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The Effects of Monetary Policy on the Economy in Türkiye: FAVAR Approach*

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Abstract
We investigate the effects of monetary policy on key macroeconomic variables in Türkiye over the [2005, 2019] period. We employ the Factor Augmented Vector Autoregressive (FAVAR) model involving 125 macroeconomic variables, including economic activity, money supply, interest rate, exchange rate, price level, and their sub-items. We aim to provide a comprehensive and coherent picture of the effect of monetary policy on the Turkish economy compared to the standard VARs. We examine the effects of two shocks on Turkish economy: 'interbank interest rate', a proxy variable for the policy rate of the Central Bank of the Republic of Türkiye, and 'spread', an alternative monetary policy measure which is the difference between interbank interest rate and treasury auction rate. Both of these shocks have significant effects on key macroeconomic variables in Türkiye. A positive interbank interest rate shock decreases the industrial production index, money supply, and real effective exchange rate, while increasing the short- and long-term deposit interest rates, which are largely consistent with conventional wisdom. However, following the monetary tightening, consumer inflation increases, contrary to economic theory. Thus, the price puzzle is observed. But a positive spread shock decreases the consumer inflation and the price puzzle disappears.

Keywords: Monetary policy, developing countries, Türkiye, price puzzle, FAVAR

JEL Codes Classification: C01, C38, C87, E32, E52

1. Introduction

Developing countries that are more integrated with global economic and financial markets with respect to trade and financial linkages, such as Türkiye, Brazil, Mexico, Chile, Sri Lanka, Egypt, Pakistan and Iran, are exposed to significant spillovers from the rest of the world. Their economies' vulnerability to both external and internal shocks causes a significant effect on domestic macroeconomic and financial variables (Kamin and Rogers, 1999; Arora and Censola, 2000; Le Fort and Parrado, 2006; Catao et al., 2008; Alp and Elekdag, 2011; Perera and Wickramanayake, 2013; Munir and Quayyum, 2013; Tabaghi, 2013; Kilinc and Tunc, 2014; Lemaire, 2019; Banaian et al., 2020). Therefore, investigating the effects of monetary policy

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shocks in these countries is important for understanding the transmission mechanism of monetary policy specifically and implementing effective policies using appropriate policy instruments.

One of the primary policy instruments of the central banks is the 'policy rate', holding paramount significance as it not only mirrors the central bank's stance but also communicates critical signals to economic actors. For instance, when a central bank implementing an inflation targeting regime opts to raise the policy rate, it aims to counter the perception of an impending upward trend in inflation (Woodford, 2005). In this paper, we try to examine the effects of monetary policy on key macro-economic indicators of the Turkish economy, including industrial production index, money supply (M2), short- and long-term deposit interest rates, real effective exchange rate, and inflation, during the period from 2005 to 2019. Moreover, this paper provides a detailed analysis of response of inflation to the policy rate shock, considering Türkiye's enduring struggle with high inflation. We analyze the effects of two shocks on Turkish economy: 'the interbank interest rate', determining as a proxy variable for the policy rate of the Central Bank of the Republic of Türkiye (CBRT) (similar to Clarida et al. 1998), and 'the spread' is used as an alternative monetary policy measure. The spread, used as a solution to the price puzzle, can be regarded as a variable containing information about future inflation, which is not incorporated into the model. Accordingly, the spread is constructed by taking the difference between the short-term interest rate and the long-term interest rate to eliminate the disconnect between short-term interest rates controlled by the central bank and long-term interest rates that shape the expectations of economic agents (Laurent, 1988; Stock and Watson, 1989; Berument et al., 2014). In many studies in the literature, the concept of ‘spread’ is defined in relation to different macroeconomic variables. For example, Laurent (1988) defines the spread as the difference between the 20-year bond yield and the federal funds rate, while Stock and Watson (1989) define the spread as the difference between the 1- and 10-year Treasury bond yields. In this paper, we follow Berument et al. (2014) and use their definition of the spread as the difference between the interbank interest rate and the treasury auction rate. The short-term interest rate is represented by the interbank interest rate, which is a measure of the overnight funding rate for the financial system. The long-term interest rate is denoted by the treasury auction rate, which measures returns on long-term investments (Berument et al., 2014). In the empirical analysis, we employ the Factor-Augmented Vector Autoregressive (FAVAR) approach developed by Bernanke et al. (2004), which integrates factor analysis with the standard Vector Autoregressive (VAR) model.

In the literature, the VAR model is generally used in studies analyzing the effects of monetary policy on the economy (Bernanke and Gertler, 1995). However, the standard VARs employ more than six to eight variables to conserve degrees of freedom. This contradicts the decision-making process in central banks, which have much more information than can be included in VAR models. Furthermore, the exclusion of comprehensive information sets available to policymakers, and the limitation of analysis to sparse information sets, can result in inaccurate measures of monetary policy (Bernanke and Boivin, 2003; Bernanke et al., 2004; Stock and Watson, 2005). On the other hand, with the FAVAR approach, all relevant macroeconomic variables can potentially be included in the model without creating multicollinearity problems and an impulse-response function can be obtained for any variable used in the analysis. In contrast to the standard approach, FAVAR provides a more accurate approximation of policymakers' information sets due to its reliance on a comprehensive dataset (Bernanke et al., 2004; Senbet, 2007). We estimate the FAVAR model by employing 125 macro-economic variables including economic activity, money supply, interest rate, exchange rate, price level, and their sub-items. The dataset employed in this paper is larger and more comprehensive when compared to previous studies (Varlik et al., 2015; Akdeniz and Catik, 2017; Bayraktar, 2017; Kucukefe, 2019) that have employed the FAVAR approach with the

Turkish economy dataset (see Table 1). Our aim is to provide a comprehensive and coherent picture of the effects of monetary policy on the Turkish economy.

In the empirical findings, both of these shocks are found to have significant effects on key macro-economic variables in Türkiye. A positive interbank interest rate shock (i.e. a tighter monetary policy) decreases the industrial production index, money supply (M2), and real effective exchange rate, while increasing the short- and long-term deposit interest rates, which are largely consistent with conventional wisdom. However, following the monetary tightening, the consumer inflation increases, contrary to economic theory expectations. In other words, the price puzzle is observed. Sims (1992) suggests that the traditional finding in the VAR literature, where a monetary policy contraction leads to a slight increase in inflation rather than a decrease, may be attributed to potential deficiencies in the control information available to the central bank regarding future inflation. Drawing inspiration from Sims (1992), the FAVAR model was developed by Bernanke et al. (2004) as a solution to the price puzzle, which refers to an increase in price levels following a tightening monetary policy shock, contrary to the expectations of economic theory, frequently encountered in VAR model applications, which dominate the literature in monetary policy researches. However, in the empirical findings of this paper, a price puzzle is observed, with inflation increasing in response to a positive interbank interest rate shock. This finding is interpreted as suggesting that the superiority of the FAVAR approach, often applied to economic data of developed countries like the United States in the literature (see Table 1), may not necessarily apply to developing countries' economies like Türkiye, where prices tend to be more volatile, and inflation rates are generally high. Therefore, we also investigate the effects of the spread shock, which is used as a solution to the price puzzle phenomenon. In the empirical findings, we observe that the consumer inflation responds negatively to a positive spread shock, as predicted by economic theory, and the price puzzle phenomenon disappears.

The rest of the paper is organized as follows: Section 2 presents the literature review. Section 3 presents the methodology of FAVAR approach. Preliminary analyses consisting of the data, number of factors and lags are presented in Section 4. Section 5 presents the empirical results of the paper. Discussions and conclusions based on the empirical findings of the study are presented in Section 6.

2. Literature Review

The FAVAR approach developed by Bernanke et al. (2004) has become the preferred method in recent years for monetary policy applications, contributing significantly to the literature. In the FAVAR approach, Bernanke et al. (2004) developed two alternative estimation methods: (i) a one-step Bayesian probabilistic approach involving Markov Chain Monte Carlo (MCMC) estimation and (ii) a two-step approach based on principal components analysis. Bernanke et al. (2004) employed both of these alternative methods in their analysis and found no significant difference in the results between the two. Furthermore, the study indicated that the FAVAR approach outperformed VAR models in delivering comprehensive and coherent estimations.

