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DETERMINING AFFECTING MACROECONOMIC INDICATORS ON INTEREST RATES IN EMERGING COUNTRIES: A COMPARATIVE EXAMINATION UPON CHINA, BRAZIL, AND TURKEY WITH MULTIVARIATE ADAPTIVE REGRESSION SPLINES (MARS)

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ABSTRACT

China, Brazil, and Turkey are important emerging countries and have different interest rate trends. China and Brazil enjoyed the lower interest rate of approximately 1.5% and 6.8% respectively whereas Turkey was faced with increasing interest rate problems reaching 23.35% as of 2018 end. The study aims to analyze and define macroeconomic determinants of interest rates. 11 independent variables, yearly data between 2002 and 2018 were examined with the MARS method. The study determines that growth and reserves have effects in China; credits and net export have effects in Brazil whereas inflation and money supply are influential in Turkey on interest rates.

Keywords: Interest Rate, Macroeconomic Determinants, MARS, China, Brazil, Turkey

JEL Codes: M41, M42, M49

1. INTRODUCTION

Each country tries to develop itself and provide much more benefit to its citizens through economic channels. In this context, the championship in the stability of macroeconomic indicators is quite an important issue.

Financial markets and indicators have substantial importance for the development of countries and realizing its aims such as developing life quality, extending lifetime, etc. It is clear that each macroeconomic indicator has importance; however, some of them have much more importance like interest rate because they have effects on the other indicators. Moreover, they may affect the economy in other ways. For example, interest rates make effects on the other macroeconomic and microeconomic indicators, besides; they have an effect on the investment decisions of economic actors like public authorities, companies, funds, etc. Besides, the cost/value of money can be measured by interest rates. In other words, the amount of investments decreases when the interest rates increases and vice versa. Therefore, taking into consideration the overall effects of interest rates, it can be said that that the (low)

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level and development trend of interest rates have substantial importance for the development and economic growth of countries.

As can be understood from the information explained above, interest rates are associated with almost all macroeconomic indicators. They affect the economic growth capacity and the development of countries in this way. As a natural result of this framework, every country targets and prefers to have a lower interest rate so that they can achieve their goals (Tumwine et al., 2018). Although low-level interest rates are preferred, it's not always possible to reach or sustain this wish. When there are problems related to inflation or foreign exchange rate (FER), it is compulsory to retain high-level interest rates so that these problems can be taken under control (Entrop et al., 2017).

In the globalizing environment, countries have been becoming much more interdependent. In such an environment, unfortunately, it is not easy to reach and sustain low-level interest rates while countries are generally open economies. For this reason, a variety of factors should be taken into consideration to manage interest rates. To be able to do so, factors, whether they have effects on interest rates either negative or positive, must be determined first.

In most countries, the banking sector is the main financial intermediary and banks are the main fund source for economic actors. Banks provide funds via the credit channel. It is commonly known that banks provide credits from the source in which they collect named as deposits. In this context, credit and deposit interest rates have importance for the development of countries where funding sources are provided by banks. In this context, macroeconomic determinants of interest rates have a primary priority to achieve and sustain low-level interest rates due to their importance in the financial intermediary process.

When examining the condition of interest rates in countries, it is seen that developed countries achieved and have sustained generally low-level interest rates. However, emerging countries have been facing difficulties in keeping interest rates under control and sustaining a low-level after achieving. In this context, analyzing emerging countries rather than developed countries have much more importance. In this context, determining of affecting macroeconomic indicators on interest rate is aimed at making an analysis upon which factors have effects on emerging countries is necessary for this study. 11 macroeconomic determinants as independent variables and yearly data between 2002 and 2018 and are selected for analysis by using the MARS method. The examination includes three important emerging countries as China, Brazil, and Turkey which take place in international peer groups of BRICST and E7. The study is prepared to make a comparative analysis for these countries in a single study to determine influential macroeconomic indicators on interest rates taking into consideration that they are all emerging countries and competing with each other.

The main contribution of the study to literature is to define affecting variables of interest rates in selected emerging countries by focusing on macroeconomic factors, thereby contributing to the literature

in different ways. First, this study focuses on China, Brazil, and Turkey comparatively. They are two important emerging economies in the world. Second, by focusing on China, Brazil, and Turkey, the study examines these countries and affecting macroeconomic factors in detail on the country base. Third, it will be possible to recommend policy proposals to prevent the increase in interest rates, keep it under control in Turkey, and to sustain a relatively low-level in China and Brazil by including on the data of recent periods. Fourth, a model having relatively high estimation power, named as MARS, is selected to be applied in the study for analysis. These all can be summarized as contributions of the study.

