Uncertainty and Monetary Policy: A Svar Analysis for Turkey

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Abstract
It is known that periods of high uncertainty in a country have significant effects on economic activities. Therefore, monetary policymakers should consider the degree of uncertainty in the decision-making process. In Turkey, changing the form of government from the parliamentary system to a presidential system in 2018, combined with the global Covid pandemic that started in 2020, caused an extraordinary increase in uncertainty and became one of the main sources of economic problems in the country. This study quantifies the effects of uncertainty on the Turkish economy through an SVAR model estimated with Bayesian techniques. The results show that high uncertainty has a negative and significant effect on economic activities, mainly with the decrease in consumption and investment expenditures. The Central Bank of the Republic of Turkey reacts to these developments with an expansionary monetary policy that injects liquidity into the economy. However, it should not be overlooked that such a policy has limitations due to its long-term negative effects.

Keywords: uncertainty, economic activities, monetary policy, SVAR model

1. Introduction

In an economy, uncertainty shocks are defined as one of the main drivers of business cycles (Ludvigson et al., 2021; Bloom, 2009). The fact that the two major declines observed in real economic activities during the last century, namely the Great Depression and the Covid-19 Recession, are matched with the uncertainty shocks, strengthens this idea. In this case, the degree of uncertainty in the economy should be taken into account while making monetary policy decisions. Despite this importance, there is no consensus in the literature on the definition of the phenomenon of uncertainty. Different methods have been developed to measure the effects of uncertainty on real economic activities. Over time, conceptually different indicators have emerged in terms of both the methods and the source of information used (Deutsche Bundesbank-DB, 2018). Studies using different methods and information sets have proven that uncertainty has negative effects on both micro and macroeconomic variables.

Different events, both in the world economy and in individual countries, and different factors playing a role in these events have encouraged the conduct of more studies analyzing the economic effects of uncertainty. Globalization, economic and financial crises, volatility in raw

931material and food prices, tensions in international trade, developments with global repercussions (such as Brexit) can be considered prominent events, among others. The recent global Covid-19 pandemic has led to the emergence of new studies to evaluate its effects on the volume of world economic activity. A group of these studies focused on the effects of this epidemic through the uncertainty channel and found negative results for the volume of economic activity (Baker et al. 2020; Leduc&Liu, 2020, Pinshi, 2020; Pellegrino et al., 2020; Marschner&Ceretta, 2021, Blot et al., 2020; Prabheesh et al, 2021).

In this study, a structural vector autoregressive (SVAR) model estimated by Bayesian techniques is used to quantify the economic effects of uncertainty in the Turkish case. The Turkey Uncertainty Index (WUI_TUR) obtained from the World Uncertainty Index (WUI) website was used to represent the level of uncertainty. This index makes it possible to distinguish periods of high uncertainty, often symbolized by political and social instability, and to a lesser extent by an economic slowdown. The emergence of Covid-19 during the political transition period in which Turkey transformed from a parliamentary system to a presidential one in 2018 created an extraordinary increase in uncertainty. According to the empirical results obtained, periods of high uncertainty have a significant negative impact on economic activities in Turkey. This negative effect is mainly transmitted to the economy through a decrease in consumption and investment expenditures. The Central Bank of the Republic of Turkey (CBRT) reacts with an expansionary monetary policy by injecting liquidity into the economy in these periods. However, it is a well-known fact that this kind of expansionary policy has its limits.

In the following part of the study, a brief literature review is presented by emphasizing the findings obtained in some previous studies regarding the main economic consequences of uncertainty. The third section describes the general characteristics of high uncertainty periods and discusses how the CBRT reacted during the review period. The fourth section explains the main features of the estimation method used, while the fifth section discusses the data set used and the results obtained. In the sixth section, the conclusions are highlighted.

2. Literature Review

As stated in Bachmann et al. (2013), the phenomenon of uncertainty is included in the economic analysis in Thorstein Veblen's 1904 work titled "The Theory of Business Enterprise" and Joseph A. Schumpeter's 1912 work titled *"The Theory of Economic Development. An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle"*. Uncertainty as an economic concept was first defined by Knight (1921) as "the inability of economic agents to predict the probability of occurrence of events". In other words, uncertainty is the inability of the public to determine the possible future state of the economy. A high level of uncertainty about the future limits the decision-making skills of economic agents. With the work of Bernanke (1983) in the 1980s, the number of studies focusing specifically on the economic effects of uncertainty began to increase. The 2008 Global Financial Crisis and the 2020 Covid-19 pandemic have led to a renewed interest of decision-makers and economists on the channels through which uncertainty arises and affects the economy.

The general conclusion reached by the literature on uncertainty can be summarized as "it is a phenomenon that decision-makers should consider more in the formulation of monetary policy

decisions and crisis management" (for example, Bernanke, 1983; Greenspan, 2004; Bloom, 2009 and 2014; Aastveit et al., 2013; Pinshi, 2020; Priyaranjan&Pratap, 2020; Pellegrino et al., 2020; Marschner&Ceretta, 2021). Pinshi (2020) divides the uncertainty that a central bank should consider in making monetary policy decisions into three groups: uncertainty about the state of the economy, uncertainty about the structure of the economy, and strategic uncertainty. Therefore, the evaluation of the economic effects of uncertainty primarily depends on the adequate determination of this phenomenon (DB, 2018). Although there are theoretical developments regarding the definition of the uncertainty concept, a widely accepted definition could not be reached and, as a result, different uncertainty criteria have emerged. These criteria are conceptually different from each other in terms of both the source of the information and the methodology used in the process of establishing them. According to DB (2018), which gives a comprehensive review of the different types of uncertainty indicators that have been developed in the literature, these indicators are a combination of uncertainty, risk and, in certain cases, surprises.

Given the nature of the uncertainty concept, theoretically, there may be a vast number of transmission channels through which uncertainty can have a negative impact on production volume (Bloom, 2014). The most studied and different results obtained transmission channel is the one that works through investments. This channel is often known as the "real options" channel and states that uncertainty will cause firms to delay investments and employment (Bernanke, 1983; Caballerro, 1991; Pindyck, 1991). As stated by Bertola&Caballero (1994), the direction of the relationship between variables representing investments and uncertainty cannot be proven *a priori*. A wide number of studies reach the conclusion that the relationship between uncertainty and investments is the inverse direction (Bloom, 2014). However, there are also opinions suggesting that uncertainty may have a positive effect on economic activities under certain conditions. According to the Oi-Hartman-Abel effect, if firms think that it will be beneficial to adapt to different economic and political conditions in the future, uncertainty can have a positive effect on investments and therefore on economic activities (Abel, 1983). However, it is believed that such an effect can only be strong in the long run. According to a transmission channel that we can call the "cost of financing" channel, it is possible to experience a decrease in investments due to the increased risk premium and the correspondingly rising borrowing cost (Christiano et al., 2014; Arellano et al., 2017).

