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# Distortionary effects of economic crises on policy coordination in Turkey: Threshold GMM approach[1]

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**Abstract**: This study investigates the interaction between fiscal and monetary policies and how crises affect the coordination between policymakers in Turkey. This study's novelty is that a nonlinear Taylor rule indicating monetary policy response function is estimated based on the Threshold Generalized Method of Moments (Threshold GMM) methodology over the period January 2006—March 2020. The empirical findings reveal that when fiscal policy has an expansionary stage, especially in crises times, the policy interest rate does not react significantly to the inflation gap, output gap and real effective exchange rate gap in expansionary periods. On the contrary the policy interest rate gives statistically important responses to these variables during contractionary fiscal policy periods. Thus, the effectiveness of the Taylor rule appears in a period of contractionary fiscal policy. This situation gives rise to the significant policy implication that the monetary policymaker's success in controlling inflation increases with the contractionary fiscal policy. Finally, it has been observed that effective coordination between monetary and fiscal policies did not occur during crisis periods, but compatible coordination was achieved in other periods.

**Keywords:** economic crises, fiscal policy, monetary policy, nonlinear econometric model, policy coordination, Threshold GMM.

**JEL codes:** E52, E61, E63, E51, C13.

## Introduction

Policymakers play an active role in reestablishing macroeconomic stability during economic crises (Kitrar & Lipkind, 2021; Żak & Garncarz, 2020). Since the early 1980s coordination has become more critical to examine central banks' and governments' role and the relationship between monetary and fiscal poli-

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cymakers (Abdel-Haleim, 2016; Afonso, Alves, & Balhote, 2019). During the recent global financial crisis in 2008 central banks and governments had to coordinate the operation of fiscal and monetary policies to prevent the slowdown of economic activities (Jawadi, Mallick, & Sousa, 2016; Frascaroli, Oliveira, & Almeida, 2019). However, the differentiation of policymakers' primary goals can lead to difficulties in providing policy coordination or even a policy conflict. Economic decisions of the central bank about price stability and government responsibility and borrowing require an understanding of the coordination between monetary and fiscal policy decisions (Arby & Hanif, 2010; Stawasz-Grabowska, 2020). Therefore, policies realized in line with various goals often affect each other. These different goals explain why the government and central bank have trouble coordinating their decisions or why coordination has never been achieved (Stawska, Malaczewski, & Szymańska, 2019; Büyükbaşaran, Çebi, & Yılmaz, 2020). Coordination between fiscal policy and monetary policy means that there are regulations to ensure that fiscal and monetary authorities' decisions are not contradictory; if a policymaker decides it will not affect other policy objectives indirectly (Abdel-Haleim, 2016).

The policy coordination needs to recognize that monetary and fiscal policy regulations take place in different time horizons. Typically, it takes a long time to alter the fiscal policy stance, but it is possible to make monetary policy adjustments daily. In such a case any fine-tuning in stabilization policies is only possible with the intervention of monetary policy. Hence, thanks to policy coordination, the commitment of policy makers to the jointly determined target is ensured and thus the problem of time lag in the formulation of fiscal policy is overcome (Laurens & Piedra, 1998). Lack of coordination in economic policies often leads to ineffective macroeconomic stability (Demid, 2018). In the macroeconomic environment where coordination between the monetary and fiscal policy is weak, fiscal policy will affect the monetary policy's effectiveness. It could weaken the central bank's credibility and transparency making an overall macroeconomic program less consistent. Coordination helps once again to avoid any problem with credibility. Besides these fiscal deficits, high-interest rates, inflation, low investment, and growth can be the main adverse effects (Arby & Hanif, 2010; Arestis, Şen, & Kaya, 2019; Guler, 2019a). Therefore, it is essential to ensure close coordination among decision-makers in monetary and fiscal policies.

It is seen that economists have disagreements on the solutions put forward on how to ensure policy coordination. Many economists consider that monetary policy-based stabilization policies are more effective in ensuring macroeconomic stability. Moreover, together with fiscal policies, fiscal variables' effects on other macroeconomic variables are generally ignored. Economists who do not support the same opinion think that fiscal policy instruments have a higher control power than monetary policy instruments (Cevik, Dibooglu, & Kutan, 2014). Therefore, it is essential to restore macroeconomic stability and

both policymakers play an active role. Another point about economic policies is the distinction between rules-based monetary policy and discretionary monetary policy, debated in economic literature since the 1970s (Dixit & Lambertini, 2001). The discussions of the economic policy implementation process are carried out in two points: following specific rules or determining them according to the situation. These discussions are about which policy is more effective in achieving macroeconomic stability. Under discretionary policies monetary authorities are entirely free to act on their judgment. The rule-based policy is a systematic decision-making process that uses information predictably and consistently. Nevertheless, even though the debate on discretionary policies and rule-based policies is by no means settled, discretion rather than rules-based policies has become more popular for policymakers to guide actual economic policy. Moreover, rule-based policies, referred to as "rulebooks," are not often implemented during a financial crisis (Taylor, 2013).

The recent Turkish economy provides a rich environment in monetary and fiscal policy coordination that is interesting to examine. The coordination of monetary and fiscal policies has been one of the main objectives in ensuring macroeconomic stability in the Turkish economy since 2001. Moreover, as required by the disinflation policy implemented after the 2001 financial crisis, tight monetary and fiscal policy have become essential tools to control inflation. As a result, Turkey reduced the inflation rate from two-digit numbers to single-digit numbers in 2004, decreased the budget deficit to GDP ratio, debt to GDP ratio, and maintained sustained economic growth due to intense and coordinated monetary and fiscal policies.