In literature review, studies using the FAVAR approach typically investigate the effects of monetary policy shocks on economies of countries. Table 1 presents a selection of studies employing the FAVAR approach found in the literature, categorized by country, estimation methods, identification schemes, and the number of variables.

As indicated in Table 1, it is evident that the two-step principal components approach is widely employed in the majority of studies, while only a few use the one-step Bayesian likelihood approach. In this study's empirical analysis, we adopt the two-step principal components approach for FAVAR estimation. Moreover, it is also apparent that a significant proportion of studies apply the BBE identification scheme. In our empirical analysis, we also implement the BBE identification scheme.

Table 1. FAVAR Approach Literature Review

Study	Country	Estimation	Identification	Number of Variables
Bernanke et al. (2004)	USA 1959:M1-2001:M8	2-Step Bayesian	BBE	120
Ahmadi and Uhlig (2009)	USA 1959:01-2001:08	Bayesian	Sign Restrictions	120
Liu et al. (2017)	USA,Korea,Japon,China 1997:M12-2015:M12	2-Step Bayesian	BBE	24
Blaes (2009)	Euro Zone 1986:Q4-2006:Q4	2-Step	BBE	65
Belke and Osowski (2017)	OECD 1996:M1-2015:M12	Bayesian	BBE	10
Sun and Kim (2018)	USA 1973:M2-2007:M12	Bayesian	BBE	117
Yin and Han (2015)	USA, China 1999:M1-2012:M12	2-Step	BBE	96-152*
Lagana and Mountford (2005)	United Kingdom 1992:M10-2003:M1	2-Step	BBE	105
Bagzibagli (2012)	Euro Zone 1999:M1-2011:M12	2-Step Bayesian	BBE	120
Munir and Quayyum (2013)	Pakistan 1992:M1-2010:M12	2-Step	BBE	115
Akdeniz and Catik (2017)	Türkiye 1992:M1-2015:M12	Bayesian	Parameter Restrictions	13
Varlik et al. (2015)	Türkiye 2001:M12-2014:M4	2-Step	BBE	123
Bayraktar (2017)	Türkiye 2002:Q1-2016:Q1	2-Step	BBE	88
Kucukefe (2019)	Türkiye 2005:M01-2016:M12	2-Step	BBE	50

Note: 2-Step is the abbreviation of the two-step principal components method, one of the FAVAR model estimation methods. BBE is an abbreviation for the recursive ordering identification scheme used in Bernanke et al. (2004).
*: In this study, 96 variables are used for the USA, and 152 variables for China.

Furthermore, the literature review in this study involves an examination of research focused on the effects of monetary policy in developing countries. These investigations generally employ VAR models (Berument, 2007; Catao et al., 2008; Perera and Wickramanayake, 2013; Kilinc and Tunc, 2014; Lemaire, 2019; Sumer, 2019; Can et al., 2020),

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the TVAR model (Catik and Martin, 2012; Erer et al., 2016), and the DSGE model (Alp and Elekdag, 2011) to assess how monetary policies impact Türkiye. Additionally, Berument (2007) and Berument et al. (2014) explored the consequences of the 'spread' shock, defined as the CBRT's tightening monetary policy measure, on output and prices using the VAR model. In Section 1, the disadvantages of using the VAR model in monetary policy research are discussed in detail. Moreover, Table 1 illustrates that the FAVAR approach has been predominantly employed in studies focusing on economic data from developed countries like the USA. Only four studies have employed the FAVAR approach for Türkiye, with this study using the most recent and extensive dataset available. It's worth noting that these studies primarily investigate the impact of monetary policy from a singular perspective, often centered on financial markets and interest rates (Varlik et al., 2015; Bayraktar, 2017). Therefore, we make a significant contribution to the existing literature for developing countries by offering a comprehensive and consistent analysis of the effects of monetary policy through the utilization of the FAVAR model with an extensive dataset.

3. Methodology

Bernanke et al. (2004) follow the literature on dynamic factor models, which proposes that the movements of large numbers of macro-economic time series can be summarized by the estimation of a relatively small number of “factors” or “indices” as a solution to the disadvantages of VAR models mentioned in the introduction section (Stock and Watson, 2002; Bernanke and Boivin, 2003), and argue that “if a small number of estimated factors effectively summarize a large amount of information about the economy, a natural solution to the degrees of freedom problem in VAR analyzes is to augment the standard VAR model with estimated factors.” From this idea the FAVAR model is born. The key insight of the FAVAR approach is that by using factors integrated into the model without introducing multicollinearity problems, it is possible to take into account all potentially relevant information for policy makers, and describe monetary policy shocks in a simple way as in standard VAR models.

3.1. FAVAR Model

Let Y_t be a vector of M×1 observable variables that have widespread effects on the economy. In this study, Y_t contains a variable, and this variable is the CBRT policy rate. Let X_t be a vector of N×1 informative economic time series that Y_t affects and describes all aspects of the economy, where N is a large number, and t is the time index ($t = 1,2, \ldots, T$). F_t is a vector of K×1 unobservable factors and extracted from X_t and reflects the joint movements of informative variables in period t. F_t presents abstract economic concepts that cannot be easily captured by one or two time series, such as 'economic activity' or 'credit conditions', but are instead reflected by a wide range of economic variables. In the observation equation (3.1) given below, it is assumed that the informative time series X_t is related to unobservable factors (F_t) and observable variables (Y_t):

$$X_t = \Lambda^f F_t + \Lambda^y Y_t + u_t, \quad u_t \sim N(0, R). \qquad (3.1)$$

where Λ^f is a $N \times K$ matrix of factor loadings and Λ^y is $N \times M$. u_t is a N×1 vector of error terms with zero mean, and R is the covariance matrix assumed to be diagonal. Therefore, the error terms of the observable variables are mutually uncorrelated. Equation (3.1) captures the idea that both Y_t and F_t present forces driving the joint dynamics of X_t.

Let's assume that the joint dynamics of (F_t, Y_t) are given by the following FAVAR transition equation (3.2) in a VAR process:

$$\begin{bmatrix} F_t \\ Y_t \end{bmatrix} = \Phi(L) \begin{bmatrix} F_{t-1} \\ Y_{t-1} \end{bmatrix} + v_t, \quad v_t \sim N(0, \mathbb{Q}). \qquad (3.2)$$

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where $\Phi(L)$ is a conformable lag polynomial of finite order p, which may contain a priori restrictions as in the structural VAR literature. v_t is a $(K+M) \times 1$ vector of error term with zero mean and covariance matrix $\mathbb{Q}$.

Bernanke et al. (2004) presented two approaches to estimate equations (3.1) and (3.2): (i) the likelihood-based Gibbs sampling technique developed by Geman and Geman (1984), Gelman and Rubin (1992) and Carter and Kohn (1994). (ii) a two-step principal component approach proposed by Stock and Watson (2002b). Bernanke et al. (2004) stated, these approaches differ in various dimensions. However, there is no absolute priority that requires one to be preferred over the other. In this study, FAVAR estimation is applied with a two-step principal components approach.

3.2. Estimation

Equation (3.2) cannot be estimated directly. Because F_t factors cannot be observed directly. In the two-step principal components approach, equations (3.1) and (3.2) are estimated separately. In the first step of the two-step approach, principal component analysis is applied to equation (3.1) to estimate the space spanned by the factors using the first $(K+M)$ principal components of X_t, denoted by $\hat{C}(F_t, Y_t)$(Stock and Watson, 2002b). It seems that the fact that Y_t is observable is not taken into account in the first step of estimation. Also, Bernanke et al. (2004) and Stock and Watson (2002b), when N is a large number and the number of principal components used is at least as large as the required number of factors, the principal components consistently spanned the space covered by both F_t and Y_t. $\hat{F}_t$ is obtained as the part of the space spanned by $\hat{C}_t$ that is not spanned by Y_t. This process is carried out with the assumption of identification used and specifically defined in the second step. In the second step, Y_t is extracted from the space covered by the principal components "by a performing a transformation of the principal components, taking advantage of the different behaviors of (so-called) "slow-moving" and "fast-moving" variables.