It is also necessary to mention the studies which determine that uncertainty will have negative effects on employment and consumption. In the employment context, employers may prefer a wait-and-see approach before hiring workers, which contributes to higher unemployment (Baker et al., 2016; Caggiano et al., 2017; Leduc&Liu, 2020). According to the "precautionary savings" channel operating at the household level, in times of high uncertainty, households reduce their expenditures for prudence and increase their savings. This causes a decrease in consumption, especially in the demand for durable goods (Basu&Bundick, 2017; Belke&Kronen, 2017), resulting in a contraction in output level.

The results obtained on the effect of uncertainty on prices make it difficult to reach a final decision. In some studies, results indicate that inflation decreases as a sign that production and prices move in the same direction (Leduc&Liu, 2016). However, it is necessary to mention the studies that provide evidence that inflation increases due to the fact that firms increase prices in
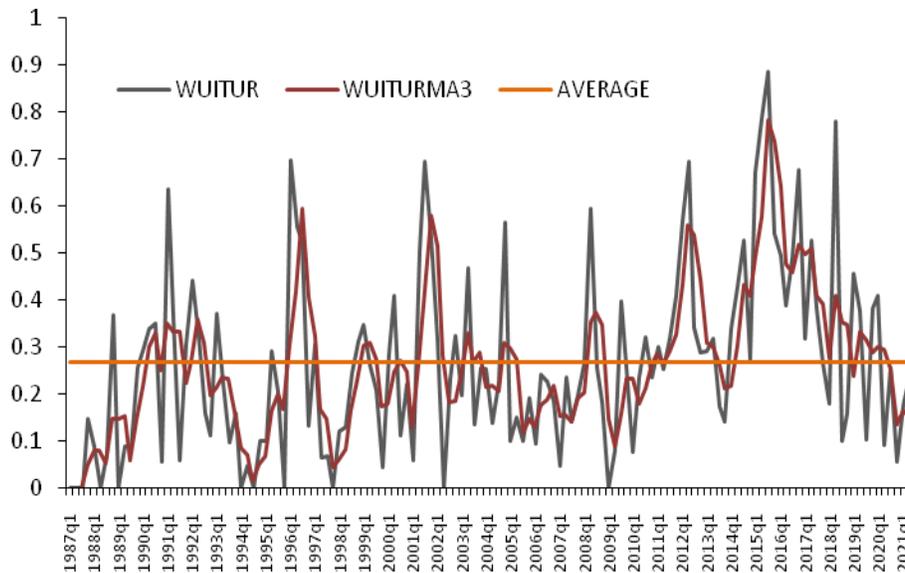
the face of the negative effect of uncertainty shocks (Born&Pfeifer, 2014). There are also studies that have found that increasing uncertainty does not have a significant effect on inflation (DB, 2018).

Much of the literature on uncertainty and its economic effects uses data from developed countries. The number of studies on the economic effects of uncertainty in emerging markets is limited (see, for instance, Carriere&Cespedes, 2013; Abiad et al.,2016; Cerda et al., 2018; Pinshi, 2020 and Sahinoz&Cosar, 2020). However, emerging economies are more volatile than developed economies in terms of macroeconomic variables. Given that these countries need more external financial resources to maintain stable economic growth, it can be easily understood that reducing uncertainties arising from domestic factors is of vital importance. As an emerging economy, the number of research on the economic effects of uncertainty in Turkey is quite limited, although it has increased due to the Covid-19 pandemic. For instance, in her study, Guney (2018) examines the effect of uncertainty on the monetary policy response function and finds that the output gap increases in the face of uncertainty. The study uses the GMM estimation technique for the 2002-2015 monthly data and the uncertainty is included in the analysis with the standard deviation of the year-end annual inflation expectations obtained from the CBRT's survey. In the study of Sahinoz&Cosar (2020), a composite uncertainty index based on newspaper coverage frequency is developed for Turkey and the relationship between uncertainty and basic macroeconomic variables is investigated through a VAR model estimated for the 2006-2017 period. While the results show that increasing uncertainty has a negative effect on economic growth, consumption and investments, it is determined that the most intense negative effect is on investments. In a recent study, Mugaloglu et al. (2021) create an economic uncertainty index for the 2011-2020 period by using basic macroeconomic indicators through principal component analysis. In the study, the effect of the uncertainty shock experienced during the Covid-19 period on economic activities is investigated through a SVAR model. The results obtained point to a serious decrease in output due to the contraction in the production of intermediate and industrial goods.

3. Uncertainty in Turkey: Some Stylized Facts

Quantitative determination of the macroeconomic effects of uncertainty is carried out by using various indicators that are thought to represent the phenomenon of uncertainty. Some studies use more than one indicator to support and verify the results obtained. In this study, the phenomenon of uncertainty is included in the analysis by using WUI_TUR (the sub-index of the World Uncertainty Index (WUI)) calculated for Turkey by Ahir et al. (2022). Depending on the method used in its creation, this indicator falls within the scope of criteria based on newspapers, but instead of information in newspapers, information in economic reports is used. In the creation of the indicator, the number of occurrences of the word "uncertainty" and its derivatives in the quarterly country reports published by the Economist Intelligence Unit (EUI) of The Economist magazine is used, and they calculate uncertainty indices at a quarterly frequency for 143 countries.EIU reports take the key political and economic developments in each country and make predictions for the future course of the related country." The indices are normalized by the total number of words and rescaled by multiplying by 1,000. A higher number means higher

uncertainty and vice versa" (Ahir et al., 2022). The course of the uncertainty indicator calculated for Turkey in the period considered in this study (1987 – 2021) is shown in Figure 1.

Note: WUITUR: Uncertainty index for Turkey, WUITURMA3: 3-Quarter Moving Average of WUITUR, AVERAGE: Simple Mean of WUITUR

Figure 1: WUI_TUR Uncertainty Index (1987 – 2021)