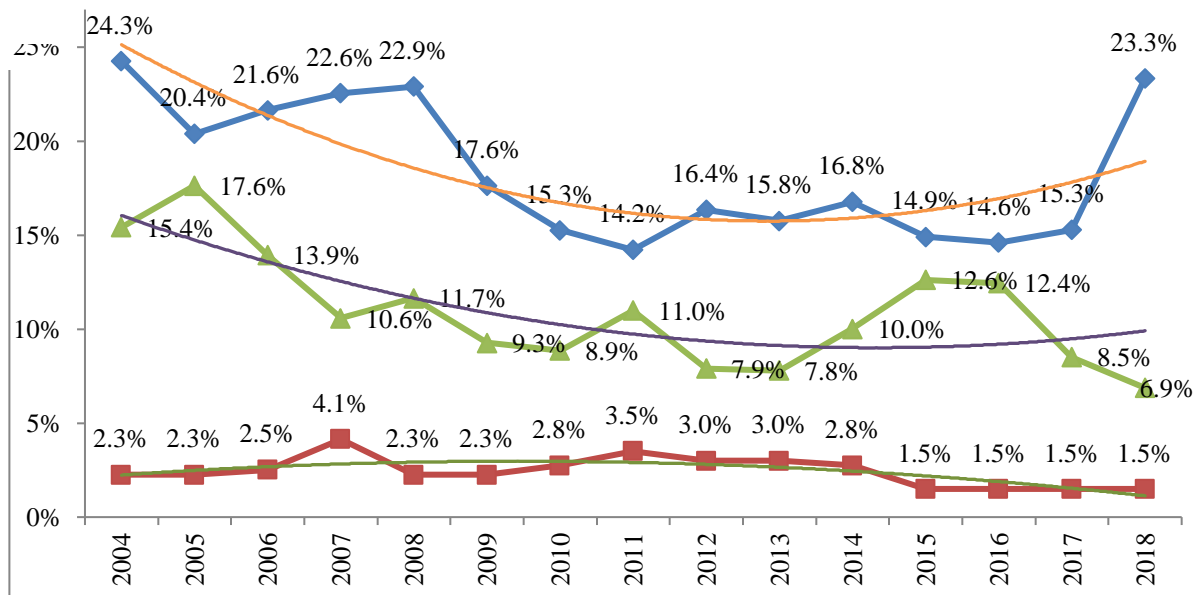
In this study, it is expected that the results of the study provide clear determinations of why there is an important difference between three emerging countries in having different levels of interest rates. The study is structured as consisting of 6 parts. The development of interest rates in the selected emerging countries which are China, Brazil, and Turkey are presented in Section 2. A summary of the literature review is presented in Section 3. The scope, data source, variables, and methodology are presented in Section 4. The empirical results are presented in Section 5. The conclusion takes place in Section 6.

2. DEVELOPMENT OF INTEREST RATES

It can be seen that developed countries have low-level interest rates and enjoyed this condition for a long time. However, the picture is different for emerging countries. Depending on the change of the value of the national currency and other national and international factors, some emerging countries have been facing the increasing interest rates problem like Turkey while some of the others have been sustaining low-levels like China and Brazil.

Taking into consideration that this study focuses on emerging countries that consist of China, Brazil, and Turkey, Figure 1 includes the development trends of interest rates in these three emerging countries.

Figure 1. The Development of Interest Rates (Deposit, %) in China, Brazil, and Turkey for 2004- 2018 (among announced 103 countries).



Source: World Bank Open Data Database, 2019.

As can be seen in Figure 1, although the interest rate decreased in some periods, Turkey has generally quite high-interest rate throughout the period of 2004 and 2018. Turkey has the highest interest rate with 23.35% which was 15.29% in 2017. These figures show that there is a 53% increase in Turkey in the last two years. On the other hand, China has a quite low-level interest rate level with 1.5% as of 2018 end and it has been the same since 2015. Similarly, Brazil has a lower level interest rate than Turkey and a higher level interest rate than China with 6.9% as of 2018. As general, China has a horizontal trend; Brazil has a decreasing trend whereas Turkey has an increasing trend in interest rate.

In addition to China, Brazil, and Turkey, other emerging countries have higher interest rates than developed countries. Generally, it is possible to say that emerging countries have the highest interest rate among 103 countries, of which deposit interest rate figures are published for 2018 end.