In the second step of the two-step approach, the standard VAR is estimated by replacing the unobservable factors in equation (3.2) with the principal component estimates obtained in the first step to estimate $\widehat{\Phi}(L)$:

$$\begin{bmatrix} \hat{F}_t \\ Y_t \end{bmatrix} = \Phi(L) \begin{bmatrix} \hat{F}_{t-1} \\ Y_{t-1} \end{bmatrix} + v_t.$$

The two-step approach was advantageous in terms of ease of implementation. It also has few distributional assumptions and allows for some degree of cross-correlation of the error term (u_t), as discussed by Stock and Watson (2002). However, the two-step approach implies the presence of "generated regressors" in the second step. To obtain accurate confidence intervals on the impulse response functions implements a bootstrap procedure, based on Kilian (1998), which accounts for the uncertainty in the factor estimation. Bai (2002) states that, in theory, when N is relatively larger than T, the uncertainty in the factor estimation is negligible.

3.3. Identification

Contrary to the standard VAR literature, identification issues in the FAVAR framework is more complex. In the FAVAR model, the most frequently used identification scheme in the literature is the BBE approach used in Bernanke et al. (2004) (see Table 2). There are two steps of identification in the FAVAR model: (1) Identification of factors. (2) Identification of monetary policy shocks.

In the two-step estimation by principal components method, the factors are obtained entirely from the equation (3.1). Identification of the factors is standard and BBE propose that factor identification condition for the two-step estimation is to restrict the factor loadings by $\Lambda^{f\prime}\Lambda^{f}/N = \mathrm{I}$ or to restrict the factors by $\mathrm{F}'F/T = \mathrm{I}$. Either approach introduces the same common component $\mathrm{F}\Lambda^{f\prime}$ and the same factor space. When factor restriction is applied, $\hat{F} = \sqrt{T}\hat{Z}$ is obtained. Here $\hat{Z}$ are the eigenvectors corresponding to the K largest eigenvalues of the matrix XX', sorted in descending order.

Stock and Watson (2005) classify the BBE as a similar form of simultaneous timing restriction. To identify a shock in a structural FAVAR, BBE separates structural shocks and X_t variables into three groups: “slow-moving” variables, monetary policy variable (short-term interest rate) and “fast-moving” variables. A slow-moving variable is a variable that is largely predetermined for the current period, such as output, employment and prices, while a fast-moving variable is a variable that is highly sensitive to simultaneous economic news or shocks such as asset price, exchange rate, interest rate. Following the Cholesky decomposition and simultaneous timing restrictions, BBE assumes a recursive structure for equation (3.2) that orders the policy instrument after the slow-moving factors.

4. Preliminary Analyses

4.1. Data

In this paper, we analyze quarterly data spanning from the first quarter of 2005 to the fourth quarter of 2019. The dataset, denoted as X_t, comprises 125 time series variables encompassing various macroeconomic indicators of the Turkish economy, including economic activity, price levels, interest rates, exchange rates, and monetary aggregates. All the data used in this research has been sourced directly from the CBRT Electronic Data Distribution System, ensuring data consistency and reliability. A comprehensive list of the variables utilized in this paper, along with their specific definitions and data sources, is provided in Appendix 1, contributing to transparency and facilitating the reproducibility of the research. To ensure the robustness of our analysis, we have limited our dataset to periods characterized by the stable performance of the policy rate and most macroeconomic variables. This decision is driven by the CBRT's transition to the explicit inflation targeting regime in 2006, as well as the varying policy frameworks employed in earlier periods. As a result, we have chosen to initiate our dataset from 2005, aiming to concentrate on a coherent time frame marked by relatively consistent economic dynamics. Furthermore, we have omitted data from the year 2020 onward in consideration of the substantial economic upheaval inflicted by the global Covid-19 pandemic. This exclusion is aimed at preventing potential structural breaks within the dataset. In this paper, we utilize the FAVAR methodology introduced by Bernanke et al. (2004), following Stock and Watson's (1998) dynamic factor analysis framework. To ensure the suitability of the variables for FAVAR analysis, it is imperative that they are stationary. Consequently, we subject the variables to Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. The results of these tests indicate that the majority of these time series are either stationary at the level (I(0)) or exhibit first-order stationarity (I(1)), with only 13 variables displaying second-order stationarity. The detailed results of these unit root tests for the time series can be found in Appendix 2. Following the confirmation of stationarity, the series affected by seasonality are adjusted using the Tramo-Seats method. Furthermore, as detailed in Section 3, the data employed in the FAVAR model are categorized into two distinct groups: slow-moving and fast-moving variables. The classification of variables as either fast or slow is determined based on the principles outlined by economic theory and substantiated by empirical literature.[3] Incorporated within this determination are relevant references from Section 2 and

[3] While distinguishing fast/slow variables, cluster analysis was performed to examine whether the series behave differently and/or in accordance with economic theory and empirical literature. However, as a result of the cluster analysis, there were only 2 variables in one of the two classes and 123 variables in the other.

Section 3. In our analysis, we classify economic activity, prices and money indicators as slow-moving variables that respond to policy rate shocks, while financial indicators such as interest rates and exchange rates are fast-moving variables that respond simultaneously to policy rate shocks. A detailed description of the series classification can be found in Appendix 1. In this paper, we use the code created by Chan et al. (2019) in MATLAB

Following the FAVAR methodology, Y_t is used as a policy rate shock. Firstly, Y_t presents 'the interbank interest rate' which is determined as a proxy variable for the CBRT policy rate (similar to Clarida et al. 1998) is used as a policy rate shock. As the interbank interest rate is stationary at level (I(0)), no transformation has been applied (Refer to: Appendix 2). Secondly, Y_t presents the 'spread' used as the policy rate shock. The spread is constructed by taking the difference between the short-term interest rate and the long-term interest rate, as commonly done in the literature, to incorporate expectations of future economic activities. Following Berument et al. (2014), the short-term interest rate is measured by the interbank interest rate, which represents the overnight funding rate for the financial system, and the long-term interest rate is presented by the treasury auction rate interest rate, measuring the return on long-term investments. It is worth noting that the spread is also stationary at level (I(0)), and no transformation has been applied (See: Appendix 2).

As previously discussed in Section 1 and Section 3, it's important to note that in the FAVAR approach, it is possible to determine the responses of any variable in X_t to a monetary policy shock. In this paper, the variables incorporated in X_t, and for which responses are estimated using impulse response functions in the FAVAR model, include the following: total industrial production index (IP01), general consumer price index (CPI01), M2 money supply (M02), interest rate for deposits opened in EUR with a maturity of up to 1 month (IR08), interest rate for deposits opened in EUR with a maturity of 1 year and longer (IR12), and consumer price index-based real effective exchange rate (RER01). From these variables, those that are stationary at level (I(0)) are included in the analysis at the level. In contrast, first-order stationary (I(1)) variables are included in the analysis by taking their logarithmic difference or just their difference (see Table 2).

Tablo 2 Variables who respond to a monetary policy rate shock

Variables	Abbreviation	Transformation Formula
Total Industrial Production Index	IP	$IP_t = IP01_t$
Money Supply (M2) Rate of Change	M2	$M2_t = LnM2_t - LnM2_{t-1}$
Inflation Rate	INF	$INF_t = LnCPI01_t - LnCPI01_{t-1}$
Interest Rate for Deposits Opened in EUR with a Maturity of up to 1 Month	SIR	$SIR_t = IR08_t$
Interest Rate Change for Deposits Opened in EUR with a Term of 1 Year and Longer	LIR	$LIR_t = IR12_t - IR12_{t-1}$
Consumer Price Index (CPI) Based Real Effective Exchange Rate (2003=100)	RER	$RER_t = RER01_t$

4.2. Number of Factors

One of the most important step of the preliminary analyses is determining the number of factors to be included in the FAVAR model. In our analysis, the number of factors is determined based on two criteria. Firstly, we estimate the cumulative amount of variance explained by a predefined number of factors. A common threshold in the empirical literature is to use 80% as a lower bound for the amount of explained variance (Blaes, 2009; Belke and Osowski, 2017). In our study, factor analysis reveals that 4 factors explain 81.665% of the cumulative variance. It's important to note that this criterion does not include the observable factor (Y_t) in the model, and this might lead to a relatively high explanatory power. Secondly, we assess the amount of variance in X_t explained by observable and unobservable factors using a regression model $X_t = \Lambda^f \hat{F}_t + \Lambda^y Y_t + e_t$. For this criterion, the adjusted R^2 value is found to be 0.9921, achieved by regressing the relevant series on the common factors $\hat{F}_t$ and Y_t. Consequently, this indicates that a substantial portion of the variation in the variables in X_t is explained by these 4 factors ($\hat{F}_t$, Y_t) (Blaes, 2009). Thus, we determine that the appropriate number of factors for the analysis is 4.