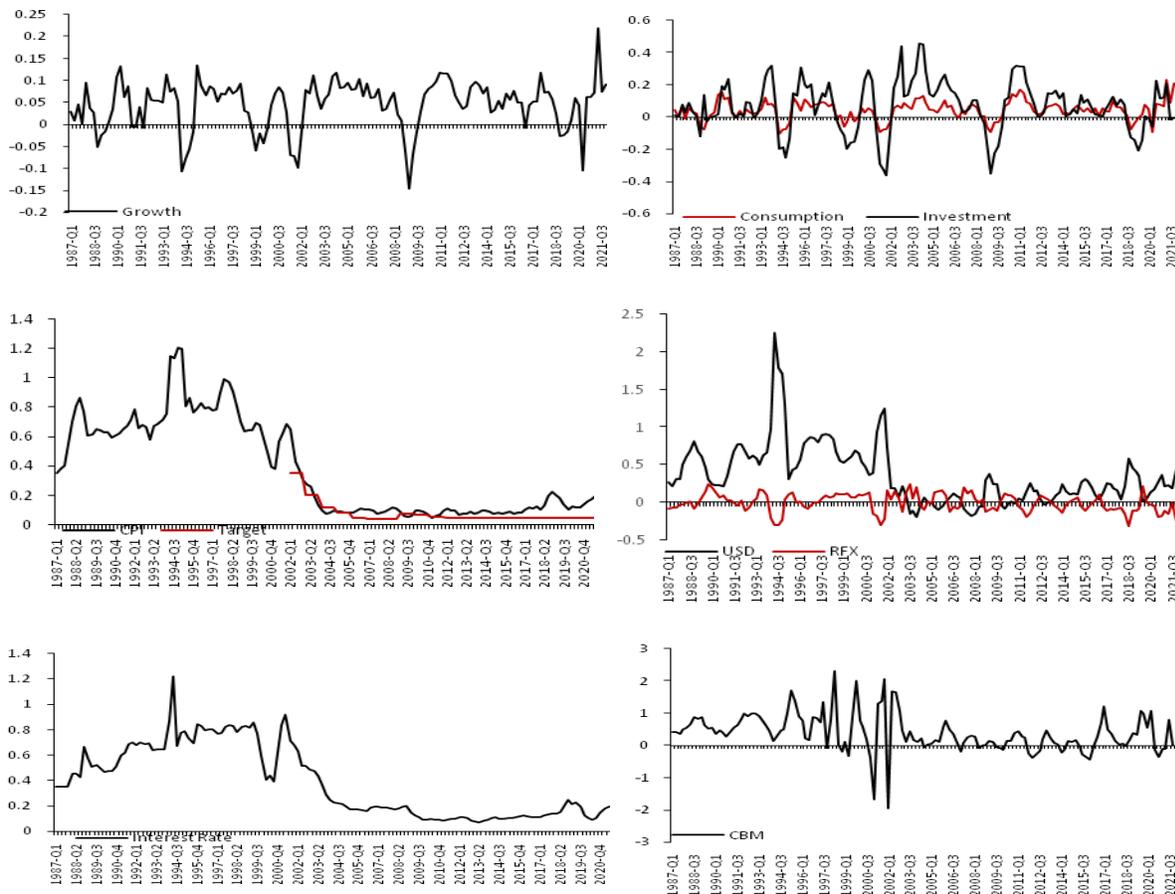### 3.1. Developments in the Uncertainty Index for Turkey

The political, social and economic developments in the periods when the uncertainty index peaked above the average are summarized in Table 1, and the monetary policy responses in these periods are discussed in the next section.

Table 1: Political, Social and Economic Developments That Create Uncertainty in Turkey

Year	Sources of Uncertainty
1988	Iran-Iraq war, the assassination attempt on Prime Minister
1990	Political assassinations, Iraqi invasion of Kuwait, increased risk of war
1991	First Gulf War, political assassinations, change of government, disintegration process in the Soviet Union, parliamentary elections, change of government
1992	Increasing political tension, terrorist acts intensifying in Southeast Anatolia, military operations launched in Northern Iraq
1993	Political assassinations, death of the President, change in political cadres, Sivas massacre, change of government
1994	Political assassinations, intensifying acts of terrorism, economic crisis
1995	Parliamentary elections
1996	Political assassinations, increasing terrorist acts, government change, Susurluk scandal (politics-mafia relationship) and increasing social-political tension
1997	"February 28" military memorandum
1999	Parliamentary elections, government change, Marmara earthquake, political assassinations, banking sector crisis
2000	Increasing social and political tension, bank failures
2001	Political assassinations, transformation of political crisis into economic crisis, political party closure decisions, Twin Towers attack
2002	Parliamentary elections
2003	Second Gulf War, refusal to accept foreign troops
2004	Ongoing Second Gulf War, major management changes in politics and the Army
2007	Parliamentary elections, referendum (related to the way the President is elected)
2008	The global financial crisis, Ergenekon investigation (army-related operation), closure case against the ruling party
2009	Tension with Israel, closure of political parties, "Solution Process" decisions for Southeastern Anatolia, political assassinations
2011	Parliamentary elections
2012	Tension with Syria, increasing political and social tension, arrest of the former Chief of General Staff
2013	Increasing political tension due to corruption allegations, dismissal of some ministers, mass terrorist attacks, increasing social unrest ("Gezi Park" events)
2014	Increasing political and social tension due to corruption allegations, Presidential elections, change of government
2015	Increasing political and social tension due to corruption allegations, Parliamentary elections, terrorist acts intensifying in Southeast Anatolia and restrictive measures taken (such as curfews), renewed Parliamentary elections, tension with Syria, beginning of the refugee problem
2016	Increasing political and social tension, intensifying terrorist attacks, military coup attempt, military intervention in Syria
2017	Referendum for the transition to the presidential system
2018	Military operations launched in Iraq and Syria, tension with Israel, President and Parliament elections, tension with the USA (Priest Bronson), murder of Cemal Khashoggi (Saudi journalist)
2019	Local elections, cancellation of local election in Istanbul and re-election, the military operation in Syria and therefore political tension with the USA
2020	Military operations in Syria, the Covid-19 pandemic and the onset of restrictions on social life
2021	Increasing restrictions due to the pandemic (such as curfews, the closing of cafes and restaurants), dismissal of various ministers and Central Bank governor, unrealistic interest rate cuts by the Central Bank, increasing economic instability, exchange rate interventions

3.2. Monetary Policy Response

The 1990s was a period in which inflation rapidly increased, the Turkish lira depreciated and the CBRT resources continued to be used due to the inability to maintain the budget balance, in short, fiscal dominance in monetary policy increased (see the main economic indicators shown in Figure 2 below). The most important developments that left their mark on the period are the uncertainty created by the early election decision taken with the Gulf Crisis that started in 1990. During this period, the CBRT had to sell foreign currency in order to eliminate the negative effects of the net short-term capital outflow, the CBRT resources were used extensively in public finance and the Bank carried out open market operations to attract excess liquidity in the market. The Turkish economy faced a new crisis in 1994 due to the rise in public expenditures and the intense funding of the CBRT to the public, the consolidation of the public's debts to the CBRT in 1993, the high current account deficit, the overvalued Turkish lira, and the fragile structure of the banking sector. In this period, the CBRT continued to provide financing to the Treasury while trying to create stability in the foreign exchange markets by using its foreign exchange reserves.

Note: Interest rate shows the level of short-term interest rate.
Figure 2: Growth Rates of Main Macroeconomic Variables

A series of economic measures were put into effect in April 1994 to restore stability in the economy. The measures aimed, in the short term, to reduce the inflation rate from 120 percent to reasonable levels, to ensure equilibrium in financial markets and exchange rates and, in the medium term, to achieve sustainable growth by providing a permanent solution to the problems of public and current account deficits. In addition, steps were taken to increase the CBRT's autonomy and the CBRT's control area over short-term interest rates was increased.

In the second half of the 1990s, the fragility of the economy increased due to high real interest rates, high inflation, unstable growth, budget deficits, increasing debt stock, political instability and problems stemming from the banking sector. Crises in Southeast Asia, Russia and Brazil also had an increasing effect on the vulnerabilities of the economy. In this framework, in 1996-1997, the CBRT implemented policies aimed at stabilizing financial markets instead of reducing inflation. In 1996, the short-term advance rate provided to the Treasury was also reduced, and the practice of giving loans to other public institutions was stopped. In July 1997, with a protocol signed between the CBRT and the Treasury, the Treasury completely gave up using the short-term advance mechanism.