3. LITERATURE REVIEW

The literature includes a lot of studies about interest rates. A variety of different independent macroeconomic indicators have been used in these studies which can be summarized as borrowing, debt, debt stock, international debt, and public deficit; budget deficit; current account balance; economic growth; FER; government expenditures; inflation; money supply; oil prices; reserves; stock return, and unemployment. In addition, interest rates have been analyzed by using various methods such as ARCH, bounding test, causality analysis (Granger, Toda-Yamamoto), cointegration test (Gregory-Hansen, Hiemstra-Jones, Johansen), multifractal detrended cross-correlation analysis method, dynamic and static estimation model, EGARCH, GARCH, generalized method of moments (GMM), Markov switching

vector error correction model, multifractal detrended cross-correlation analysis method, multivariate adaptive regression splines (MARS), MGARCH, regression (logit, panel, OLS), threshold auto regression with a unit-roots model, vector autoregressive (VAR) model, and vector error correction model (VECM).

Some studies examine the relationship between interest rate with a different type of debt such as debt borrowing, debt stock, international debt, and the public deficit. Bulut and Canbolat (2003) investigated Turkey with regression analysis and defined that public deficit affects interest rates. Hol (2006) examined Norway, Sweden, and Denmark via ARCH analysis and concluded that international debt is a significant determinant in explaining interest rates. Demir and Sever (2008) analyzed Turkey via Johansen cointegration analysis and determined that public domestic borrowing is correlated with interest rate. Also, Öztürk and Durgut (2011) examined Turkey also with Johansen cointegration analysis and defined that domestic debt stock is positively related to the interest rate in the long-run. Also, Akıncı and Yılmaz (2016) observed Turkey via Johansen cointegration analysis and stated that external debt service has statistically significant effects on interest rates. Tumwine et al. (2018) examined Uganda with regression analysis and determined that public debt is a significant factor in interest rates. Dinçer et al. (2019) studied Turkey with MARS analysis and defined that foreign debts have an influence on (deposit) interest rates.

Some of the other studies focus on the relationship between the interest rate and the current account balance. Akıncı and Yılmaz (2016) examined Turkey with Johansen cointegration analysis and concluded that the current account balance has a statistically significant effect on interest rates. Dinçer et al. (2019) studied Turkey by MARS analysis and determined that the current account deficit has an effect on (deposit) interest rates.

Another group of studies focuses on the relationship between interest rates and economic growth. Akıncı and Yılmaz (2016) and Torun and Karanfil (2016) examined Turkey by Johansen cointegration analysis and determined that economic growth has a statistically significant effect on interest rates. Holston et al. (2017) examined the United States of America (USA) by VECM analysis and defined that economic growth is related to the interest rates. Obeng and Sakyi (2017) determined the same results by the same method for Ghana. Shaukat et al. (2019) researched 38 transitory economies by using the GMM method and determined that there is a multi-fold inverse relation between economic growth and real interest rate.

Also, the relationship between the interest rate and FER is examined in some studies. Günay (2001) examined Turkey with regression analysis and stated that exchange rate risk is positively related to interest rates. Karaca (2005) examined Turkey via a bounding test and concluded that exchange rate volatility is related to interest rates. Hol (2006) examined Norway, Sweden, and Denmark via ARCH analysis and defined that the exchange rate regime has significance in explaining interest rates. Gül et

al. (2007) observed Turkey via Granger causality analysis and stated that there is a one-way causality relationship from FER to the interest rate. Sever and Mızrak (2007) examined Turkey via the VAR model and determined that FER is one determinant of the interest rates. Taşbaşı (2014) examined Hong Kong via GARCH analysis and concluded that there is a strong relationship between exchange rates volatilities and interest rates. Ekinçi et al. (2016) examined Turkey via regression analysis and stated that increasing FER causes an increase in interest rates. Kartal (2019) studied Turkey via MARS analysis and defined that USD/TL FER affects (credit) interest rates.