However, the adverse effect of the global financial crisis in 2008 caused a contraction in economic activities, which brought about the implementation of an expansionary fiscal policy and a moderately loose monetary policy. Moreover, the targeted inflation rate of 5% has been continuously missed for a long time and the inflation target has not been achieved except in 2009 and 2010. After the global financial crisis, a new macroprudential policy tool has considered financial stability on the monetary policy side. On the fiscal policy side, the task of reducing the adverse effects of the factors that threaten economic growth in the light of political instabilities (such as the frequent general elections, the effects of the Syrian civil war and subsequent migration, regional and international terrorist acts and the failed military coup attempt) come to the fore. Finally, the Turkish economy has reached a severe economic crisis with the exchange rate depreciation shock in August of 2018. At this point Turkey's monetary and fiscal policies have been currently implemented under macroeconomic instabilities such as high inflation, low economic growth below the historical average, excessive exchange rate volatilities and higher interest rates. Moreover, while high inflation has ceased to be a macroeconomic issue worldwide and has reached low levels the Central Bank of the Republic of Turkey (CBRT) has failed to control inflation and achieve its targets.

From this point of view and considering that coordination with fiscal policy plays an essential role in achieving price stability and sustainable economic growth levels, this study investigates how the coordination between monetary and fiscal policymakers is affected during economic crises. Furthermore, it aims to reveal the periods when policymakers prioritize their own goals in case of possible policy conflict. The study differs from other studies on the Turkish economy in two points and contributes to the literature. First, unlike previous studies on the Turkish economy, a Taylor rule is examined considering fiscal policy's stance which allows for understanding policy coordination. Second, the monetary and fiscal policy coordination is estimated using a nonlinear model through the Threshold Generalized Moments Method (Threshold GMM).

The rest of the study is organized as follows. The first section presents the existing literature on the relationship between monetary policy and fiscal policy coordination. The second section gives detailed information about the estimated model, methodology, and data used in this paper. The third section discusses the empirical findings and finally, the conclusions are presented in the last section.

## 1. Literature review

The interaction between monetary and fiscal authorities and the necessity of better coordination to ensure macroeconomic stability has been emphasized in many studies on both developed and developing countries (Cevik et al., 2014; Abdel-Haleim, 2016; Arora, 2018; Demid, 2018; Petrevski, Trenovski, & Tashevska, 2019; Stawska et al., 2019). Most of these studies reveal the contribution of coordination in monetary and fiscal policies to the stability of macroeconomic variables such as economic growth, employment and inflation in both developed and developing countries (Ćorić, Šimović, & Deskar-Škrbić, 2015; Jawadi et al., 2016). The literature also shows that economic unions significantly affect the coordination in monetary and fiscal policy. Afonso and others (2019) provide new information on how institutional arrangements such as the Maastricht Treaty significantly affect the monetary union's coordination by examining monetary and fiscal policy coordination for 28 EU countries. For example, it shows that when governments achieve high levels of public debt or budget deficits, the central bank takes a slightly more dominant position to face the financial problem. These results reveal the substitution relationship between both policymakers. In a recent study, Stawska, Malaczewski, Malaczewska and Stawasz-Grabowska (2021) examine the interaction for monetary and fiscal policy in the Nash equilibrium framework, a non-cooperative game between the central bank and government for three EU countries such as Czechia, Hungary, and Romania. The study reveals that in Romania, the government's response

to changes in interest rates is the highest, while the central bank's response to changes in the budget deficit is the smallest. They also show that Hungary has the strongest central bank 's response to significantly adjust interest rates because of changes in the budget deficit.

Fetai (2013) investigates monetary and fiscal policy's effectiveness by examining 83 financial crises experienced in 66 developing countries. The findings reveal that fiscal policy is a more effective tool than monetary policy in times of financial crisis. It is also shown that a macroeconomic policy consisting of a discretionary fiscal policy and neutral monetary policy is likely to reduce output costs in these countries during the financial crisis. Gomes de Silva and Vieira (2014) examined the monetary and fiscal policy coordination in 113 developed and developing countries for 2001–2012, before and after the 2008 global financial crisis. The findings show that monetary policy can be countercyclical, but fiscal policy is in the same direction as the conjuncture. However, the financial crisis shows that both policies were used in a coordinated manner, especially at the crisis's onset.

Some studies in the literature show that the lack of coordination between monetary and fiscal policy strengthens macroeconomics instability and the crises experienced. Elhendawy (2019) explores how the coordination between fiscal and monetary policies in Egypt is effective. The findings show that budget deficits create inflation, significantly hindering monetary policy's success and causing macroeconomic instability. Arora (2018) examines the coordination between monetary and fiscal policy in India and reveals that fiscal policy does not act accordingly and reduces its effectiveness when monetary policy becomes active. Tule, Onipede and Ebuh (2020) investigate the degree of policy coordination between monetary and fiscal policy and how this coordination has contributed to the formation of macroeconomic stability in Nigeria. The study shows that monetary and fiscal policies when used in a coordinated manner rather than divergence measures, could inspire economic growth without threatening price stability. Recently, Liu, Sun and Chang (2021) examine the monetary-fiscal policy interactions using data from China to understand the role of policy coordination in determining the business cycles in the largest emerging economy. The study demonstrates that the best policy transmission mechanism works under the passive monetary and active fiscal policy combination, also called a fiscal dominance regime. Moreover, the effect of fiscal policy shocks under that regime on inflation and output fluctuations is substantially valid in short- and long-term periods.