By 1999, the Turkish economy was faced with high real interest rates, high debt stock, high inflation and economic contraction problems due to external shocks. At the end of the year, a stand-by agreement was signed with the IMF and a program based on the exchange rate anchor was started to implement. Until November 2000, the program predictions were realized and the liquidity management was carried out in line with the previously announced targets within the program announced to the public. However, due to the fact that the structural change envisaged by the economic program could not be realized at the desired level, a loss of confidence began in the economy at the end of 2000 and Turkey experienced the deepest financial stalemate in its recent history.As a result of the 2001 Crisis that emerged with the deepening of the loss of confidence, the exchange rate-based stabilization program was terminated, and the exchange rates were left to fluctuate with the joint decision of the CBRT and the Government in February 2001.

The post-crisis period was a turning point for the Turkish economy and it was aimed to achieve a permanent structural transformation in many areas of the economy, including central banking.In this context, a new stand-by agreement signed with the IMF in May 2001 began to be implemented. With the program, it is aimed to reduce uncertainty in financial markets by taking measures regarding the banking sector, to ensure stability in interest rates and exchange rates, to use macroeconomic policies effectively in the fight against inflation and to create a sustainable growth environment. The CBRT's practice of financing public deficits by making advances and loans to the Treasury and other public institutions has been legally terminated. In addition, an important step was taken toward making monetary policy decisions within a more institutional structure by establishing the Monetary Policy Committee.

In 2002, the CBRT started to implement the implicit inflation targeting regime to ensure price stability, which is its main target. In this period, the CBRT aimed to establish the preconditions for the transition to the explicit inflation targeting regime and took important steps to improve the institutional infrastructure of the monetary policy. In this process, the CBRT activated its

institutional framework, laid out its communication policy more clearly, expanded its information set and developed inflation forecasting methods.

As a result of the structural transformation moves in the economy and the implicit inflation targeting regime practices of the CBRT, inflation remained below the targets for four years after 2002. Inflation fell to 9.3 percent in 2004 decreasing to a single digit for the first time in 30 years. The year 2005 was declared as the "transition year" before the explicit inflation targeting regime and the technical preparations required by the regime were completed within this year. In 2005, one of the most striking and important economic decisions in the history of the Republic was made, and six zeros were removed from the Turkish lira, with a significant decrease in inflation and an increase in confidence that low inflation rates would continue. In 2006, the CBRT started to implement the explicit inflation targeting regime, taking into account the realization of the prerequisites for the inflation targeting regime to a large extent.

The reflections of the global crisis, which started in the financial markets of developed countries and deepened to cover the whole world as of the last quarter of 2008, continued to be effective throughout 2009 as well, even though they decreased. Since the last quarter of 2008, the sharp contraction in total demand and the decline in commodity prices have led to a rapid decline in inflation rates all over the world. In the face of all these developments, the CBRT followed an active policy and focused on limiting the possible damage of the crisis on economic activity. In this context, the CBRT started the monetary expansion process in November 2008 and was one of the earliest central banks to initiate interest rate cuts among developing countries. Anticipating that the probability of inflation remain below the target increased in 2009, the CBRT became the central bank that made the most rate cuts among the countries that implemented inflation targeting.

After the global financial crisis that affected the world since the last quarter of 2008, risk appetite increased and the volatility of short-term capital flows increased. These developments have led central banks to seek alternative policies by increasing awareness of financial stability. Similarly, the CBRT started to implement a new monetary policy mix by expanding the framework of the explicit inflation targeting regime to include financial stability as well as to limit macro-financial risks. In this direction, the CBRT has developed new instruments such as the interest rate corridor and the Reserve Option Mechanism to support financial stability without compromising price stability. Accordingly, in 2012, the inflation rate was 6.16 percent and the lowest year-end consumer inflation in the last 44 years was reached.

Despite the limited recovery observed in developed countries in 2015, the weakening trend in global economic activity continued with the slowdown in developing countries. In this period, financial markets followed a volatile course mainly as a result of uncertainties regarding global monetary policies and growth concerns. The financial asset prices of developing countries were also significantly affected by these fluctuations. During the year, risk premium indicators of developing countries deteriorated, portfolio flows towards these countries displayed a weak outlook and local currencies depreciated. The reflections of these general global trends, with the addition of domestic developments and geopolitical risks, were also felt heavily on the Turkish economy. In this process, by actively using the 1-week repo rate, interest rate corridor, TL and foreign currency liquidity policies and required reserve instruments, the CBRT implemented

policies aimed at limiting the negative effects of internal and external uncertainties on the Turkish economy and eliminating the deterioration in the inflation.

2018 has been a period of significant shocks in different dimensions of the Turkish economy. The uncertainty created by the depreciation of the Turkish lira in the third quarter of the year and the tightening in financial conditions affected domestic demand and loan supply. Consumer inflation increased mainly due to the depreciation of the Turkish lira and the consequent deterioration in producer prices and pricing behavior. During this period, it is witnessed that a strong monetary tightening was implemented against the risks related to the deterioration in the pricing behavior and the inflation outlook.

In 2019, the CBRT determined its monetary policy stance to ensure the continuation of the disinflation process and effectively used macroprudential tools such as required reserves for financial stability. While the CBRT kept the policy rate constant in the first half of the year, it reduced the policy rate by 12 points in total, taking into account the improvement in the inflation outlook as of July.

By 2020, economic activity started to weaken as of mid-March due to the effects of the Covid-19 pandemic on foreign trade, tourism and domestic demand. The slowdown in the economy became evident in April and spread across sectors. With the sharp contraction in global economic activity, especially in the European region, which is Turkey's main trading partner, export opportunities have weakened significantly and tourism activities have come to a standstill after international travel restrictions. Movement restrictions, such as economic shutdowns and curfews, which were strictly enforced until May, adversely affected economic activity and employment, most notably in the services sector most affected by the pandemic. With the gradual easing of the pandemic-related restrictions since mid-May, the impact of supportive policies on domestic demand and economic activity became evident. With the significant relaxation in financial conditions and strong credit momentum, deferred domestic demand came into play quickly and a strong recovery was achieved in the economy with the support of exports./The rapid recovery in the economy, driven by the strong credit momentum, had significant repercussions on the external equilibrium and inflation outlook. While the rapid expansion in loans and monetary aggregates in a short time supported the recovery in economic activity, it adversely affected the inflation and current account equilibrium. Despite the improvement in export volume, the current account deficit increased rapidly with the decline in service revenues, especially tourism, and the recovery in imports. In this period, in addition to global uncertainties, the deterioration in domestic inflation expectations and the strengthening of the dollarization trend increased the demand for gold and adversely affected the external equilibrium.

Despite the limiting effects of the pandemic in the first quarter of 2021, economic activity remained strong due to domestic and foreign demand. With the relaxation of pandemic restrictions at the beginning of March, economic activity revived in services and related sectors. In the second quarter of the year, economic activity remained above its long-term trend, although it lost some momentum due to the pandemic restrictions and the tightening in financial conditions. The spread of vaccination throughout the society allowed the services, tourism and

related sectors that were adversely affected by the pandemic to revive and economic activity to be maintained with a more balanced composition.