Furthermore, the relationship between the interest rate and inflation is examined in studies. Mehra (1996) studied the USA via Johansen cointegration analysis and defined that inflation influences interest rates. Berument and Malatyali (2001) examined Turkey with GARCH analysis and concluded that expected inflation increases interest rates. Güneş and Tulçal (2002) examined Turkey via regression analysis and defined that the most important factor affecting interest rates is the wholesale price index. Berument et al. (2004) researched the United Kingdom (UK) by using a time-varying parameter model with a GARCH analysis for the period of 1961/06 and 2002/02. They determined that uncertainties of inflation (structural and steady-state inflation measured in terms of consumer prices index (CPI)) increase the spreads of interest rate (long-term government bond yields, overnight interbank minimum interest rate, short-term government bond yields, the lending rate of clearing banks, deposit rate, Treasury bill rate bond equivalent, Treasury bill rate). Muinhos and Nakane (2006) examined Brazil via regression analysis and stated that inflation risk takes a negative role in interest rates. Aytaç and Sağlam (2014) defined that the most significant determinants of the interest rate are the inflation rate for Turkey by using the VAR model. Tanrıöver and Yamak (2015) studied Turkey by bounding test analysis and determined that nominal interest rates increase when the general price level increases. Tunalı and Erönel (2016) analyzed Turkey via Gregory-Hansen cointegration test analysis and determined that the interest rates are positively related to inflation in the long run.

Besides, the relationship between interest rates and money supply is examined in some studies. Onanuga and Shittu (2010) analyzed Nigeria by VECM analysis and defined that real money supply influences (Treasury bill) interest rates. Akıncı and Yılmaz (2016) observed Turkey via Johansen cointegration analysis and stated that the money supply has statistically significant effects on the interest rate. Kartal (2019) studied Turkey with MARS analysis and determined that money supply (M2 volume) affects (credit) interest rate.

Indeed, various studies are examining the relationship of different determinants with interest rates and examining interest rates from different perspectives. Patnaik and Vasudevan (1999) studied India via Johansen cointegration analysis and defined that returns on foreign assets play an increasing and significant role in the determination of (domestic) interest rates. Hol (2006) examined Norway, Sweden, and Denmark by ARCH analysis and concluded that unemployment is significant in explaining interest rates. Poddar et al. (2006) examined Lebanon via regression analysis and determined that (global)

interest rates have a strong effect on (domestic) interest rates. Jammazi et al. (2017) studied the USA with granger causality analysis and concluded that stock return is the main driving force of interest rate. Cao et al. (2018) examined the interest rate market in China in terms of efficiency of the interest rates market by using a grey detrended fluctuation analysis method. They concluded that the interest rates market has still been inefficient. Arslanalp et al. (2019) examined 42 selected countries via panel regression analysis and defined that openness of capital account limits the direct sensitivity of a country's interest rates. Kartal (2019) studied Turkey by MARS analysis determined that (deposit) interest rate, reserves of the central bank, and foreign trade balance affect (credit) interest rate.

Also, Kanas and Tsiotas (2005) worked on the interest rate linkage between the USA and UK by using bivariate Markov switching VECM. They determined that the USA's real interest rate is granger cause of the UK in the regime of high volatility. Cheung et al. (2008) examined China, researched the relationship between interest rates of China and the USA, and defined that the effect of the USA interest rate on China's interest rate is quite weak. However, according to observed interest rate interactions, the requirement of a flexible RMB to insulate the monetary policy of China from the USA effect is not verified. Jardet and Le Fol (2010) examined the reaction of the Euro money market interest rate to operational framework change by EGARCH analysis and concluded that operational changes and new liquidity management result in a significant decrease in interest rate volatility. Broga et al. (2016) analyzed the effect of distinct levels of interest rates on the stability of the financial network and researched the link between interest rates (federal funds rate in the USA) and crashes (credit & liquidity failure). They determined that it is more likely to emerge of banking failures under sustained high-interest rates. Bikker and Vervliet (2018) worked on the USA banking sector in terms of the relationship between the interest rate and profitability by using dynamic and static estimation models. They found that the performance of USA banks is weakened by the low-interest rate environment and this result in the decline in net interest margins. However, although this condition, banks have maintained overall profit levels due to lower provisioning.

The last group of studies focuses on the relationship between different factors and interest rates. Wang and Hu (2015) researched the cross-correlations between the interest rate (effective federal funds rate in the USA) and commodity markets (corn, soybean, wheat, and rice futures) in China by using multifractal detrended cross-correlation analysis method. They concluded that there is a significant cross-correlation between the interest rate and the commodity markets.

There are a variety of studies related to interest rate and it is obvious that the effects of various independent macroeconomic indicators on interest rates are either positive or negative depending on the periods covered, countries selected, and methods used. Taking into consideration the importance of interest rates for countries and some emerging countries that have been faced with increasing and high-level interest rate problems, there is always a need for new studies focusing on emerging countries. Besides, it is important to examine these countries comprehensively and comparatively with covering

more recent periods. In this context, it could be thought that a new study, which covers the data of recent periods and focuses on important emerging countries like China and Turkey, would be beneficial. By using macroeconomic determinants, which may influence interest rates, with the data including the most (accessible) recent periods and applying a new method like the MARS method in terms of analysis of interest rate has the potential to contribute to the literature. Also, it is possible to express that interest rates will take place in different studies in the coming period because they will still have importance for lots of countries.