4.3. Number of Lags

In the VAR literature, lag lengths are often chosen based on statistical criteria such as the Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn. However, in the FAVAR literature, there is no specific well-established criterion. For instance, Bernanke et al. (2004), Belviso and Milani (2006), and Stock and Watson (2002b) used a lag length of 13 for their studies with monthly data to capture sufficient dynamics in their models. Stock and Watson (2005) also employed a 2-lag FAVAR model on an updated version of the monthly Stock and Watson (2002b) dataset. In the context of this paper, different lag lengths are experimented with in the second step of the FAVAR model estimation when applying the VAR estimation to the transition equation (3.2). The appropriate lag length was determined to be 1 by referencing the SIC information criteria.

4.4. Identification

The identification schemes of factors and the monetary policy shock in the FAVAR model are extensively explained in Section 3. In this analysis, the identification scheme utilized is the BBE approach developed by Bernanke et al. (2004). Under this scheme, a standard recursive order is employed in equation (3.2), where the 4-factor estimation ($\hat{F}_t = (\hat{F}_1, \hat{F}_2, \hat{F}_3, \hat{F}_4)'$) obtained from equation (3.1) precedes the CBRT policy rate shock (Y_t). Consequently, it is assumed that the policy rate shock responds endogenously and simultaneously to changes in other variables. However, the effect of the policy rate shock on unobservable factors is expected to occur at least a few periods later, in line with previous studies (Disyatat and Vongsinsirikul, 2003; Berument, 2007; Perera and Wickramanayake, 2013; Kilinc and Tunc, 2014)

5. Empirical Results

In this paper, we estimate a FAVAR model by the two-step principal components method. This method is more commonly used compared to the one-step likelihood method, as seen in Section 2 (see Table 1). Our primary findings are presented in Figures 1 and 2 below. We investigate the effects of (1) the interbank interest rate and (2) the spread as a tightening monetary policy shock (i.e., a positive shock) on the macroeconomic variables listed in Table 4.1

Figure 1 reports the impulse response functions of 6 macro-economic variables given in Table 2 for 8 periods with 90% confidence intervals represented by dashed lines. These intervals are generated from 1,000 bootstrap samples when a one-standard deviation shock is applied to the interbank interest rate. Similar to the approach in Bernanke et al. (2004), we construct the confidence bands using Kilian's (1998) bootstrap procedure.

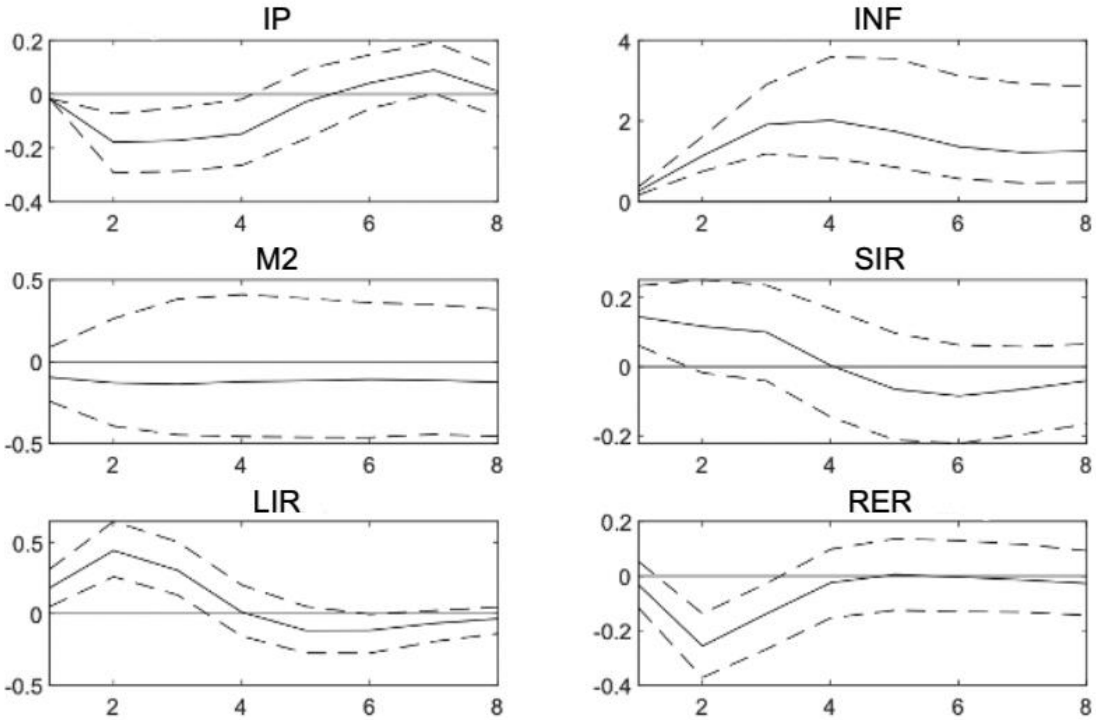

Figure 1: Impulse responses to a interbank interest rate shock

First of all, our findings in Figure 1 are largely consistent with conventional wisdom: the total industrial production index responds statistically significantly and negatively to a positive interbank interest rate shock. This response is peak in its second period. However, the effect of the shock is not permanent on the total industrial production index. The rate of change in M2 money supply respond negatively to a interbank interest rate shock, and the effect of the shock is permanent. The response of the rate of change in M2 money supply moves parallel to the zero line, and appears to be statistically insignificant. The change in short-term interest rate and long-term interest rate respond positively and similarly to the interbank interest rate shock. However, it can be expected that the effects of the interbank interest rate shock will not be permanent in the long term for both of these interest rates. Figures 1 shows that as maturities increase, the responses of these interest rates to the interbank interest rate shock increase. The real effective exchange rate responds negatively to the interbank interest rate shock. In other words, there appears to be no exchange rate puzzle, which is a special case where the local currency loses value. The response of the real effective exchange rate moves towards the zero line after the second period. Inflation responds positively to the interbank interest rate shock. The positive relationship between the policy rate and inflation is called the 'price puzzle', as mentioned in detail in Section 1. Furthermore, the 'spread', proposed in the literature as a solution to the price puzzle and an alternative monetary policy measure in countries like Türkiye, characterized by a small open economy with high inflation rates, is also employed as a tightening policy shock (Berument et al., 2014).