The studies on the coordination of monetary and fiscal policy in the Turkish economy are relatively limited to developed countries. Aktaş, Kaya and Özlale (2010) show that public debt affects monetary policy's power in countries implementing inflation targeting. They also reveal that an increase in the risk premium may cause the price level to rise when the central bank follows a tight monetary policy, and fiscal policy substantially contributes to the monetary

policy's success. Cukadar and Algan (2018) show that Turkey's monetary policy and fiscal policy coordination could not be achieved even during the crisis years. Tetik and Ceylan (2017) show that there is a conflict between the monetary and fiscal policymakers in the Turkish economy, especially in some periods. They state that the coordination problem created by this conflict is affecting social welfare negatively. Çoban (2015) examines the impact of coordination between monetary and fiscal policies on macroeconomic stability. The findings obtained from the study show that the strong relationship between inflation targeting and fiscal discipline and the continuation of both practices will be beneficial. It is also revealed that slack in the fiscal discipline would negatively affect the success of inflation targeting. Arestis and others (2019) state that there should be coordination between monetary and fiscal policies to increase the fiscal policy's performance. Tetik and Ceylan (2016) show that the central bank implements a narrowing monetary policy in the face of positive demand and adverse supply-side shocks, while the financial authority applies an expansionary fiscal policy. Therefore, it is emphasized that a negative supply shock may lead to a policy conflict between monetary policy and fiscal policy. Guler (2019b) reveals that obtaining the central bank's real independence is very important for ensuring policy coordination more effectively. The study also suggests that communication between the central bank and the debt management authority should be strengthened for a successive policy coordination.

## 2. Model, methodology, and data

In this study, the monetary policy response function is taken as a basis to analyze the interaction structure between the monetary policymaker and the fiscal policymaker. By estimating the nonlinear structure of the monetary policy response function according to the variable representing the fiscal policy (threshold variable), the policy interaction structure will be revealed. In this model, fiscal policy stance is defined according to the threshold value. When the expansionary and contractionary regime periods of the fiscal policy are obtained, the reaction behavior of the monetary policy in these regime periods is estimated and interaction fiction is provided. Now a Taylor rule model to represent the response function of the monetary policymaker is considered. It is used the Generalized Methods of Moment (GMM) to estimate the Taylor rule (Tamasauskiene & Žičkienė, 2021). Clarida, Gali and Gertler (1998) suggest the following equation to estimate the model:

$$i_t = \beta_1 + \beta_2 i_{t-1} + \beta_3 \sum_{k=1}^{3} (E_{t-1}\, \pi_{t+k} - \pi^T) + \beta_4 \sum_{k=1}^{3} (E_{t-1}\, y_{t+k}) + \beta_5 \sum_{k=1}^{3} (E_{t-1}\, rer_{t+k}) + \varepsilon_t \quad (1)$$

where $i_t$ is the policy rate $\pi_{t+k}$ represents inflation rate, $\pi^T$ is inflation target, $y_{t+k}$ and $rer_{t+k}$ are output gap and real effective exchange rate gap. In addition, $E_t$ is the expectation operator. In equation (1), the 3-month lead average is utilized for these variables in the estimation to measure the response of Taylor rule as in Martin and Milas (2013) and Caporale, Helmi, Çatık, Ali and Akdeniz (2018).

A nonlinear form of the monetary policymaker response function in equation (1) is used to analyze the interaction between the monetary policymaker and the fiscal policymaker. To obtain the threshold model equation (2) is formed, as in Taylor and Davradakis (2006) and Martin and Milas (2013):

$$\begin{aligned} i_t = {} & D(FPS_{t-1} \le FPS^*) \\ & \left[ \alpha_1^E + \alpha_2^E i_{t-1} + \alpha_3^E \sum_{k=1}^{3} (E_{t-1}\pi_{t+k} - \pi^T) + \alpha_4^E \sum_{k=1}^{3} (E_{t-1} y_{t+k}) + \alpha_5^E \sum_{k=1}^{3} (E_{t-1} rer_{t+k}) \right] + \\ & + D(FPS_{t-1} > FPS^*) \\ & \left[ \alpha_1^C + \alpha_2^C i_{t-1} + \alpha_3^C \sum_{k=1}^{3} (E_{t-1}\pi_{t+k} - \pi^T) + \alpha_4^C \sum_{k=1}^{3} (E_{t-1} y_{t+k}) + \alpha_5^C \sum_{k=1}^{3} (E_{t-1} rer_{t+k}) \right] + \varepsilon_t \end{aligned} \tag{2}$$

The *Fiscal Policy Stance, FPS*, is operated as a threshold variable in equation (2) estimated through the threshold GMM. It allows for an interaction between monetary policymakers and fiscal policymakers which constitutes the study's original part. As a result, it aims to examine the monetary policymaker (monetary policy behavior) by looking at the changes in the *FPS*. *FPS** is the optimal value of the threshold variable which is endogenously determined. The optimal value of the threshold variable defines the expansionary and contractionary regimes of the fiscal policymaker. *D* function is a dummy indicator and takes the value 0 when $FPS_{t-1} < FPS^*$ is and 1 when it is $FPS_{t-1} \ge FPS^*$. Accordingly, it is possible to call the regime where the FPS takes values above *FPS** a contractionary fiscal policy regime. The regime in which FPS values below *FPS** can be called the regime in which the expansionary fiscal policy is applied. The optimal value of *FPS* determined as the above equation's threshold variable is obtained using the one-dimensional grid research that includes the possible breakpoints of the threshold variable and the parameters to be estimated as in Taylor and Davradakis (2006).

The study uses monthly data covering the period March 1, 2006—March 3, 2020 to estimate the policy rules in investigating the monetary and fiscal policy coordination. According to the implementation period of the explicit inflation targeting strategy the starting date of data is selected. Table 1 summarizes the detailed information about macroeconomic variables. All data are obtained from the CBRT.