4. DATA AND METHODOLOGY

As known, having low-level interest rates is crucial for the development of countries. In this context, determining which macroeconomic factors affect interest rates is very important. With the determination, countries can develop policies, and hence they could keep interest rates at lower levels. So, this study is structured to determine affecting macroeconomic indicators on interest rates in China, Brazil, and Turkey. The period of 2002 and 2018 is examined in the study by using the MARS 2.0 method. Also, in this study, it is dependent on the other studies taking place in the literature to form a contextual background and find and select independent variables.

4.1. Scope and Data Source

In this study, it is aimed at examining intersection emerging countries of BRICST and E7 countries in terms of the interest rates. This country groups included countries as follows:

- BRICST: Brazil, Russia, India, China, South Africa, Turkey.
- E7: Brazil, China, India, Indonesia, Mexico, Russia, Turkey.

The intersection set of these peer groups can be summarized as Brazil, China, India, and Turkey. It was aimed to examine these 4 important emerging countries. India is excluded since interest rate data has not been gathered. So, China (CHN), Brazil (BRA), and Turkey (TUR) are included in the analysis. Data for variables have been gathered from the World Bank Open Data Database (2019) to analyze the influential macroeconomic variables on interest rates. Only, lending (credit) interest rate for Turkey has been gathered from the Central Bank of the Republic of Turkey (2019).

4.2. Methodology

The MARS method is preferred to be used in the analysis because the MARS method provides much better estimation results compared to other methods like probit and logit.

Mr. Friedman developed the MARS method (Friedman, 1991). This method is a non-linear and non-parametric regression technique that can find out the optimal variable and interaction effects from high-dimensional data. The MARS model has no specific assumptions about the underlying functional relationship between the dependent variable and one or more independent variables.

The general form of the MARS model can be expressed as follows:

$$f(x_i) = \beta_0 + \sum_{m=1}^M \beta_m B_m(X) \quad (1)$$

β_0 is the intercept and β_m is corresponding coefficients that are estimated using the least-squares method and $B_m(X)$ is the m-th basis function (Goh et al., 2017). MARS algorithm has a two-stage process that consists of forward and backward iterative procedures. In the forward process, a model is started, including only the intercept coefficient and iteratively adds two-by-two combinations to improve optimal BFs by reducing the error of training data. To reduce the probability of overfitting problem from the first stage, this model is pruned by the least importance to model until it finds the best sub-model. This is done in the backward process with Generalized Cross-Validation (GCV) that can be formulated as follows:

$$GCV = MSE_{train} / \left(1 - \frac{C(M)}{N}\right)^2 \quad (2)$$

$$C(M) = M + dM \quad (3)$$

where $C(M)$ is a complexity penalty function, M is the number of basic functions, N is the number observations, and d is the penalty factor. The best model is preferred by the evaluation of the GCV and R^2 statistics, which are the goodness of fit criteria. The best model is the model that has the highest GCV and R^2 values (Sephton, 2001).

4.3. Description of Variables

Some of the studies in the literature use lending (credit) interest rates as a dependent variable while some of the others use a borrowing (deposit) interest rate. Also, other types of interest rates such as Treasury bill interest rates have been used in studies. In this study, lending (credit) interest rate (abbreviated as INT) is selected to be used as the dependent variable for analysis because we would like to examine interest rates in terms of funding cost.

There are a variety of independent determinants, which have been used to research interest rate, in the literature. Some of them are summarized in Table 1.