4. Model and Estimation Methodology

In order to quantify the effect of uncertainty experienced in Turkey on economic activities, it has been preferred to use a structural VAR model estimated by Bayesian techniques has been preferred. Such multi-equation models allow the determination of dynamic relationships among a large number of variables. For this reason, these models are one of the basic tools used to understand the effects of uncertainty correctly.

4.1. SVAR Model

The basis of structural VAR models is the use of residual terms derived from individual equations to describe the determinants of the model (structural shocks). The SVAR model is represented as follows:

$$\Gamma y_t = \Gamma_1^* y_{t-1} + \cdots + \Gamma_k^* y_{t*k} \Psi v_t \tag{1}$$

This equation states that a $(n \times 1)$ vector of the endogenous variable y_t is associated with $(n \times n)$ matrix of structural coefficients $\Gamma_k^*(n \times 1)$ and vector of white noise residuals v_t. If we pre-multiply this equation with the inverse of Γ, we get the following equation (4):

$$\Gamma^{-1}\Gamma y_t = \Gamma^{-1}\{\Gamma_1^* y_{t-1} + \cdots + \Gamma_k^* y_{t-k} + \Psi v_t\} \tag{2}$$

$$\Gamma^{-1}\Gamma y_t = \Gamma^{-1}\Gamma_1^* y_{t-1} + \cdots + \Gamma^{-1}\Gamma_k^* y_{t-k} + \Gamma^{-1}\Psi v_t \tag{3}$$

$$y_t = \Gamma_1 y_{t-1} + \cdots + \Gamma_k y_{t-k} + \xi_t \tag{4}$$

In the last equation, it is defined that $\Omega = \Gamma^{-1}\Psi \xi_t = \Omega v_t$ and. Constraints that allow the identification of structural shocks affecting each of the SVAR variables are included in the model through the matrix Ω. For this purpose, long-term restrictions are handled recursively using this matrix. Model identification is usually achieved by Cholesky decomposition of residuals. Recursive SVAR type models are identified by short-term restrictions on the effects of structural shocks (Lütkepohl, 2017). This means that Γ or Ψ matrices are constrained to the lower or upper triangle in equation (1). If the SVAR is configured as Γ or Ψ, an estimate of Ψ can be constructed from the inverse of the estimate of Γ or vice versa. In a recursive model, partial identification may also be possible if only one economic relationship is defined or only one structural shock is dealt with (Lütkepohl, 2017).

4.2 Bayesian Estimation

An important point in SVAR-type models is the estimation, and this process depends on the type of identification being made (it should be noted that this is a model-specific function as well). After the model is constructed with the restrictions, following the recommendations in Kilian&Lütkepohl (2017), it can be estimated using ordinary least squares, generalized method of moments, maximum likelihood or Bayesian techniques. Parameter estimations and econometric projections to be realized with the Bayesian estimation method developed by Koop (2003) are based on probability theory. In this context, the point that gains importance in

Bayesian estimation is the priors. According to Litterman (1986), three basic principles should be taken into consideration in determining prior values: (1) Prioritizing their own dynamics over the dynamics of other variables in the model, (2) the effect of lags decrease over time, and (3) there is cointegration if the series is stationary. In this study, the SVAR model is estimated with four lags, as it allows the stability of the model to be maintained. Since recursive and non-recursive identifications will be used, the Markov Chain-Monte Carlo (MCMC) algorithm (as a stochastic sampling method) was used in the estimation of the model. Thus, posteriors distribution based on priors attained by estimating the SVAR model with OLS is obtained. These posteriors are used as default priors for the Metropolis-Hasting algorithm.

4.3. Data and Identification

The moving average of the WUI_TUR index mentioned earlier (see section 3.1) is used to represent uncertainty in Turkey. Economic growth is treated as the annual change in quarterly real GDP. Consumption expenditures, which are defined as the sum of final consumption expenditures of households and non-profit organizations, and investment expenditures, which are defined as the sum of gross fixed capital formation and stock changes, are obtained from the GDP figures by type of expenditures. The inflation variable in the model is defined as the annual change in the quarterly Consumer Price Index. Since Turkey is an open and small economy, the annual rate of change in the real exchange rate index constructed by the CBRT is included in the model as a variable representing the effects coming from the rest of the world. The response of monetary policy is initially included in the model through two variables: the interbank market repo rate and the central bank money[1]. From the two estimated versions of the model developed by using these variables separately, the model using the interest rate does not give meaningful results. The reason for such a result can be explained by two factors: (1) The full sample of this study covers the 1987-2021 period and monetary policy was carried out by targeting monetary aggregates in the pre-2001 period. (2) The policy interest rate lost its meaning as a result of the political interventions of the Central Bank in the post-2018 period. Therefore, the results of the model in which only central bank money is used will be included in the following sections. The data for the said variables are quarterly data for the period 1987:1 – 2021:4. All variables, except the uncertainty index, are handled with annual rates of change in logarithmic levels of seasonally adjusted series. A detailed description of the variables used in the study and the data sources are given as an appendix at the end of the study.

Recursive identification is used to define the structural shocks created by uncertainty on macroeconomic variables. Under this method, it is assumed that the shocks of some variables, initially, have a lagged effect on selected variables. In other words, these shocks do not have a direct effect on the determined variables in the same period (Sims, 1980).In this identification strategy, the order of variables in the model determines how quickly individual indicators will respond to certain shocks. In this method, which is used in many studies, the uncertainty index is placed in front of all variables, that is, it is assumed that uncertainty shocks have an immediate

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[1]Central bank money is a balance sheet aggregate calculated by adding net open market operations and public deposits at the Central Bank to the reserve money, which is defined as the sum of currency in circulation and bank reserves (required and excess). In this context, central bank money is an important indicator of monetary policy as it expresses the total liability of the CBRT to domestic markets.

effect on other variables. Considering the number of constraints used, the model is exactly identified as follows:

$$
\begin{bmatrix}
\omega_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\
\omega_{21} & \omega_{22} & 0 & 0 & 0 & 0 & 0 \\
\omega_{31} & \omega_{32} & \omega_{33} & 0 & 0 & 0 & 0 \\
\omega_{41} & \omega_{42} & \omega_{43} & \omega_{44} & 0 & 0 & 0 \\
\omega_{51} & \omega_{52} & \omega_{53} & \omega_{54} & \omega_{55} & 0 & 0 \\
\omega_{61} & \omega_{62} & \omega_{63} & \omega_{64} & \omega_{65} & \omega_{66} & 0 \\
\omega_{71} & \omega_{72} & \omega_{73} & \omega_{74} & \omega_{75} & \omega_{76} & \omega_{77}
\end{bmatrix}
\begin{bmatrix}
\upsilon_{UTR} \\
\upsilon_{GDP} \\
\upsilon_{CPI} \\
\upsilon_{CON} \\
\upsilon_{INV} \\
\upsilon_{CBM} \\
\upsilon_{RFX}
\end{bmatrix}
=
\begin{bmatrix}
\xi_{UTR} \\
\xi_{GDP} \\
\xi_{CPI} \\
\xi_{CON} \\
\xi_{INV} \\
\xi_{CBM} \\
\xi_{RFX}
\end{bmatrix}
$$