The CBRT overnight borrowing rate is used for the policy rate, the dependent variable in a Taylor rule reaction function that shows the CBRT's policy stance. The inflation gap is calculated by considering the targeted inflation rate

**Table 1. Description of the data**

| Variables | Conversion | Data source |
|---|---|---|
| *CBRT Overnight Borrowing (Policy Rate)* | level | CBRT |
| *Inflation Gap* | the target inflation rate differs from the annual percentage change of the consumer price index | CBRT |
| *Output Gap* | it is calculated by subtracting the long-term equilibrium value obtained by filtering Hodrick Prescott (HP) from the seasonally adjusted industrial production index | CBRT |
| *Real Exchange Rate Gap* | it is calculated by applying HP to the seasonally adjusted real effective exchange rate | CBRT |
| *FPS* | seasonally adjusted primary fiscal balance/GDP | CBRT |

Source: Own work.

from the annual percentage change of the consumer price index. The industrial production index is used to represent economic activity. The output gap variable is calculated by subtracting the long-term equilibrium value obtained

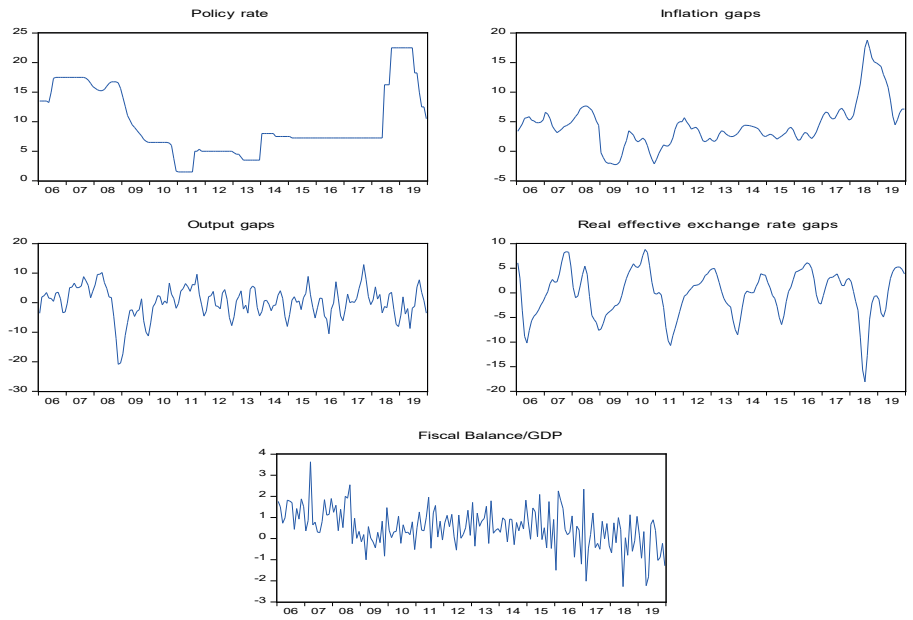



**Figure 1. The evolution of the variables**

Note: The vertical axis shows the percentage change of the variables, and the horizontal axis shows the time interval of these variables.

Source: Data is downloaded from CBRT.

by the Hodrick Prescott (HP) filtering method from the industrial production index. The exchange rate gap is calculated by taking the difference of the real effective exchange rate whose natural logarithm is taken from the long-term balance value calculated with the HP filter. Finally, the budget deficit / GDP ratio is used to represent *FPS*.[4] Figure 1 presents the graphs of the variables used. All econometric analyses have been carried out using WinRATS 10 software in this study.

Due to the global economic crisis, there were significant changes in Turkey's economic indicators from the second half of 2008 until the last quarter of 2009. The main economic problems in this period were the severe decrease in GDP and the increase in unemployment. However, thanks to monetary expansion in the global market after the 2008 crisis, Turkey has progressed almost smoothly until 2017. However, the growth model based on the construction sector, which slowed down significantly in 2018, was unsustainable. Moreover, the debt denominated in foreign currency and Turkish lira denominated enterprises' revenue with potential risks has increased vulnerability to exchange rate risk. As a result of the monetary tightening in the FED during this period, the inflation rate in Turkey reached a 25% level in 2018 and the current account deficit increased significantly. Rising unemployment rates, foreign trade deficits and a decreasing trend in economic growth performance after 2017 are considered an indicator of money and debt crisis, according to Sivramkrishna and Nandipati (2019). Figure 1 shows that the policy interest rate fell to its lowest level, especially in the period immediately after the 2008 financial crisis and reached its maximum level in the 2018–2019 period. When the inflation gap is considered, it is seen that the volatility has increased recently and there are apparent deviations from the target. In addition, the output gap and real effective exchange rate gap are very volatile during the sample period. Finally, it is seen that the *FPS* variable has very volatile and negative values in the 2008 financial crisis period and the post-2017 period.

Table 2 reports various descriptive statistics for all variables. According to Table 2, while the policy rate, inflation gap and output gap averages are positive for the whole period the exchange rate gap's average is negative. Among these variables, the variable with the highest volatility is the policy rate followed by the output gap variable. The Jarque-Bera (J-B) test result shows the null hypothesis that they are normally distributed at the 5% level for all variables is rejected and it is concluded that all variables are not normally distributed.

Standard and nonlinear unit root tests have been carried out to examine the variables' stationarity properties under consideration. Table 3 presents the Augmented Dickey-Fuller, ADF (Dickey & Fuller, 1981), PP (Phillips-Perron, 1988), and KPSS (Kwiatkowski, Phillips, Schmidt, & Shin, 1992) test results.

[4] The TRAMO/SEATS procedure to de-seasonalize all the variables. The forecast horizon is set at 12.