Table 1. Independent Variables

Determinants	References
Current Account Deficit	Akıncı & Yılmaz (2016), Jammazi et al. (2017), Akçay et al. (2018), Dinçer et al. (2019)
Economic Growth	Güneş & Tulçal (2002), Desroches & Francis (2006), Ersoy (2011), Aytaç & Sağlam (2014), Torun & Karanfil (2016), Yüksel & Zengin (2016), Holston et al. (2017), Obeng & Sakyi (2017), Yüksel (2017), Shaukat et al. (2019)
FER	Angeloni & Prati (1993), Günay (2001), Karaca (2005), Hol (2006), Gül et al. (2007), Sever & Mızrak (2007), Öztürk & Durgut (2011), Taşbaşı (2014), Gupta & Goyal (2015), Akıncı & Yılmaz (2016), Ekinçi et al. (2016), Torun & Karanfil (2016), Obeng & Sakyi (2017)
Foreign Trade	Gupta & Goyal (2015)

Determinants	References
Inflation	Benjamin & Kochin (1984), Mehra (1996), Berument (1999), Berument & Malatyali (2001), Desroches & Francis (2006), Muinhos & Nakane (2006), Sever & Mızrak (2007), Gupta & Goyal (2015), Atgür & Altay (2015), Tanrıöver & Yamak (2015), Doğan et al. (2016), Ratti & Vespignani (2016), Torun & Karanfil (2016), Dinçer et al. (2019)
Investments	Güneş & Tulçal (2002), Desroches & Francis (2006)
Money Supply	Knot (1995), Patnaik & Vasudevan (1999), Güneş & Tulçal (2002), Onanuga & Shittu (2010), Öztürk & Durgut (2011), Gupta & Goyal (2015), Akıncı & Yılmaz (2016)
Reserves	Hol (2006), Gupta & Goyal (2015)
Savings	Güneş & Tulçal (2002), Desroches & Francis (2006), Akıncı & Yılmaz (2016)
Unemployment	Hol (2006), Taylor & Wieland (2016), Shapiro (2018), Mitchell & Pearce (2017)

Taking into consideration the variables in Table 1 and also domestic credits may be influential on interest rates, totally 11 independent macroeconomic determinants are included in the analysis. Details of independent determinants are included in Table 2.

Table 2. Details of Independent Variables

Determinants	Description	Abbreviation	Expected Effects
Current Account	Current account balance (USA Dollar)	CA	+
Domestic Credits	Domestic credit provided by the financial sector (% of Gross Domestic Product (GDP))	CRDTS	+
Economic Growth	Annual growth of GDP	GRWTH	+,-
FER	Value of national currencies against the USA Dollar	FER	+
Foreign Trade	The net difference between export/GDP and import/GDP	EXIM	+
Inflation	Consumer prices index (Annual %)	CPI	+
Investment	Net inflow amount of Foreign Direct Investments (FDI) (USA Dollar)	FDI	+,-
Money Supply	Broad Money (% of GDP)	MNY	+,-
Reserves	Total reserves including gold (USA Dollar)	RSRVS	-
Savings	Gross savings (% of GDP)	SVNGS	+,-
Unemployment	The unemployment rate in the total labor force	UNEMP	+,-

5. EMPIRICAL RESULTS

5.1. Descriptive Statistics

Table 3 presents summary figures for the 2018 year-end for the analyzed countries.

Table 3: Descriptive Statistics for Variables as of 2018 Year-End

Variables	CHN	BRA	TUR
INT _{1,2}	4.35	39.08	24.01
CA ₃	49.09	-14.51	-27.12
CRDTS ₄	218.31	113.70	83.28
GRWTH ₂	6.60	1.12	2.57
FER	0.1511	0.2737	0.2071
EXIM ₄	0.78	0.53	-1.18
CPI ₂	2.07	3.66	16.33
FDI ₃	203.49	88.32	13.02
MNY ₄	199.15	96.29	53.98
RSRVS ₃	3,168.22	374.71	92.98
SVNGS ₄	-	14.57	26.60
UNEMP ₂	4.42	12.54	10.90

₁ The dependent variable; ₂ Percentage; ₃ Billion USD; ₄ % of GDP.

5.2. Empirical Results for CHN

In the first step, MARS produces all possible basis functions by using 11 independent variables which may have effects on interest rates. In the second step, the 3rd model has been selected as the best model which the highest GCV R₂ value (0.628) and has the lowest GCV value (0.283) among all models. Also, the most important and influential macroeconomic indicators have been determined as GRWTH (importance level: 100.000), and RSRVS (importance level: 56.007). Adjusted R₂ of the best model is 0.871, which means that the variation of the interest rate is explained highly with these independent variables used in the model. On the other hand, other included variables do not have an effect on interest rates for the period of 2002-2018 in CHN.

Details of the best model are included in Table 4.

