the other hand the more restrictive monetary policy causes government to choice more expansive fiscal policy end vice-versa. The lines cross for selected targets only.

The calculated Nash equilibrium: 2.5% inflation and 4.5% growth rate is better than the historical: inflation3.8% and growth rate 3.3%.

In figure 7 arrows illustrate actions of the authorities realizing the best response strategies. The case (c) illustrates too ambitious targets of the authorities. The lines presenting the strategies have not any joint point in the considered set of instruments. It means that the both targets cannot be satisfied simultaneously. The final state exists for the combination of the most restrictive monetary policy and the most expansive fiscal policy. In the case (d) another example of the targets is shown. The final state is in this case at the most expansive monetary and the restrictive fiscal policy. The real Nash equilibria in the area of admissible intervals of instruments are not Pareto optimal.

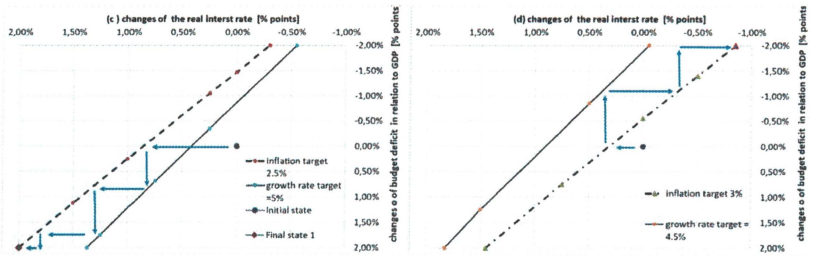

Figure 7. The best response strategies: (c) for the targets: growth rate = 5% and inflation = 2.5%; (d) for the targets: growth rate = 4.5% and inflation = 3%

6. Final remarks

The paper presents selected results obtained within the research dealing with analysis of interactions of the fiscal and monetary policies with application of the game theory and the optimization tools.

A dynamic macroeconomic model has been proposed. It describes influences of the instruments of the monetary and fiscal policies on the state of the economy i.e. influences of the real interest rate and of the budget deficit on inflation and GDP growth. The model have been estimated for the Polish economy 2000-2014.

A monetary-fiscal game has been formulated and analyzed in which monetary and fiscal authorities are treated as players. The model relations enabling calculation of players payoffs have been implemented in the form of a computational algorithm. The algorithm is a part of a computer-based system used for simulations and analysis of the game in an interactive way. The system calculates: payoffs as dependent on strategies of the players, the best response strategies, Nash equilibria, Pareto optimal outcomes.

The simulations which have been made include calculations of effects of the policies alternative to the historical ones, more expansive and more restrictive as well as derivation of the best respond strategies for different targets of the authorities. The historical policies carried on in different periods of time and their economic effects are compared with possible strategies obtained from analysis of the proposed monetary-fiscal game. The simulations have been made for two periods of time: the time of economic expansion 2004-2005 related to the accession of Poland to EU and the period of global economic crisis 2008 – 2009.

The simulations include different moderate as well as ambitious targets of the authorities. Possible Nash equilibria have been derived. The computational results

show typical cases when the Nash equilibrium in the game is or is not Pareto optimal. It is shown that very ambitious targets of the authorities, i.e. too high target of the growth rate with respect to the inflation target of the Polish Central Bank (NBP) may lead in the game to extreme policies of the authorities: a very restrictive monetary policy and a high expansive fiscal policy. The best respond strategies do not cross in the interval of reasonable values of instruments and the respective Nash equilibrium is not Pareto optimal. It has been shown that respective coordination of the policies could lead to better results than the historical ones. In the period 2004-2005 the coordinated monetary and fiscal policies could lead to the Nash equilibrium with inflation 2.5% and GDP growth 4.75% which are better than the historical ones: inflation 2.8% and GDP growth4.4%. In the period 2008-2009 the calculated Nash equilibrium: inflation 2.5% and growth rate 4.5% is better than the historical: 3.8% inflation and 3.3% growth rate. Let us see the better results have ben obtained not only for the recession period 2008 –2009 but also for the period of prosperity 2004 – 2005.

The methodology proposed in the paper may support looking for the Pareto-optimal consensus of the authorities in the policy-mix problem. It can be checked when the targets assumed by the fiscal and monetary policies lead to the Pareto-optimal Nash equilibrium.

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