**Table 2. Descriptive statistics**

| | $i_t$ | $\pi_{t+k}$ | $y_{t+k}$ | $rer_{t+k}$ | $FPS_t$ |
|---|---|---|---|---|---|
| Mean | 9.8768 | 4.4183 | 0.1866 | –0.0939 | 0.5174 |
| Maximum | 22.5 | 18.7927 | 12.8805 | 8.8038 | 3.6351 |
| Minimum | 1.5 | –2.2723 | –20.8435 | –18.1011 | –2.2777 |
| Standard deviation | 5.6885 | 3.8281 | 5.3312 | 4.7931 | 0.9287 |
| Skewness | 0.719 | 1.3504 | –0.9251 | –0.7612 | –0.2058 |
| Kurtosis | 2.3928 | 5.8677 | 5.2184 | 3.7746 | 3.7954 |
| J-B | 17.057*** | 108.625*** | 58.4112*** | 20.4232*** | 5.615*** |
| Observations | 168 | 168 | 168 | 168 | 168 |

Notes: $i_t$, $\pi_{t+k}$, $y_{t+k}$, $rer_{t+k}$, and $FPS_t$ denote the short-term policy rate, inflation gap, real effective exchange rate gap, output gap and fiscal policy stance. J-B is the Jarque-Bera test for normality. *** and ** indicate statistical significance at the 1% and 5% levels, respectively.

Source: Authors' calculations.

Table 3 implies that the policy rate, inflation gap, and *FPS* (except the PP test) are not stationary in levels, while the output gap and real exchange rate gap are stationary at the level I(0). When all the series in Figure 1 are regarded, it might be thought that there will be structural breaks in these series. The recent financial crisis in 2008 and the currency and debt crisis in 2018 appear to have had a significant impact on all series. Perron (1989) remarks that structural breaks observed in series reduce standard unit root tests' power. In the

**Table 3. Linear unit root test results**

| | ADF | | PP | | KPSS | |
|---|---|---|---|---|---|---|
| | Intercept | Intercept and trend | Intercept | Intercept and trend | Intercept | Intercept and trend |
| $i_t$ | –2.556 | –2.559 | –1.899 | –1.862 | 0.329*** | 0.312** |
| $\pi_{t+k}$ | –0.370 | –1.542 | –2.298 | –2.615 | 0.532** | 0.223*** |
| $y_{t+k}$ | –4.537*** | –4.517*** | –3.926*** | –3.944** | 0.058 | 0.051 |
| $rer_{t+k}$ | –5.412*** | –5.437*** | –3.862*** | –3.863** | 0.029 | 0.028 |
| $FPS_t$ | –1.845 | –2.715 | –13.102*** | –14.052*** | 1.019*** | 0.177* |

Notes: The lag length for the ADF test is chosen based on the AIC criterion. The PP and KPSS tests are estimated based on the Bartlett kernel by using the Newey-West bandwidth. The null hypothesis of the ADF and PP tests is that the series is nonstationary while the null hypothesis is stationary against the alternative of a unit root for the KPSS test. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Source: Authors' calculations.

literature, there are unit root tests that consider structural breaks. For example, Perron (1989) assumes that the date of structural breaks is known.

This study has also performed Lee and Strazicich (2003) unit root test allowing for up to two unknown breaks, which exogenously determine the dates of structural breaks. Table 4 presents the Lee-Strazicich (LS) unit root test results considering the two breaks with unknown dates. According to the Lagrange multiplier (LM) statistical values, Model A (break in constant) is not stationary, except for the real exchange rate gap. However, in model C (fixed and in trend), all series become stationary. Furthermore, significant breaks are detected for all series during the 2008 global financial crisis and the 2018 debt crisis. As a result, based on nonlinear unit root tests, all variables can be evaluated as I (0), and the threshold Taylor rule model can be estimated at the level.

**Table 4. Lee-Strazicich (LS) unit root test**

| | Model A (Crash Model) | | | Model C (Trend Shift Model) | | | | |
|---|---|---|---|---|---|---|---|---|
| | LM Statistics | Breakpoints | | LM Statistics | $\lambda_1$ | $\lambda_2$ | Breakpoints | |
| | | $D_{1t}$ | $D_{2t}$ | | | | $D_{1t}$ | $D_{2t}$ |
| $i_t$ | –2.834 | 2009:02 (–0.800) | 2011:10 (–1.854) | –6.650*** | 0.964 | –2.690 | 2010:01 (–4.930***) | 2018:04 (6.011***) |
| $\pi_{t+k}$ | –2.459 | 2008:12 (–9.026***) | 2018:09 (0.871) | –6.594*** | 1.363 | 0.023 | 2008:11 (–5.582***) | 2018:04 (5.979***) |
| $y_{t+k}$ | –2.547 | 2009:12 (–2.210***) | 2014:01 (–1.893) | –6.334*** | 12.78 | –7.828 | 2008:08 (–5.917***) | 2010:12 (6.015***) |
| $rer_{t+k}$ | –5.655*** | 2014:10 (0.842) | 2017:06 (0.233) | –6.119*** | –4.63 | 2.241 | 2009:10 (3.614***) | 2018:05 (–2.432***) |
| $FPS_t$ | –2.326 | 2011:07 (0.265) | 2016:01 (1.895) | –8.368*** | 2.595 | –7.312 | 2008:07 (–5.296***) | 2017:01 (8.595***) |

Notes: The *t*-Statistics are presented in parentheses. The critical values are obtained from Lee and Strazicich (2003). Model A allows for breaks in the intercept, whereas Model C allows for breaks in both the intercept and the trend.

Source: Authors' calculations.