Table 4: INT Basis Functions for CHN

Basis Functions	Details	Coefficient
BF0	Constant	4.655
BF1	max(0, GRWTH - 7.77)	0.360
BF2	max(0, 7.77 - GRWTH)	-1.087
BF3	max(0, RSRVS - 2,452.9)	0.001
F Test: 36.933 (0.000) Adjusted R ₂ : 0.871		

In Table 4, the coefficient of growth is positive if economic growth is higher than 7.77%; otherwise, its effect is negative. This means that the level of economic growth needs to be kept higher than 7.77% at the annual base to reduce the interest rate.

Similar to growth, reserves should be kept higher than 2,452.9 billion USD to reduce the interest rate. Then, the effect of reserves on the interest rate would be positive; otherwise negative effects would be seen on the interest rate.

5.3. Empirical Results for BRA

In the first step, MARS produces all possible basis functions by using 11 independent variables which may have effects on interest rates. In the second step, the 3rd model has been selected as the best model which the highest GCV R₂ value (0.628) and has the lowest GCV value (41.712) among all models. Also, the most important and influential macroeconomic indicators have been determined as CRDTS (importance level: 100.000), SVNGS (importance level: 47.382), and EXIM (importance level: 42.070). Adjusted R₂ of the best model is 0.871, which means that the variation of the interest rate is explained highly with these independent variables used in the model. On the other hand, other included variables do not have an effect on interest rates for the period of 2002-2018 in BRA.

Details of the best model are included in Table 5.

Table 5: INT Basis Functions for BRA

Basis Functions	Details	Coefficient
BF0	Constant	45.473
BF2	max(0, 101.06 - CRDTS)	0.686
BF3	max(0, SVNGS - 16.02)	-3.107
BF6	max(0, -0.77 - EXIM)	-7.175
F Test: 36.892 (0.000) Adjusted R ₂ : 0.871		

In Table 5, the coefficient of credits is positive if credits volume is lower than 101.06% of GDP; otherwise, there is no effect. This means that the credit/GDP ratio should be kept lower than 101.06% to have a lower-level interest rate.

Also, savings should be kept lower than 16.02% of GDP to have a lower-level interest rate. In this condition, there are no negative effects of savings on the interest rate; otherwise, savings causes the negative development on the interest rates when it exceeds 16.02% of GDP.

Net export is the third macroeconomics factor that has a significant effect on the interest rate. Based on the analysis results, net export should be higher than 0.77% of GDP; otherwise, net export would cause interest rates to increase.

5.4. Empirical Results for TUR

In the first step, MARS produces all possible basis functions by using 11 independent variables which may have effects on interest rates. In the second step, the 3rd model has been selected as the best model which the highest GCV R₂ value (0.878) and has the lowest GCV value (14.514) among all models. Also, the most important and influential macroeconomic indicators have been determined as CPI (importance level: 100.000), and MNY (importance level: 51.828). Adjusted R₂ of the best model is 0.941, which means that the variation of the interest rate is explained highly with these independent variables used in the model. On the other hand, other included variables do not have an effect on interest rates for the period of 2002-2018 in TUR.

Details of the best model are included in Table 6.

Table 6: INT Basis Functions for TUR

Basis Functions	Details	Coefficient
BF0	Constant	12.606
BF1	max(0, CPI - 6.25)	0.850
BF3	max(0, 42.07 - MNY)	1.617
F Test: 129.106 (0.000) Adjusted R ₂ : 0.941		

In Table 6, the coefficient of inflation (CPI) is positive if it is higher than 6.25%; otherwise, there is no effect. This means that the level of inflation needs to be kept lower than 6.25% at the annual base to reduce the interest rate.

Secondly, the money supply should be kept higher than 42.07% of GDP to have a lower-level interest rate. In this condition, the increase in the money supply would not cause negative effects on the interest rate; otherwise, the money supply causes the negative development on the interest rates when it is below 42.07% of GDP.

5.5. Discussion on the Findings

With the help of the analysis made, the influential macroeconomic indicators on interest rate in terms of lending (credit) interest rates have been determined for CHN, BRA, and TUR for the period of 2002 and 2018 which is very important period because of the fact that there is some national and global crisis in this period. Also, the MARS method, which has relatively high estimation power compared to other models, has been applied.

As a result of the analysis, the details of the defined determinants of lending (credit) interest rate in the countries are summarized in Table 7.

Table 7: Affecting Macroeconomic Factors on the Interest Rate

Order	CHN	BRA	TUR
1	GRWTH	CRDTS	CPI
2	RSRVS	SVNGS	MNY
3		EXIM	
Constant	4.655	45.473	12.606

As can be seen from Table 7, although the examined 3 countries are emerging countries, different influential macroeconomic indicators affect the lending (credit) interest rates.