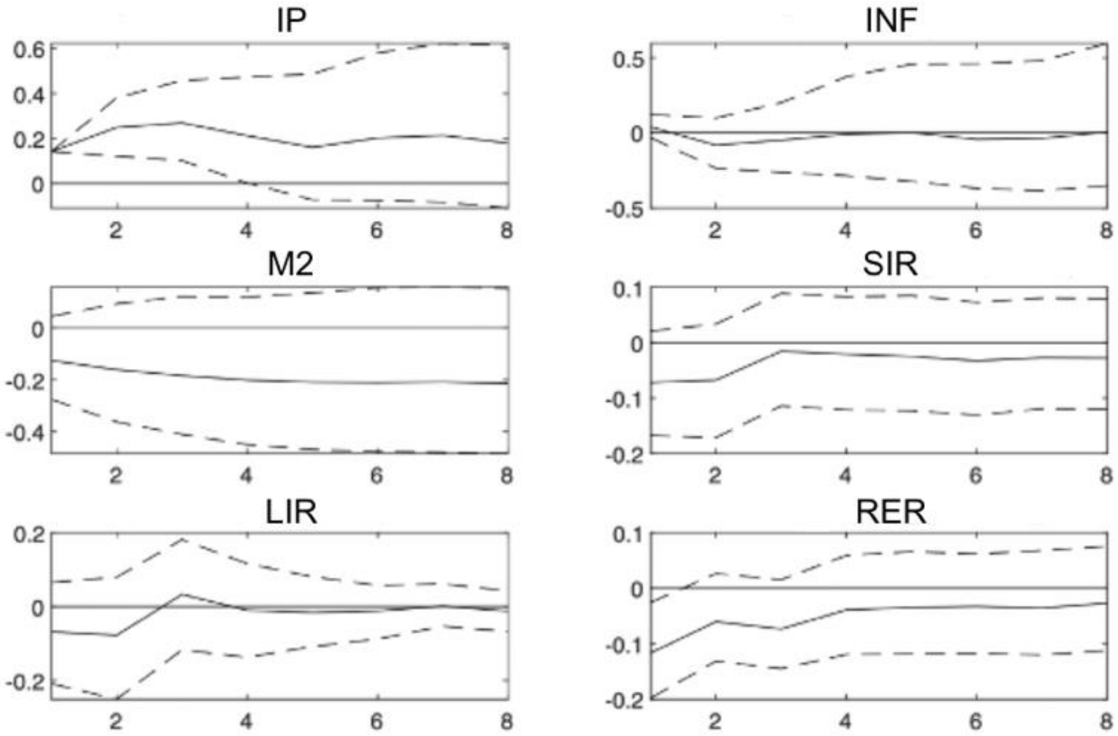

Figure 2. Impulse responses to a spread shock in the FAVAR model

Figure 2 reports the impulse response functions of 6 macro-economic variables given in Table 2 for 8 periods with 90% confidence intervals represented by dashed lines. These intervals are generated from 1,000 bootstrap samples when a one-standard deviation shock is applied to the spread. Similar to the approach in Bernanke et al. (2004), we also construct the confidence bands using Kilian's (1998) bootstrap procedure.

Figure 2 illustrates that while the initial response of inflation to a positive spread shock is positive, it turns negative after a very short period. Hence, it appears that the price puzzle phenomenon vanishes after the first period. The real effective exchange rate responds negatively and permanently to the spread shock, in other words, exchange rate puzzle phenomenon has not also been seen. Compared to the interbank interest rate shock, the response is smaller in absolute value and it will take longer for the response to converge to the zero line. The rate of change in the M2 money supply responds negatively to the spread shock. This finding is similar to the response of the rate of change in M2 money supply to the interbank interest rate. The total industrial production index responds positively to the spread shock and the effect of the shock is permanent. However, this finding is contrary to the response of the total industrial production index to the interbank interest rate. The responses of the change in short-term interest rate and long-term interest rate to the spread shock are negative, and statistically insignificant. This findings are also contrary to the responses of the change in short-term interest rate and long-term interest rate to the interbank interest rate.

6. Discussion and Conclusion

In this paper, we have investigated the effects of monetary policy on key macro-economic indicators, particularly inflation, in the Turkish economy, during the period from 2005 to 2019. In the empirical analysis, we employ the Factor-Augmented Vector Autoregressive (FAVAR) approach, which integrates factor analysis with the standard Vector Autoregressive (VAR) model. Our results provide a more comprehensive and consistent picture of the effects of monetary policy on the Turkish economy by utilizing the advantage of the FAVAR approach in working with large datasets. We analyze the two shocks to investigate the effects of monetary policy: (i) the interbank interest rate as the policy rate of CBRT, and (ii) the spread as an alternative monetary policy measure.

Empirical evidence shows that both of these shocks have significant effects on key macroeconomic variables in Türkiye. A positive interbank interest rate shock (i.e. a tighter monetary policy) decreases the industrial production index. High real interest rates resulting from tightening monetary policies reduce the demand for investment and durable goods. Additionally, the effect of tightening monetary policies on balance sheets and bank loans, by restricting the amount of bank loans, also reduces demand, leading to a decline in economic activity. This finding is consistent with studies conducted in both advanced and developing countries in the literature and with economic expectations (Christiano et al., 1994; Leeper et al., 1996; Disyatat and Vongsinsirikul, 2003; Arin and Jolly, 2005; Berument and Froyen, 2006; Berument, 2007; Catao et al., 2008; Perera and Wickramanayake, 2013; Kilinc and Tunc, 2014; Catik and Martin, 2014; Can et al., 2020). Money supply (M2) also responds negatively to the monetary tightening. This finding can be interpreted as follows: central banks use money supply as another policy tool, and hence, there is a strong liquidity effect in contractionary monetary policies. In other words, the decrease in the money supply (M2) in response to the monetary tightening is observed due to the quantitative tightening resulting from reduced credit and capital outflows. Therefore, this finding is consistent with economic expectations and the literature (Berument, 2007; Perera and Wickramanayake, 2013; Kilinc and Tunc, 2014; Catik and Martin, 2014). Following the tightening policy, the responses of short and long-term interest rates are similar and positive in line with economic expectations. The positive response of the long-term interest rate can be explained by the expectations hypothesis of the term structure, which states that the long-term interest rate reflects the average of expected future short-term interest rates. This is because central banks can be effective in short-term markets through their policy instruments. However, they are indirectly effective in long-term markets and the market determines long-term rates within its own dynamics (Boyes and Melvin, 2016). Moreover, the long-term interest rate responds more sharply to the tightening policy shock. This finding can be interpreted as a strong functioning of the expectations and interest rate channel in tightening monetary policies in Türkiye. The real effective exchange rate responds negatively to the tightening policy rate shock. In other words, there is no exchange rate puzzle, which is a special case of depreciation of the local currency. The short-term increase in the real exchange rate observed in the finding can be interpreted as a short-term increase in the real exchange rate when the nominal depreciation of the exchange rate by monetary tightening is combined with sticky prices (Perera and Wickramanayake, 2013). Therefore, the response of the real effective exchange rate is consistent with the literature and economic expectations (Kim and Roubini, 2000; Berument, 2007; Catao et al., 2008).

A tightening monetary policy has also important consequences for the consumer inflation. The consumer inflation responds positively to the tightening policy rate shock. In other words, the so-called price puzzle phenomenon, which is the situation where an unexpected tightening in monetary policy or a sudden increase in the policy rate leads to an increase in the price level instead of a decrease, is observed. If we interpret this finding similarly to the assessment of evolving monetary policies in low-income and other developing countries by the IMF (2015), it suggests that the prevalence of supply-side shocks in emerging economies like Türkiye reduces the ability of monetary policy to have a short-term influence on inflation. However, it also underscores the importance of having a clear medium-term inflation target. Moreover, models and theories describing transmission mechanisms assume a level of friction in the economy, which means that nominal prices cannot adjust immediately and proportionately following a change in monetary policy (Ireland, 2008; Walsh, 2010). This finding is not consistent with the studies for developed and developing countries such as Dale and Haldane

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(1995) for the United Kingdom, Leeper et al. (1996) for the United States, Morsink and Bayoumi (2001) for Japan, Disyatat and Vongsinsirikul (2003) for Thailand, Arin and Jolly (2005) for Australia and New Zealand. On the other hand, it is in line with Perera and Wickramanayake (2013) and Catik and Martin (2014).

The other shock whose effect is investigated in the paper is the 'spread', which has been proposed in the literature as an alternative monetary policy measure and a solution to the price puzzle in emerging economies with high inflation rates. We find that the consumer inflation responds negatively to the spread shock, thus eliminating the price puzzle phenomenon. This finding of a negative response of inflation to a positive spread shock implies that a higher interbank interest rate relative to the treasury auction rate, with all other factors remaining unchanged, implies a tighter monetary policy, and under this condition, since the central bank provides less liquidity to the market than the market accepts, it can be interpreted as a normal expectation of lower output and prices in subsequent periods. Therefore, this finding is consistent with the literature and economic theory (Berument et al., 2014). Accordingly, the finding suggests that a variable containing information about future inflation should be included as a measure of monetary policy in order to avoid the price puzzle paradox in monetary policy implementations considering the vulnerabilities in the economies of developing countries like Türkiye. In sum, the CBRT should choose the policy rate as an instrument in line with the monetary policy target and strategy without ignoring the economic structure of the country and the policy regime in place.

The empirical results of this paper are expected to shed light on the monetary policy practices of central banks and economic policymakers in developing countries such as Türkiye. In 2020, the Covid-19 pandemic, which affected the whole world and was compared to the Great Depression of 1929, caused serious damage to the economies of countries, and monetary and fiscal policies made extraordinary interventions in the economy in order to reduce the effects of the crisis. Therefore, the Covid-19 period and its aftermath should be evaluated in future studies as a new topic of study.