## 3. Empirical findings

Table 5 shows the results of the linear Taylor model estimated by the OLS and GMM method. It shows that the values and statistical significance of the parameters estimated by both methods are similar. According to the results of both estimators, the lagged value of the policy rate ($i_{t-1}$) is statistically significant and takes a value close to one. Moreover, the inflation gap ($\pi_{t+k} - \pi^T$) is statistically significant and positive. Accordingly, the interest rate positively reacts if inflation deviates from its target value. This finding is similar to the

Turkish economy studies (Güney, 2016; Bulut, 2019). On the other hand, the output gap ($y_{t+k}$) is found to be statistically insignificant as in Albayrak and Abdioğlu (2015), Caporale and others (2018), and Akdeniz and Çatık (2019). So, the CBRT reaction function does not respond to the output gap variable.

The real exchange rate gap ($rer_{t+k}$) is statistically significant and the coefficient sign is negative in the expected direction. This finding is in line with the results of Civcir and Akçağlayan (2010) and Yağcıbaşı and Yıldırım (2019). In particular, the central bank is expected to implement expansionary monetary policies as inflationary pressures will calm down when the national currency appreciates (i.e., $rer_{t+k}$ increases). In a scenario where the national currency

**Table 5. Linear Taylor rule results**

| **OLS Results** | | | | |
|---|---|---|---|---|
| **Variables** | **Parameters** | **Standard error** | ***t*-Statistics** | **Prob. value** |
| *Cons.* | 0.0931 | 0.1579 | 0.5895 | 0.5563 |
| $i_{t-1}$ | 0.9241*** | 0.017 | 54.338 | 0.000 |
| $\pi_{t+k} - \pi^T$ | 0.142*** | 0.0261 | 5.443 | 0.000 |
| $y_{t+k}$ | 0.0155 | 0.015 | 1.0307 | 0.3042 |
| $rer_{t+k}$ | –0.0515*** | 0.0174 | –2.9647 | 0.0035 |
| **GMM Results** | | | | |
| **Variables** | **Parameters** | **Standard error** | ***t*-Statistics** | **Prob. value** |
| *Cons.* | 0.121172 | 0.157395 | 0.76986 | 0.441381 |
| $i_{t-1}$ | 0.914834*** | 0.018197 | 50.27306 | 0.000 |
| $\pi_{t+k} - \pi^T$ | 0.147919*** | 0.027042 | 5.47007 | 0.000 |
| $y_{t+k}$ | 0.011203 | 0.01573 | 0.71224 | 0.476316 |
| $rer_{t+k}$ | –0.04325** | 0.018822 | –2.29771 | 0.021578 |
| *Sargan-J Specification* | 72.56 | | | |
| *Significance of Sargan-J* | 0.379 | | | |
| *Durbin-Watson Statistic* | 2.209 | | | |

Notes: In the study the constant term, the 12th lag of policy interest rate, inflation gap, output gap, and real effective exchange rate gap was used as the instrument variable following Clarida and others (1998), Taylor and Davradakis (2006) and Caporale and others (2018). To investigate our instruments' validity Sargan-J tests were carried out, the null hypothesis being that the over-identifying restrictions are valid. It cannot be rejected at the 5% level in any case, which confirms the exogeneity of the instruments. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Authors' calculations.

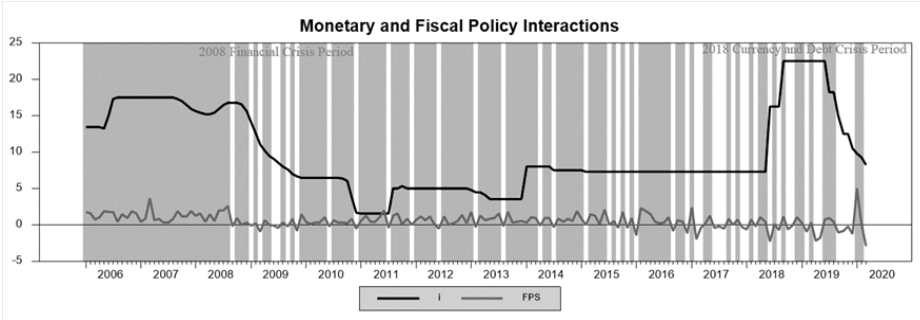
depreciates, central banks are expected to adopt a contractionary stance due to the increase in inflationary pressures. Table 5 also reports the Sargan-J and Durbin-Watson test values. The Sargan-J test assumes that model parameters are defined through a priori constraints on coefficients and tests the validity of overly descriptive constraints. Durbin-Watson shows whether there is an autocorrelation problem in the model and test values show no autocorrelation problem.

The monetary policy reaction function's linear nature causes the policy interest rate response to the inflation, output, and exchange rate gap to remain constant over time (Akdeniz & Çatık, 2019). However, the monetary policy reaction function may react differently due to the reform in fiscal policy. Accordingly, the nonlinear Taylor rule provides an opportunity to examine monetary and fiscal policy interaction. After the Taylor rule's linear estimation, the threshold model in equation (2) is estimated with the GMM method. Thus, the optimum threshold value of *FPS* is estimated by grid search. The optimum threshold value of *FPS* is calculated as 0% ($FPS^* = 0$). This ensures the *FPS*'s regime has values above 0% is called the contractionary fiscal policy regime. The regime where *FPS* values below 0% are considered the regime in which the expansionary fiscal policy is conducted. The situation where the budget balance is positive in percentage reflects a contractionary fiscal policy, while the negative one indicates an expansionary fiscal policy, so this situation seems to be theoretically plausible. Besides, in the threshold GMM method, Table 5 indicates a test result that identifies a non-linearity relationship and the threshold value that should be implemented (inherent to the regime). The quasi-likelihood ratio (Q-LR) test in Table 5 allows a comparison between linear and threshold models in terms of goodness of fit similar to Taylor and Davradakis (2006).