To verify the results to be obtained from the identification summarized above, a second model was estimated, this time using non-recursive identification. In this strategy, it is accepted that uncertainty shocks have a lagged effect on other variables in the model. As stated by DB (2018), this strategy aims to determine the effects of uncertainty on the real economy with the most conservative possible quantification.

$$
\begin{bmatrix}
\omega_{11} & \omega_{12} & \omega_{13} & \omega_{14} & \omega_{15} & \omega_{16} & \omega_{17} \\
0 & \omega_{22} & 0 & 0 & 0 & 0 & 0 \\
0 & \omega_{32} & \omega_{33} & 0 & 0 & 0 & 0 \\
0 & \omega_{42} & \omega_{43} & \omega_{44} & 0 & 0 & 0 \\
0 & \omega_{52} & \omega_{53} & \omega_{54} & \omega_{55} & 0 & 0 \\
0 & \omega_{62} & \omega_{63} & \omega_{64} & \omega_{65} & \omega_{66} & 0 \\
0 & \omega_{72} & \omega_{73} & \omega_{74} & \omega_{75} & \omega_{76} & \omega_{77}
\end{bmatrix}
\begin{bmatrix}
\upsilon_{UTR} \\
\upsilon_{GDP} \\
\upsilon_{CPI} \\
\upsilon_{CON} \\
\upsilon_{INV} \\
\upsilon_{CBM} \\
\upsilon_{RFX}
\end{bmatrix}
=
\begin{bmatrix}
\xi_{UTR} \\
\xi_{GDP} \\
\xi_{CPI} \\
\xi_{CON} \\
\xi_{INV} \\
\xi_{CBM} \\
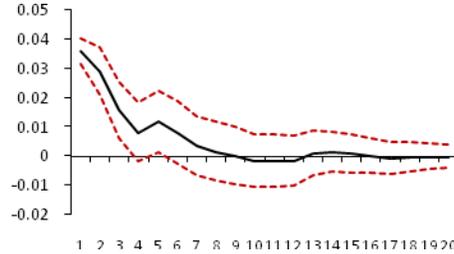\xi_{RFX}
\end{bmatrix}
$$

5. Estimation Results

Since the interpretation of single coefficients is of little use, the impulse-response functions estimated with the SVAR model are presented in this section. These functions allow determining dynamic responses of macroeconomic variables to uncertainty shocks.
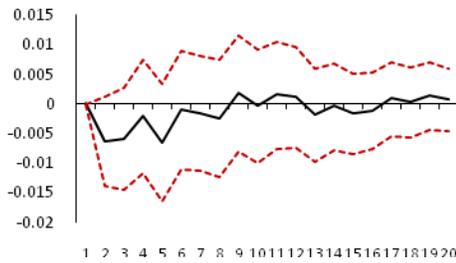
5.1. Impulse-Response Functions of Recursive Identification

The responses of the macroeconomic variables considered within the scope of the model to an uncertainty shock (Figure 3) are in line with previous studies. First of all, a high level of uncertainty reduces both the consumption expenditures of households and the investment expenditures of enterprises. While the observed decrease in consumption is short-term, the decrease in investment expenditures is permanent. On the other hand, the decrease in investment expenditures is greater than that in consumption expenditures. While consumption expenditures return to their initial level in approximately 5 quarters, investment expenditures cannot return to their initial level at the end of 20 quarters. This development in investment expenditures, which is the main source of healthy economic growth, is one of the main reasons for the growth in the Turkish economy based on consumption and public expenditures, which do not create employment (Figure 4). As stated by Bordo et al. (2016), the increase in the cost of financing
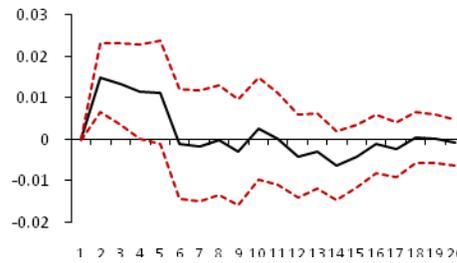
(another factor that determines investments) during periods of uncertainty may play an important role in the permanent decline in investment expenditures.
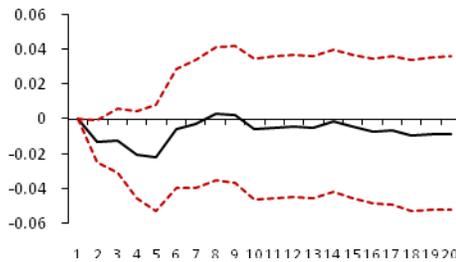

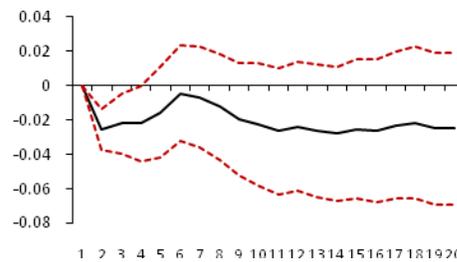
Response of Uncertainty

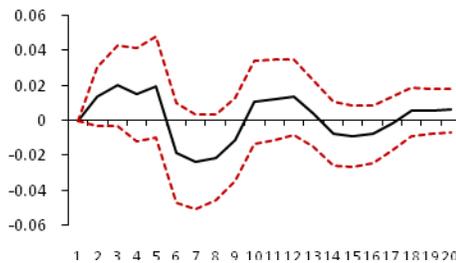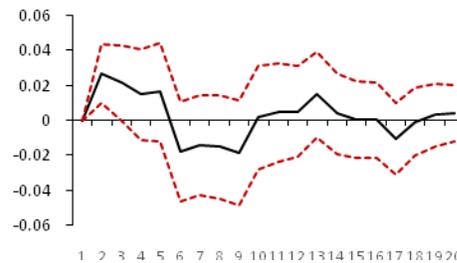Response of GDP Growth

Response of Inflation

Response of Consumption

Response of Investment

Response of Central Bank Money

Response of Real Exchange Rate

Figure 3: Response of Macroeconomic Variables to Uncertainty Shock-Recursive Model