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Appendix 1- Data Description

All series were directly taken from Central Bank of the Republic of Türkiye (CBRT). The operations performed to make the variables used in the analysis stationary are defined under the name of transformation code. For this purpose, the codes in the Chan, Koop, Poirier and Tobias (2019) study were applied to our data set. If the series are stationary, the transformation code is '1' by not applying any transformation, or the transformation code is '4' by taking only logarithms; If the stationarity level of the series is I(1), the transformation code is '2' by taking the first order differences, or the transformation code is '5' by taking the logarithmic differences. Variables that are sensitive to sudden news and shocks in the economy are called fast-moving variables and are designated with the code 'F'; On the other hand, variables that do not respond simultaneously to sudden news and shocks are called slow-moving variables and given the code 'S'.

Economic Activity		Variables	Slow(S)/Fast(F)	Transformation Codes	Source
1	Total industry-Level	IP01	S	1	CBRT
2	Intermediate goods-Level	IP02	S	2	CBRT
3	Durable consumer goods-Level	IP03	S	2	CBRT
4	Non-durable consumer goods-Level	IP04	S	2	CBRT
5	Energy-Level	IP05	S	2	CBRT
6	Capital goods-Level	IP06	S	2	CBRT
7	Low-tech-Level	IP07	S	2	CBRT
8	Medium-low technology-Level	IP08	S	2	CBRT
9	Medium-high-tech-Level	IP09	S	2	CBRT
10	High-tech-Level	IP10	S	2	CBRT
11	Mining and quarrying-Level	IP11	S	2	CBRT

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	Economic Activity	Variables	Slow(S)/Fast(F)	Transformation Codes	Source
12	Coal and lignite extraction-Level	IP12	S	2	CBRT
13	Crude oil and natural gas extraction-Level	IP13	S	1	CBRT
14	Metal ores mining-Level	IP14	S	2	CBRT
15	Other mining and quarrying-Level	IP15	S	2	CBRT
16	Manufacturing industry-Level	IP16	S	2	CBRT
17	Food products manufacturing-Level	IP17	S	2	CBRT
18	Manufacture of beverages-Level	IP18	S	2	CBRT
19	Tobacco products manufacturing-Level	IP19	S	2	CBRT
20	Textile products manufacturing-Level	IP20	S	2	CBRT
21	Clothing manufacturing-Level	IP21	S	2	CBRT
22	Manufacture of leather and related products - Level	IP22	S	1	CBRT
23	Manufacture of wood, wood and cork products (except furniture) - Level	IP23	S	2	CBRT
24	Paper and paper products manufacturing-Level	IP24	S	2	CBRT
25	Printing and duplication of recorded media-Level	IP25	S	2	CBRT
26	Manufacture of coke and refined petroleum products - Level	IP26	S	2	CBRT
27	Manufacture of chemicals and chemical products-Level	IP27	S	1	CBRT
28	Manufacture of basic pharmaceutical products and pharmaceutical materials-Level	IP28	S	2	CBRT
29	Manufacturing of rubber and plastic products-Level	IP29	S	1	CBRT
30	Manufacture of other non-metallic mineral products-Level	IP30	S	2	CBRT
31	Basic metal industry-Level	IP31	S	2	CBRT
32	Manufacturing of fabricated metal products (except machinery and equipment) - Level	IP32	S	2	CBRT
33	Manufacture of computers, electronic and optical products - Level	IP33	S	2	CBRT
34	Electrical equipment manufacturing-Level	IP34	S	2	CBRT
35	Manufacturing of machinery and equipment not classified elsewhere- Level	IP35	S	2	CBRT
36	Manufacture of motor vehicles, trailers and semi-trailers- Level	IP36	S	2	CBRT
37	Manufacture of other transportation vehicles-Level	IP37	S	2	CBRT
38	Furniture manufacturing-Level	IP38	S	2	CBRT
39	Other manufacturing-Level	IP39	S	1	CBRT
40	Installation and repair of machinery and equipment-Level	IP40	S	2	CBRT

	Economic Activity	Variables	Slow(S)/Fast(F)	Transformation Codes	Source
41	Electricity, gas, steam and air conditioning production and distribution- Level	IP41	S	2	CBRT
42	Consumption of resident households (Thousand TL)-Level	GDP01	S	5	CBRT
43	Consumption of non-profit organizations serving households (Thousand TL)-Level	GDP02	S	5	CBRT
44	Government final consumption expenditures (Thousand TL)-Level	GDP03	S	5	CBRT
45	Gross fixed capital formation (Thousand TL)-Level	GDP04	S	4	CBRT
46	Exports of goods and services (Thousand TL)-Level	GDP05	S	5	CBRT
47	(Minus) Imports of goods and services (Thousand TL)-Level	GDP06	S	5	CBRT
48	Gross domestic product (Thousand TL)-Level	GDP07	S	5	CBRT
49	Agriculture, forestry and fishing (Thousand TL)-Level	GDP08	S	4	CBRT
50	Industry (Thousand TL)-Level	GDP09	S	5	CBRT
51	Manufacturing industry (Thousand TL)-Level	GDP10	S	5	CBRT
52	Construction (Thousand TL)-Level	GDP11	S	5	CBRT
53	Services (Thousand TL)-Level	GDP12	S	5	CBRT

	Economic Activity	Variables	Slow(S)/Fast(F)	Transformation Codes	Source
54	Finance and insurance activities (Thousand TL)-Level	GDP14	S	5	CBRT
55	Real estate activities (Thousand TL)-Level	GDP15	S	5	CBRT
56	Professional, administrative and support service activities (Thousand TL)-Level	GDP16	S	4	CBRT
57	Public administration, education, human health and social service activities (Thousand TL)-Level	GDP17	S	5	CBRT
58	Total of sectors (Thousand TL)-Level	GDP19	S	5	CBRT
59	Tax-subsidy (Thousand TL)-Level	GDP20	S	5	CBRT
60	Gross Domestic Product (at buyer's prices) (Thousand TL)-Level	GDP21	S	5	CBRT

Price Indexes

	Economic Activity	Variables	Slow(S)/Fast(F)	Transformation Codes	Source
61	Consumer Price Index (General)-Level	CPI01	S	5	CBRT
62	CPI-Level excluding seasonal products	CPI02	S	5	CBRT
63	CPI-Level excluding alcoholic beverages and tobacco	CPI06	S	5	CBRT
64	Goods-Level	CPI08	S	5	CBRT
65	Energy-Level	CPI09	S	5	CBRT
66	Food and Non-Alcoholic Beverages-Level	CPI10	S	5	CBRT
67	Unprocessed food-Level	CPI11	S	5	CBRT

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68	Fresh fruits and vegetables-Level	CPI12	S	5	CBRT
69	Other unprocessed food-Level	CPI13	S	5	CBRT
70	Processed food-Level	CPI14	S	5	CBRT
71	Bread and cereals-Level	CPI15	S	5	CBRT
72	Other processed food-Level	CPI16	S	5	CBRT
73	Energy and non-food goods-Level	CPI17	S	5	CBRT
74	Clothing and Shoes-Level	CPI19	S	5	CBRT
75	Durable Goods (except gold)-Level	CPI20	S	5	CBRT
76	Other Basic Goods-Level	CPI21	S	5	CBRT
77	Alcoholic beverages, tobacco and gold-Level	CPI22	S	5	CBRT
78	Rent-Level	CPI24	S	5	CBRT
79	Restaurants and hotels-Level	CPI25	S	5	CBRT
80	Transport services-Level	CPI26	S	5	CBRT
81	Communication services-Level	CPI27	S	5	CBRT
82	Domestic Producer Price Index	PPI01	S	5	CBRT
83	Food products	PPI02	S	5	CBRT
84	Dairy products	PPI03	S	5	CBRT
85	Pesticides and other agrochemical products	PPI04	S	5	CBRT
86	Soaps and detergents, cleaning and polishing products, perfumes and care products	PPI05	S	5	CBRT
87	Essential pharmaceutical products and preparations	PPI06	S	5	CBRT
88	Plastic products	PPI07	S	5	CBRT
89	Glass and glass products	PPI08	S	5	CBRT
	Economic Activity	Variables	Slow(S)/Fast(F)	Transformation Codes	Source
90	Cement lime and plaster	PPI09	S	5	CBRT
91	Milled grain products, starch and starchy products	PPI10	S	5	CBRT