Figure 2 is divided into the dark-colored (shaded areas) periods when the fiscal policy exhibited a contractionary stance and the light-colored (white areas) periods when fiscal policy follows the expansionary policy stance. These regime switches show that the findings are robust considering the breakpoint dates of the *FPS* in Table 4. The period of breakpoints in the *FPS* variable (July 2008 and January 2017) coincided with the expansionary fiscal policy regime's dominance due to the Global Financial Crisis and Currency and Debt Crisis. Figure 2 also presents the monetary policymaker's stance, the expansionary-contractionary regimes, and the fiscal policy stance. It is necessary to estimate the monetary policy's stance against the expansionary and contractionary fiscal policy regimes for interpreting the different policy implementations.

The estimation results for the nonlinear Taylor rule are reported in Table 6.[5] Before proceeding to interpret the nonlinear Taylor rule threshold GMM results, it is seen that the Q-LR test result confirms the existence of threshold effects

[5] The RATS codes of Taylor and Davradakis (2006) are used to estimate the nonlinear Taylor rule with threshold GMM.




Note: The shaded areas represent the contractionary fiscal policy regime, where the fiscal policy stance remains above the optimum threshold value $FPS_{t-1} \geq FPS^*$, while the white areas represent the expansionary fiscal policy regime. According to the minimization case, this optimum threshold value is the value of $FPS_{t-1} < 0$ obtained from grid research.

**Figure 2. Regime classification based on fiscal policy stance**
Source: Authors' calculations.

in Turkey by rejecting the null hypothesis of the linear model ($H_0 : \alpha_1^E = \alpha_1^C$, $\alpha_2^E = \alpha_2^C$, $\alpha_3^E = \alpha_3^C$, $\alpha_4^E = \alpha_4^C$). This confirms that regime 1 is the expansionary regime where the $FPS_{t-1} < FPS^*$ and regime 2 is the contractionary regime where the $FPS_{t-1} \geq FPS^*$. Therefore, the FPS appears to be the appropriate switching indicator for Turkey. In the periods when the fiscal policymaker takes an expansionary stance ($FPS < 0$) the responses of the policy interest rate to the inflation gap, output gap and real effective exchange rate gap are not meaningful ($\pi_{t+k} - \pi^T = 0.0086$, $y_{t+k} = 0.0027$, $rer_{t+k} = 0.0044$). It is seen that only the reaction of the policy rate to its lagged value is significant ($i_{t-1} = 0.9972^{***}$). In other words, the CBRT response function does not work effectively in periods when fiscal policy is active and pursues an expansionary stance. Therefore, it shows that the CBRT cannot act on a rule-based monetary policy when the fiscal policymaker follows an expansionary stance. This situation means that the CBRT, which prioritizes inflation, needs a tight and disciplined fiscal policy to achieve this in Turkey. This finding is in line with Aktaş and others (2010).

Taylor (2013) stated that rule-based policies usually could not be implemented frequently in a financial crisis. Figure 2 also shows that periods coincide with crisis periods when fiscal policy is in an expansionary stance. This situation shows that during the crisis the fiscal policymaker mainly adopts an expansionary stance. Therefore, effective policy coordination cannot be achieved due to the monetary policymaker's inability to follow rule-based policy. These findings are reinforced by Coban (2015) and Cukadar and Algan (2018) as a recently prevailing Turkish economy characteristic.

In the periods when the fiscal policymaker pursues a contractionary stance ($FPS > 0$), the parameters of the lagged value of the interest rate, the inflation gap, the output gap, and the real effective exchange rate gap become statistically sig-

**Table 6. Nonlinear Taylor rule Threshold GMM results**

| **Fiscal Expansionary Regime** | | | | |
|---|---|---|---|---|
| **Variables** | **Parameters** | **Standard error** | ***t*-Statistics** | **Prob. value** |
| *Cons.* | –0.0215 | 0.0221 | –0.9715 | 0.3313 |
| $i_{t-1}$ | 0.9972*** | 0.0036 | 279.9161 | 0.000 |
| $\pi_{t+k} - \pi^T$ | 0.0086 | 0.0073 | 1.1742 | 0.2403 |
| $y_{t+k}$ | 0.0027 | 0.0021 | 1.317 | 0.1879 |
| $rer_{t+k}$ | 0.0044 | 0.0037 | 1.196 | 0.2317 |
| **Fiscal Contractionary Regime** | | | | |
| **Variables** | **Parameters** | **Standard error** | ***t*-Statistics** | **Prob. value** |
| *Cons.* | –0.2456*** | 0.0601 | –4.0861 | 0.000 |
| $i_{t-1}$ | 0.988*** | 0.0066 | 148.8342 | 0.000 |
| $\pi_{t+k} - \pi^T$ | 0.0431*** | 0.0073 | 5.9352 | 0.000 |
| $y_{t+k}$ | –0.0114* | 0.0069 | –1.6592 | 0.0971 |
| $rer_{t+k}$ | 0.0252*** | 0.0053 | 4.7427 | 0.000 |
| *Sargan-J Specification* | 41.574 | | | |
| *Significance of Sargan-J* | (0.359) | | | |
| *Significance of Q-LR Test* | (0.0321) | | | |
| *Durbin-Watson Statistic* | 1.783 | | | |

Notes: In the study, the constant term, the 12th lag of policy interest rate, inflation gap, output gap and real effective exchange rate gap was used as the instrument variable following Clarida and others (1998), Taylor and Davradakis (2006) and Caporale and others (2018). To investigate the instruments' validity Sargan-J tests were carried out, the null hypothesis being that the over-identifying restrictions are valid. That cannot be rejected at the 5% level in any case, which confirms the exogeneity of the instruments. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. *Q – LR* Test statistic is obtained as $Q - LR = J^{lin} - J^{threshold}$. $J^{lin}$ and $J^{threshold}$ are the objective functions that GMM minimizes for the linear and threshold models, respectively. Significance levels of the *Q – LR* statistics derived from a non-parametric bootstrap simulation based on Hansen (1996) are given in parenthesis (.). More details about the *Q – LR* test steps can be found in Taylor and Davradakis (2006).