Greater uncertainty generates greater unemployment since an employment contract represents a long-term employment relationship and hiring decisions are expensive to reverse. In this case, in times of high uncertainty, a decrease in private consumption expenditures and an increase in savings can be seen to be prudent (Leduc&Liu, 2020). Together with the decrease in investment expenditures, these factors, which suppress economic growth, cause an increase in the general level of prices during the first 6 quarters. Contrary to the results reached by Leduc&Liu (2016), uncertainty shocks in Turkey create similar results to negative supply shocks in the economy. The main reason for such a response of prices is that the decrease in investment expenditures is long-lasting. On the other hand, this behavior in prices is compatible with the reaction of the central bank money and the real exchange rate. In the face of the uncertainty shock, the Central Bank tends towards accommodating monetary policy and monetary easing to provide liquidity to the economy and reduce the effects of uncertainty. The erosion of the real exchange rate is an expected reaction in the face of monetary easing and rising prices.
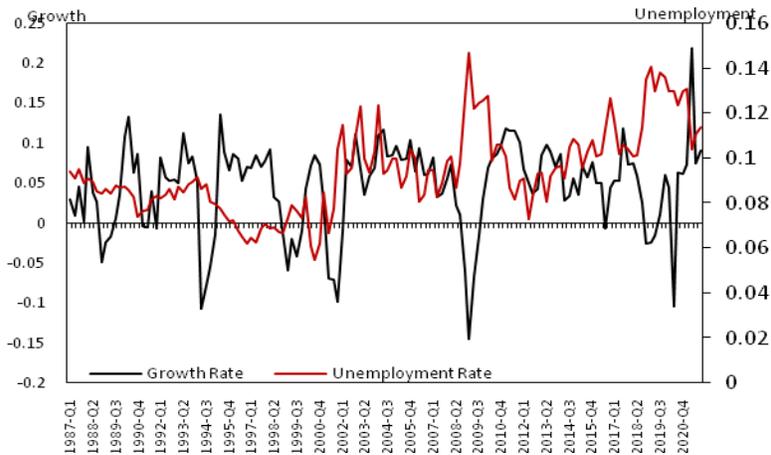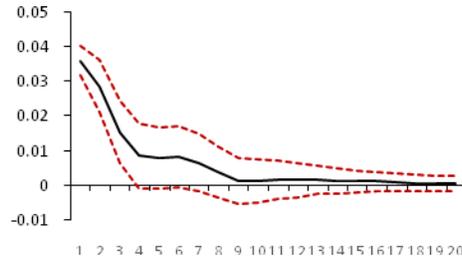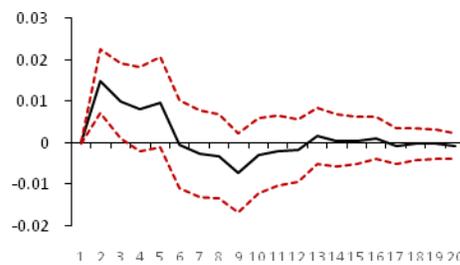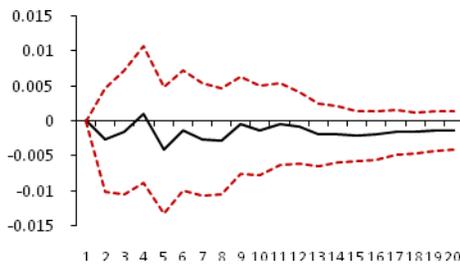

Figure 4: Economic Growth and Unemployment (1987-2021)

5.2. Impulse-Response Functions of Non-Recursive Identification

Considering that the effect of uncertainty shocks on other variables in the model may occur with a lag, the previously developed model is estimated through non-recursive identification at this stage. As stated by DB (2018), the reason for making such an estimate is to make the most conservative estimate possible in quantifying the effects of uncertainty on the real economy. Figure 5 shows the impulse-response functions obtained as a result of the estimation under this identification strategy.
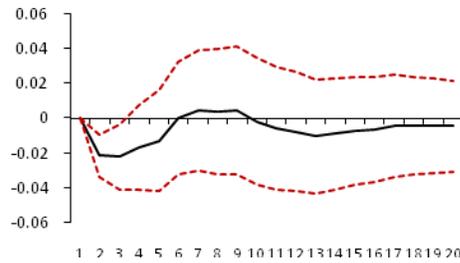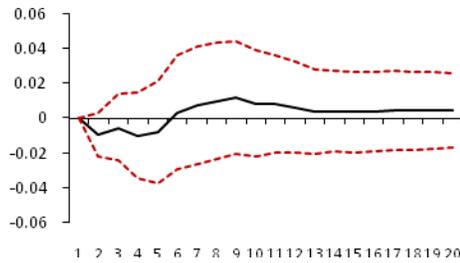
Response of Uncertainty

Response of GDP Growth

Response of Inflation

Response of Consumption

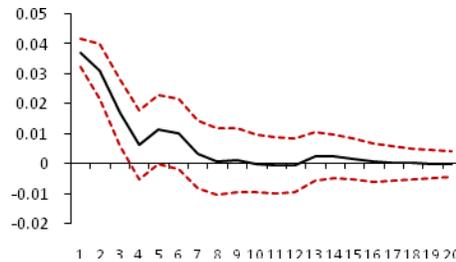Response of Investment

Response of Central Bank Money

Response of Real Exchange Rate

Figure 5: Response of Macroeconomic Variables to Uncertainty Shock-Non-Recursive Model
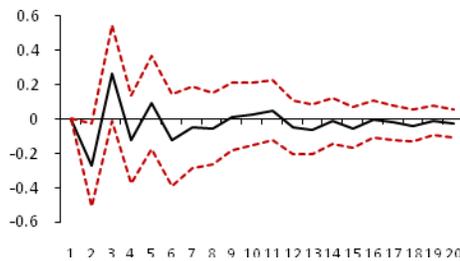
The results obtained with non-recursive identification largely overlap with the results obtained with recursive identification. While the impulse-response functions obtained for inflation, consumption, central bank money and real exchange rate overlap in terms of both magnitude and timing, the responses observed in economic growth and investment expenditures are both smaller and of shorter duration. The similarity of the results obtained for both identification methods supports the view that uncertainty has a negative effect on macroeconomic variables.
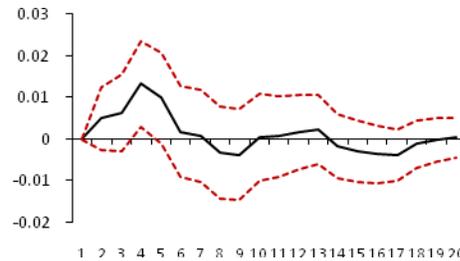
5.3. Robustness Check

The estimation results above also include a period when the extraordinary effects of the Covid-19 pandemic were experienced. The measures taken to prevent the virus from entering the country and spreading uncontrollably had significant effects on both the level of uncertainty and macroeconomic variables, especially during the last quarters of the sampling period. Although there is no single variable that concretely reflects the effects of the Covid-19 pandemic and the quarantine applied, it is seen that some variables (such as GDP, consumption expenditures and central bank money) show sudden changes. Based on this fact, the model discussed above was re-estimated for a narrower sample (1987:1 - 2019:3), excluding the Covid-19 pandemic period (2019:4 - 2021:4) for recursive and non-recursive identifications. Since the estimation results obtained for the two different identification methods overlap to a large extent, as before, only the recursive model results are discussed in this section. Figure 6 summarizes the impulse-response functions obtained as a result of the estimation.