Money

	Economic Activity	Variables	Slow(S)/Fast(F)	Transformation Codes	Source
92	M1	M01	S	5	CBRT
93	M2	M02	S	5	CBRT
94	M3	M03	S	5	CBRT

Interest Rates

	Economic Activity	Variables	Slow(S)/Fast(F)	Transformation Codes	Source
95	Need (Opened in TL) (Flow Data, %)-Level	IR01	F	1	CBRT
96	Vehicle (Opened in TL) (Flow Data, %)-Level	IR02	F	2	CBRT
97	Housing (Opened in TL) (Flow Data, %)-Level	IR03	F	1	CBRT
98	Commercial (Opened in TL) (Flow Data, %)-Level	IR04	F	1	CBRT
99	Commercial (Opened in EUR) (Flow Data, %)-Level	IR05	F	2	CBRT
100	Commercial (Opened in USD) (Flow Data, %)-Level	IR06	F	2	CBRT
101	Consumer Loan (Opened in TL) (Needs+Vehicle+Housing) (Flow Data,%)-Level	IR07	F	1	CBRT
102	Up to 1 Month Maturity (Deposits Opened in EUR) (Flow %)-Level	IR08	F	1	CBRT
103	Up to 3 Months Maturity (Deposits Opened in EUR) (Flow %)-Level	IR09	F	2	CBRT

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104	Up to 6 Months Maturity (Deposits Opened in EUR) (Flow %)-Level	IR10	F	2	CBRT
105	Up to 1 Year Maturity (Deposits Opened in EUR) (Flow %)-Level	IR11	F	1	CBRT
106	1 Year and Longer Term (Deposits Opened in EUR) (Flow %)-Level	IR12	F	2	CBRT
107	Total (Deposits Opened in EUR) (Flow %)-Level	IR13	F	1	CBRT
108	Up to 1 Month Maturity (Deposits Opened in TL) (Flow %)-Level	IR14	F	2	CBRT
109	Up to 3 Months Maturity (Deposits Opened in TL) (Flow %)-Level	IR15	F	2	CBRT
110	Up to 6 Months Maturity (Deposits Opened in TL) (Flow %)-Level	IR16	F	2	CBRT
111	Up to 1 Year Maturity (Deposits Opened in TL) (Flow %)-Level	IR17	F	2	CBRT
112	1 Year and Longer Term (Deposits Opened in TL) (Flow %)-Level	IR18	F	2	CBRT
113	Total (Deposits Opened in TL) (Flow %)-Level	IR19	F	2	CBRT
114	Up to 1 Month Maturity (Deposits Opened in USD) (Flow %)-Level	IR20	F	2	CBRT
115	Up to 3 Months Maturity (Deposits Opened in USD) (Flow %)-Level	IR21	F	2	CBRT
116	Up to 6 Months Maturity (Deposits Opened in USD) (Flow %)-Level	IR22	F	2	CBRT
117	Up to 1 Year Maturity (Deposits Opened in USD) (Flow %)-Level	IR23	F	2	CBRT
118	1 Year and Longer Term (Deposits Opened in USD) (Flow %)-Level	IR24	F	2	CBRT
119	Total (Deposits Opened in USD) (Flow %)-Level	IR25	F	2	CBRT
120	Discount Rate Applied in Rediscount Transactions (%)-Level	IR26	F	1	CBRT
121	Interest Rate Applied in Advance Transactions (%)-Level	IR27	F	1	CBRT

Exchange rates

	Economic Activity	Variables	Slow(S)/Fast(F)	Transformation Codes	Source
122	CPI Based Real Effective Exchange Rate (2003=100)-Level	RER01	F	1	CBRT
123	CPI Developing Countries Based Real Effective Exchange Rate (2003=100)-Level	RER02	F	1	CBRT
124	CPI Developed Countries Based Real Effective Exchange Rate (2003=100)-Level	RER03	F	2	CBRT
125	D-PPI Based Real Effective Exchange Rate (2003=100)-Level	RER04	F	1	CBRT

Appendix 2- Results of ADF and PP Unit Root Tests

ADF				PP			
Variable	Decision	t Statistics	Probability Value	Variable	Decision	t Statistics	Probability Value
IP01	I(0)	-3.187	0.097*	IP01	I(0)	-5.362	0.000*
IP02	I(1)	-4.316	0.001*	IP02	I(0)	-4.886	0.001*
IP03	I(1)	-10.980	0.000*	IP03	I(0)	-7.641	0.000*
IP04	I(1)	-3.659	0.007*	IP04	I(0)	-6.896	0.000*
IP05	I(1)	-3.299	0.019*	IP05	I(0)	-6.434	0.000*
IP06	I(1)	-4.262	0.001*	IP06	I(0)	-4.759	0.001*
IP07	I(1)	-9.949	0.000*	IP07	I(1)	-9.956	0.000*
IP08	I(1)	-10.283	0.000*	IP08	I(1)	-10.093	0.000*
IP09	I(1)	-10.266	0.000*	IP09	I(1)	-10.266	0.000*
IP10	I(1)	-3.003	0.040*	IP10	I(0)	-5.284	0.000*
IP11	I(1)	-3.702	0.006*	IP11	I(0)	-3.520	0.010*
IP12	I(1)	-11.121	0.000*	IP12	I(0)	-2.994	0.041*
IP13	I(0)	-3.514	0.047*	IP13	I(1)	-9.615	0.000*
IP14	I(1)	-3.717	0.006*	IP14	I(0)	-4.331	0.005*
IP15	I(1)	-3.793	0.005*	IP15	I(0)	-4.692	0.000*
IP16	I(1)	-4.040	0.002*	IP16	I(0)	-5.347	0.000*
IP17	I(1)	-5.010	0.000*	IP17	I(0)	-4.406	0.000*
IP18	I(1)	-5.001	0.000*	IP18	I(0)	-5.437	0.000*
IP19	I(1)	-9.973	0.000*	IP19	I(0)	-3.841	0.004*
IP20	I(1)	-2.537	0.012*	IP20	I(0)	-3.417	0.058**
IP21	I(1)	-8.800	0.000*	IP21	I(1)	-8.980	0.000*
IP22	I(0)	-3.582	0.040*	IP22	I(0)	-3.515	0.046*
IP23	I(1)	-3.192	0.025*	IP23	I(0)	-4.548	0.002*
IP24	I(1)	-3.467	0.012*	IP24	I(1)	-13.313	0.000*
IP25	I(1)	-16.054	0.000*	IP25	I(0)	-3.710	0.006*
IP26	I(1)	-3.809	0.005*	IP26	I(0)	-3.028	0.038*
IP27	I(0)	-3.543	0.044*	IP27	I(0)	-4.239	0.007*
IP28	I(1)	-3.609	0.008*	IP28	I(0)	-6.294	0.000*
IP29	I(0)	-3.764	0.026*	IP29	I(0)	-4.355	0.005*
IP30	I(1)	-4.356	0.001*	IP30	I(0)	-3.879	0.003*
IP31	I(1)	-2.759	0.006*	IP31	I(1)	-10.324	0.000*
IP32	I(1)	-3.380	0.016*	IP32	I(0)	-4.754	0.001*
IP33	I(1)	-3.473	0.012*	IP33	I(0)	-3.320	0.018*
IP34	I(1)	-3.125	0.030*	IP34	I(0)	-4.219	0.007*
IP35	I(1)	-3.908	0.003*	IP35	I(0)	-3.913	0.017*
IP36	I(1)	-4.610	0.000*	IP36	I(0)	-4.285	0.006*
IP37	I(1)	-10.767	0.000*	IP37	I(1)	-11.592	0.000*
IP38	I(1)	-10.509	0.000*	IP38	I(0)	-6.812	0.000*
IP39	I(0)	-5.105	0.000*	IP39	I(0)	-4.965	0.000*
IP40	I(1)	-3.050	0.036*	IP40	I(0)	-3.253	0.084**
IP41	I(1)	-3.305	0.019*	IP41	I(0)	-8.586	0.000*
GDP01	I(1)	-4.647	0.000*	GDP01	I(0)	-5.825	0.000*
GDP02	I(1)	-3.792	0.024*	GDP02	I(1)	-9.551	0.000*
GDP03	I(1)	-25.793	0.000*	GDP03	I(0)	-9.725	0.000*
GDP04	I(0)	-3.697	0.030*	GDP04	I(0)	-4.699	0.001*
GDP05	I(1)	-4.153	0.001*	GDP05	I(0)	-4.743	0.001*
GDP06	I(1)	-5.614	0.000*	GDP06	I(0)	-3.400	0.061**
GDP07	I(1)	-3.840	0.021*	GDP07	I(0)	-6.142	0.000*
GDP08	I(0)	-3.567	0.042*	GDP08	I(0)	-8.160	0.000*
GDP09	I(1)	-3.663	0.007*	GDP09	I(0)	-5.257	0.000*
GDP10	I(1)	-3.192	0.025*	GDP10	I(0)	-5.291	0.000*
GDP11	I(1)	-2.410	0.016*	GDP11	I(0)	-5.737	0.000*
GDP12	I(1)	-2.215	0.027*	GDP12	I(0)	-4.931	0.000*
GDP14	I(1)	-10.213	0.000*	GDP14	I(0)	-5.611	0.000*
GDP15	I(1)	-3.001	0.040*	GDP15	I(0)	-3.580	0.040*
GDP16	I(0)	-3.678	0.033*	GDP16	I(0)	-7.479	0.000*
GDP17	I(1)	-3.768	0.005*	GDP17	I(0)	-3.976	0.014*
GDP19	I(1)	-2.782	0.067**	GDP19	I(0)	-6.056	0.000*
GDP20	I(1)	-3.376	0.016*	GDP20	I(0)	-7.200	0.000*
GDP21	I(1)	-3.840	0.021*	GDP21	I(0)	-6.142	0.000*