Source: Authors' calculations.

nificant ($i_{t-1} = 0.988^{***}, \pi_{t+k} - \pi^T = 0.0431^{***}, y_{t+k} = -0.0114^{*}, rer_{t+k} = 0.0252^{***}$). This situation asserts that the Taylor rule is valid under conditions where exhibit the contractionary stance of fiscal policymakers in the Turkish economy. The negative output gap variable coefficient does not mean that the Taylor rule is not valid; it merely characterizes the monetary policymaker's policy behav-

ior specific to the period investigated (Caporale et al., 2018). The fact that the Taylor rule is effective only in periods when the fiscal policymaker exhibits a contractionary stance indicates that the monetary policymaker could use the short-term interest rate as a useful policy tool only in these periods.

The coefficient sign of the contractionary regime's output gap is remarkably related to the study's question. In a traditional Taylor rule, the policy rate's response to the output gap is mostly positive. This situation can be interpreted as the monetary policymaker aiming at price stability is intervening in the heating economy. On the other hand, when the fiscal policymaker exhibits a contractionary position the policy interest rate's response to the output gap is significant and negative ($y_{t+k} = -0.0114^{*}$), meaning a decrease in policy interest rate response to the positive output gap. Therefore, in this regime it can be said that the monetary policymaker adopts a policy in line with the contractionary stance of the fiscal policymaker and thus policy coordination is achieved. Dealing with that the periods in which the fiscal policymaker exhibits a contractionary stance are outside the crisis periods, and effective coordination is more likely to be achieved in non-crisis periods.

## Conclusions

This study explores the structure of coordination between monetary and fiscal policymakers within the policy behavior framework, especially during crisis periods. A nonlinear form of the monetary policymaker response function (i.e., nonlinear Taylor rule) analyzes monetary and fiscal policymaker interaction. The nonlinear Taylor rule is also expanded to include the exchange rate considering that monetary policymakers frequently intervene in foreign exchange markets (Daude, Yeyati, & Nagengast, 2016). The fiscal policy stance is used as a threshold variable in the nonlinear Taylor rule estimated by the threshold GMM method. Thus, an interaction between monetary and fiscal policymakers is established and the changes in the monetary policymaker's response function are examined by looking at the changes in the fiscal policy stance variable.

Results indicate that a nonlinear Taylor rule has successfully identified the interaction between fiscal and monetary policies, including the threshold variable defined as the fiscal policy stance. Findings show that the Taylor rule implies different behaviors according to whether the fiscal policy stance is above or below the threshold value. While the policy interest rate does not react significantly to the inflation, output and real effective exchange rate during the fiscal policy's periods exhibit an expansionary stance; it gives meaningful reactions in the contractionary fiscal policy period. In other words, this situation shows that the Taylor rule is valid only under conditions in which the fiscal policymaker exhibits a contractionary stance. Correspondingly, these findings reveal the importance of the government's tight stance for the CBRT to pursue

the rule-based monetary policy. As an important policy implication, it is inferred that the contractionary fiscal policy supports the rule-based monetary policy's functioning. Additionally, it has been concluded that monetary policymakers need to take the role of fiscal discipline and policies more seriously to achieve significant success in combating price stability.

This study also indicates that the coordination between monetary and fiscal policy became a problem with the 2018 currency crisis. While the regime-switching period that emerged in 2008 was short-range, after 2018 regime changes took place at widespread intervals indicating that policy coordination disappeared. The loss of credibility and independence of the CBRT plays an essential role in explaining this situation. The decrease in the central bank's independence negatively affects its power to follow a rule-based economic policy. Demiralp and Demiralp (2019) show that political commentaries for a lower policy rate environment have increased dramatically, especially since 2013. This situation reveals that the CBRT has succumbed to these pressures and that the instrument independence is at great risk. As a result of this situation, an environment has emerged where the credibility of the CBRT has decreased, inflation cannot be controlled due to political pressures despite implementing inflation targeting and the uncertainty of the exchange rate has increased (Cakmakli & Demiralp, 2020). In addition, the fact that the central bank governor has changed four times in the last two years has led to an increase in the dose of criticisms against the independence and credibility of the monetary policy. In such an environment, this situation should be considered when making inferences about monetary and fiscal policy coordination.

This study also has a limitation which might be considered as time lag when revealing the interaction between monetary and fiscal policy. The time it takes for the effects of the implemented policies to produce the desired result is called the effect / time lag. Since there is no big-time lag between announcement and implementation of fiscal policy in Turkey the effect / time lag in this study was ignored as in Büyükbaşaran and others (2020).

In conclusion, both the notable expansionary fiscal policy stance and inability to follow rule-based policy in CBRT reveal an uncoordinated policy response in Turkey during a crisis. Hence, the policy rate reacts negatively to the output gap under a contractionary fiscal policy regime leading to an expansionary monetary policy. If this situation is considered as a significant coordination indication, it is seen that effective coordination is more likely to be achieved in non-crisis periods. Further research could include measuring the various fiscal policy indicators as the threshold variable in the model to reveal the coordination between monetary and fiscal policies.

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