Taking into consideration the analysis findings, China should focus on increasing the level and the speed of economic growth. Also, China should retain the current level of reserves. Hence, it is possible for China to sustain the current low-level interest rates and to prevent the lending interest rates for increasing.

For Brazil, the picture is different completely from China. Brazil should focus on credits, net export, and savings in terms of % of GDP to preserve the current low-level interest rates and to provide a decrease in the lending interest rates.

When examining Turkey, it is clear that Turkey should sustain its focus on inflation to provide a decrease in lending interest rates. Also, it is important to have a money supply level which higher than 42.07% of GDP to prevent negative effects of money supply on the lending interest rate.

As a last, as can be seen from Table 7, there is a different constant for each country. These constants mean that each country has a different count risk level. Hence, it can be understood that China has the lowest country risk premium while Brazil has the highest one. Turkey has a constant equal to 12.606 at which it has a middle-level country risk premium in terms of the lending interest rate.

6. CONCLUSION

Financial stability and stability in macroeconomic indicators such as FER, inflation, unemployment, etc. are very important for countries. In this context, there is no doubt that interest rates are one of the most important macroeconomic indicators. That is why, because they have an effect on nearly all the other macroeconomic indicators and they are also affected by nearly all the other macroeconomic indicators. Hence, it can be possible to say that interest rates are the main tool for an economy to provide balance among all macroeconomic indicators.

Interest rates are important for economies because their changes may result in either negative or positive effects on economic actors, and also they are indicators to make decisions on investments of companies and institutions by setting the level of the cost of money. Besides, interest rates have a crucial role in some economies of which their financial infrastructure depends on mainly banks because most of the economic activities in such countries are funded by banks. Taking into consideration that credits are the main funding channels of banks, then it can be clearly understood the key importance of (credit) interest rates. Also, it should be stated that the level of interest rates has leverage for international investments (FDI) of international investors which is very important for the development of emerging countries because they have shortcomings for saving and need external capital inflows.

For all these reasons mentioned above, having low-level interest rates is crucial for countries to reach low-cost finance sources, and hence sustain to funding their economic development. In this context, emerging countries have to determine which factors contribute to change in interest rates firstly. Hence, they can understand how and when the factors make effects on the interest rate, which factors have positive effects while others have negative effects. Hence, regulatory authorities of the countries may have the opportunity to develop policies to stabilize the negative effect of the factors on interest rates to have a lower level interest rate. In the next step, they should take the necessary actions to apply the developed policies.

This study aims to determine the affecting macroeconomic indicators on interest rates in emerging countries by taking into consideration that some of the emerging countries have been facing with the increasing interest rates problem. In this context, Brazil, China, and Turkey have been selected as target population to be examined, because they are the intersection set of BRICST and E7 countries of which

these groups include most of the important emerging countries. In the analysis, 11 independent macroeconomic determinants have been selected by searching the literature. Moreover, yearly data between 2002 and 2018 has been used by gathering from the World Bank and the Central Bank of the Republic of Turkey sources. These variables and the data are analyzed by using the MARS method. The followings are founded as a result of the analysis. First, economic growth and reserves have an influence on the lending (credit) interest rates in China for the period examined. Second, credits and net export are the influential macroeconomic factors on the lending (credit) interest rates in Brazil for the period examined. Third, inflation and money supply are the macroeconomic factors having effects on the lending (credit) interest rates in Turkey for the period examined. Finally, as a whole, all of the other macroeconomic indicators, except the determined influential ones on a country basis, have no effect on the lending (credit) interest rates in China, Brazil, and Turkey for the period examined.

Taking into consideration the findings of the analysis, it is recommended that China should focus on economic growth and reserves, Brazil should care about credits and net export, and Turkey must be careful about inflation and money supply to keep the credits rate under control and, reach and sustain low-level interest rate. The necessary policies should be applied accordingly. Also, policies should be implemented gradually and continuously to prevent negative developments. It is important to avoid drastic actions regarding the interest rate for these emerging countries.

Analysis results show that some variables affect negatively interest rates in a country while they do not affect the other countries. The negative effects of variables defined in the analysis should be prevented to decrease interest rates from the current level. When achieving low-level interest rates, emerging countries would benefit and provide sustainable and important financial support for their economic growth.

It may be true to say that new variables, which would be added to the literature, could be added into analysis and different and new statistical and econometric methods could be used in new studies. These studies could provide a beneficial contribution to extend the current literature. Also, new studies, including a different bundle of countries and including many more countries could be made.

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