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ADF				PP			
Variable	Decision	t Statistics	Probability Value	Variable	Decision	t Statistics	Probability Value
CPI01	I(1)	-4.163	0.001*	CPI01	I(1)	-4.163	0.001*
CPI02	I(1)	-3.752	0.005*	CPI02	I(1)	-3.548	0.010*
CPI03	I(1)	-4.275	0.001*	CPI03	I(1)	-4.102	0.002*
CPI04	I(1)	-6.023	0.000*	CPI04	I(1)	-4.550	0.000*
CPI05	I(1)	-6.744	0.000*	CPI05	I(1)	-4.976	0.000*
CPI06	I(1)	-6.063	0.000*	CPI06	I(1)	-6.004	0.000*
CPI08	I(2)	-8.680	0.000*	CPI08	I(1)	-7.213	0.000*
CPI09	I(2)	-8.766	0.000*	CPI09	I(0)	-3.302	0.075**
CPI10	I(1)	-5.565	0.000*	CPI10	I(1)	-5.538	0.000*
CPI11	I(2)	-10.730	0.000*	CPI11	I(1)	-3.800	0.004*
CPI12	I(1)	-3.353	0.016*	CPI12	I(1)	-3.313	0.018*
CPI13	I(2)	-11.910	0.000*	CPI13	I(1)	-4.206	0.001*
CPI14	I(2)	-6.408	0.000*	CPI14	I(1)	-7.263	0.000*
CPI15	I(2)	-5.871	0.000*	CPI15	I(1)	-8.549	0.000*
CPI16	I(1)	-4.857	0.001*	CPI16	I(0)	-4.380	0.004*
CPI17	I(1)	-3.860	0.020*	CPI17	I(1)	-5.178	0.000*
CPI19	I(1)	-4.932	0.000*	CPI19	I(1)	-4.910	0.000*
CPI20	I(2)	-2.438	0.015*	CPI20	I(2)	-10.548	0.000*
CPI21	I(2)	-10.239	0.000*	CPI21	I(1)	-2.966	0.044*
CPI22	I(1)	-3.761	0.005*	CPI22	I(1)	-3.761	0.005*
CPI23	I(1)	-5.661	0.000*	CPI23	I(1)	-5.661	0.000*
PPI01	I(1)	-4.673	0.000*	PPI01	I(1)	-4.724	0.000*
PPI02	I(1)	-4.727	0.000*	PPI02	I(1)	-4.687	0.000*
PPI03	I(2)	-14.687	0.000*	PPI03	I(1)	-4.141	0.001*
PPI04	I(1)	-5.087	0.000*	PPI04	I(1)	-5.179	0.000*
PPI05	I(1)	-4.184	0.001*	PPI05	I(1)	-4.184	0.001*
PPI06	I(2)	-6.329	0.000*	PPI06	I(1)	-4.378	0.000*
PPI07	I(2)	-6.800	0.000*	PPI07	I(1)	-4.250	0.001*
PPI08	I(1)	-3.086	0.033*	PPI08	I(1)	-2.952	0.045*
PPI09	I(1)	-3.533	0.010*	PPI09	I(1)	-3.539	0.010*
PPI10	I(1)	-3.948	0.003*	PPI10	I(1)	-4.024	0.002*
M01	I(1)	-6.679	0.000*	M01	I(1)	-7.316	0.000*
M02	I(2)	-6.333	0.000*	M02	I(1)	-7.269	0.000*
M03	I(2)	-5.874	0.000*	M03	I(1)	-7.312	0.000*
IR01	I(0)	-2.641	0.090**	IR01	I(0)	-2.676	0.084**
IR02	I(1)	-5.032	0.000*	IR02	I(1)	-5.053	0.000*
IR03	I(0)	-2.962	0.044*	IR03	I(1)	-5.706	0.000*
IR04	I(0)	-2.596	0.099*	IR04	I(0)	-2.610	0.096**
IR05	I(1)	-6.144	0.000*	IR05	I(1)	-6.089	0.000*
IR06	I(1)	-6.380	0.000*	IR06	I(1)	-6.441	0.000*
IR07	I(0)	-2.774	0.068**	IR07	I(0)	-2.734	0.074**
IR08	I(0)	-3.611	0.037*	IR08	I(1)	-5.859	0.000*
IR09	I(1)	-5.654	0.000*	IR09	I(1)	-5.654	0.000*
IR10	I(1)	-6.612	0.000*	IR10	I(1)	-6.612	0.000*
IR11	I(0)	-3.688	0.031*	IR11	I(1)	-5.921	0.000*
IR12	I(1)	-6.195	0.000*	IR12	I(1)	-6.232	0.000*
IR13	I(0)	-3.604	0.038*	IR13	I(1)	-5.692	0.000*
IR14	I(1)	-4.318	0.001*	IR14	I(1)	-4.316	0.001*
IR15	I(1)	-4.627	0.000*	IR15	I(1)	-4.608	0.000*
IR16	I(1)	-5.246	0.000*	IR16	I(1)	-5.230	0.000*
IR17	I(1)	-5.438	0.000*	IR17	I(1)	-5.418	0.000*
IR18	I(1)	-6.120	0.000*	IR18	I(1)	-6.120	0.000*
IR19	I(1)	-4.527	0.000*	IR19	I(1)	-4.513	0.000*
IR20	I(1)	-5.845	0.000*	IR20	I(1)	-5.847	0.000*
IR21	I(1)	-6.476	0.000*	IR21	I(1)	-6.460	0.000*
IR22	I(1)	-6.210	0.000*	IR22	I(1)	-6.140	0.000*
IR23	I(1)	-7.448	0.000*	IR23	I(1)	-7.448	0.000*
IR24	I(1)	-6.036	0.000*	IR24	I(1)	-6.226	0.000*
IR25	I(1)	-5.929	0.000*	IR25	I(1)	-5.933	0.000*

ADF				PP			
Variable	Decision	t Statistics	Probability Value	Variable	Decision	t Statistics	Probability Value
IR26	I(0)	-1.944	0.050**	IR26	I(1)	-7.376	0.000*
IR27	I(0)	-2.053	0.039*	IR27	I(1)	-7.513	0.000*
RER01	I(0)	-3.196	0.095**	RER01	I(1)	-8.520	0.000*
RER02	I(0)	-3.882	0.018*	RER02	I(0)	-3.925	0.016*
RER03	I(1)	-8.153	0.000*	RER03	I(1)	-8.239	0.000*
RER04	I(0)	-3.537	0.044*	RER04	I(0)	-3.606	0.037*
Interbank Rate	I(0)	-4.070	0.002*	Interbank Rate	I(0)	-2.995	0.041*
Spread	I(0)	-6.911	0.000	Spread	I(0)	-4.243	0.001*

*: Stationary at 5% significance level.
**: Stationary at 10% significance level.