Response of Uncertainty

Response of GDP Growth

Response of Inflation

Response of Consumption

Response of Investment

Response of Central Bank Money

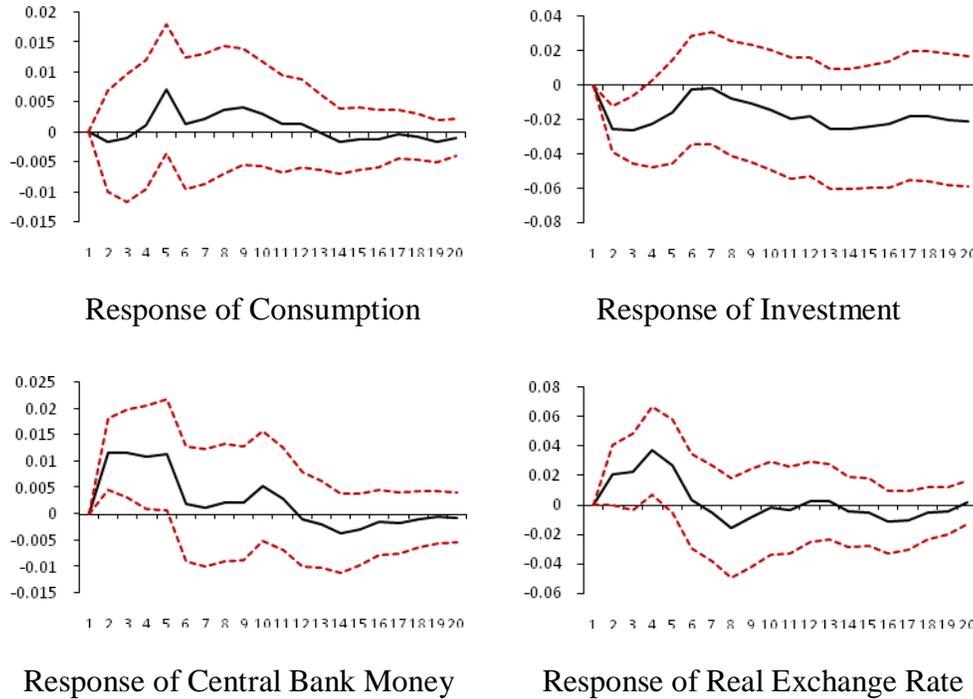Response of Real Exchange Rate

Figure 6: Response of Macroeconomic Variables to Uncertainty Shock - Recursive Model
(Excluding Covid-19 Pandemic Period)

In the absence of Covid-19, while inflation, investment, central bank money and real exchange rates show similar reactions to the uncertainty shock relative to the full sample period including the pandemic, the responses of economic growth and consumption expenditures differ to a certain extent. First of all, in the absence of the pandemic, the response of consumption expenditures to the uncertainty shock is both smaller and shorter-lived. In this version of the estimation, the recovery time in consumption expenditures decreases from approximately 6 quarters to 4 quarters. Therefore, it is possible to state that the pandemic period has extended its duration by strengthening the contraction in consumption. In the absence of the pandemic, the effect of an uncertainty shock on economic growth is short-lived, but the fluctuation trend continues over 20 quarters. In other words, the economy is exposed to short-term business cycle fluctuations and the time from one trough to the next is shortened. However, in the sample that includes the pandemic period, the recession in the economy continues for a long time and it takes approximately 12 quarters for the economic growth to enter the recovery process. Therefore, we can conclude that the most important effect of the uncertainty shock caused by the pandemic on the Turkish economy is that it has created a "prolonged recession" trend.

6. Conclusion

Periods of high uncertainty have significant effects on economic activity. For this reason, those who make monetary policy decisions should consider the degree of uncertainty in the economy. Turkey is a country that has been negatively affected economically as a result of the uncertainties

created by the political, social and economic fluctuations it has experienced. The recent Covid-19 pandemic is a factor that increases the negative effects of these uncertainties.

In this study, the effect of the increase in the uncertainty level on the main macroeconomic variables was examined by using a SVAR model estimated by Bayesian techniques. The uncertainty phenomenon is represented by the WUI_TUR index obtained in the context of the World Uncertainty Index (WUI). This index shows that periods of high uncertainty largely coincide with periods of political and social instability, and to a lesser extent, periods of economic recession. The recent Covid-19 pandemic has also had a significant impact on the level of uncertainty.

The impulse-response functions were obtained by recursively estimating the SVAR model, which was developed to determine the effect of increasing uncertainty on economic activities. A high level of uncertainty reduces consumption expenditures of households and investment expenditures of enterprises. Compared to the decrease in consumption expenditures, the decrease in investment expenditures is larger and of longer duration. The permanent decline in investment expenditures results in a contraction in GDP and price increases. In this respect, uncertainty shocks in Turkey produce similar effects to those of negative supply shocks. The main factor in this process is the accommodation of the central bank and relaxation of monetary policy by turning to expansionary monetary policies. While this reaction of the Central Bank is reflected simultaneously on the central bank money, which expresses the total domestic liabilities, it is also determined as the main factor behind the positive reaction of inflation and therefore the real exchange rate.

In order to quantify the effects of uncertainty on the real economy in the most conservative way possible, the same model was estimated by using a non-recursive identification, which assumes that uncertainty shocks have a lagged effect on other variables in the model. This estimation produces results that confirm previous ones regarding the negative effects of uncertainty. In addition, to see the robustness of the results obtained, the previously estimated model was re-estimated using recursive identification, excluding the effects of the Covid-19 pandemic. The results show that the main effect of the increase in uncertainty experienced with the Covid-19 pandemic is transmitted to the economy through consumption and, accordingly, economic growth.

It is possible to evaluate the reaction of the Central Bank as a necessary response since the uncertainty shocks experienced in Turkey affect the economy in a similar way to the negative supply shock. The Central Bank provides liquidity to alleviate the negative effects of high uncertainty periods, but this process causes the inflationary process to begin. In an economy with high currency substitution, this process will become a factor that limits the effectiveness of monetary policy after a while. Therefore, there is a need to complement monetary policy measures with fiscal policy and macroprudential policy measures.

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APPENDIX

Definition and Sources of the Data

Symbol	Explanation
WUITUR	Definition: Uncertainty index for Turkey Content: Levels Transformation: None Period: 1987:I – 2021:IV Source: World Uncertainty Index (World Uncertainty Index)
g	Definition: Economic growth rate Content: Annual percentage change in real gross domestic product Transformation: Seasonal adjustment[*] – logarithm Period: 1987: I – 2021: IV Source: CBRT – EDDS and EDDS Archive[**]
π	Definition: Inflation rate Content: Annual percentage change in the consumer price index Transformation: Seasonal adjustment – logarithm Period: 1987: I – 2021: IV Source: CBRT – EDDS and EDDS Archive
con	Definition: Growth rate of real consumption expenditures Content: Annual percentage change in real consumption expenditures Transformation: Seasonal adjustment – logarithm Period: 1987: I – 2021: IV Source: CBRT – EDDS and EDDS Archive
inv	Definition: Growth rate of real investment expenditures Content: Annual percentage change in real investment expenditures Transformation: Seasonal adjustment – logarithm Period: 1987: I – 2021: IV Source: CBRT – EDDS and EDDS Archive
cbm	Definition: Growth rate of central bank money Content: Annual percentage change in central bank money Transformation: Seasonal adjustment – logarithm Period: 1987: I – 2021: IV Source: CBRT – EDDS and EDDS Archive
rfx	Definition: Change rate of real exchange rate Content: Annual percentage change in real exchange rate Transformation: Seasonal adjustment – logarithm Period: 1987: I – 2021: IV Source: CBRT – EDDS and EDDS Archive
Notes: * All seasonal adjustments have been carried out by using the Tramo-Seats methodology. ** EDDS refers to the electronic data delivery system of CBRT.	