

Uncertainty and monetary policy during the Covid-19 pandemic in Tunisia: Evidence from a Bayesian VAR

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Abstract. *This paper aims to examine the impact of the uncertainty shock on the Tunisian economy and the effectiveness of monetary policy during the Covid-19 pandemic. For this purpose, we employ a Bayesian VAR model considering the world uncertainty index (WUI) as a new proxy for uncertainty measure and the short-term interest rate as the main instrument of monetary policy. The results indicate that the Covid-19 uncertainty shock has a negative consequence on economic activity and on aggregate demand in Tunisia. Moreover, we show that conventional monetary policy is ineffective in times of high uncertainty period.*

Keywords: Covid-19, uncertainty, monetary policy, BVAR model, impulse response.

JEL Classification: D8, E52.

1. Introduction

The recent health crisis caused by the coronavirus disease (Covid-19) has affected the global economic and financial environment. The rapid propagation of the virus has contributed to an increase in the number of confirmed cases and deaths all over the world. In this regard, public authorities have adopted drastic measures such as social distancing, quarantine for confirmed and probable cases, as well as general containment. While this strategy was effective in containing the spread of the Covid-19 virus, it had disastrous consequences for the global economy. In fact, the containment measures affected the attitudes of economic agents and plunged some developed and emerging countries into deep economic recessions.

The IMF (2020) mentioned that this health crisis is like no other to such an extent that the economic recession exceeds that of the 2008 financial crisis. Indeed, this exceptional situation is explained by the ambiguity surrounding the duration, severity and future repercussions of this crisis. The period of increased uncertainty is followed by a significant recession in economic activity across sectors and countries in the world, in particular emerging economies that suffer from limited resources to overcome health, financial and economic crises (Pinshi, 2020; Sharif et al., 2020; Ho and Gan, 2021).

According to statistics published by the World Health Organization, the Covid-19 pandemic has been officially appearing in Tunisia since March 2020. It is noted that at the beginning of the crisis, Tunisia did not experience the same health disaster as some of the world's most developed countries. Moreover, Tunisian authorities put in place early measures and a response plan to attenuate the risk of the pandemic. Nevertheless, the effect of the crisis has been severe and has started to impact the national economy immediately due to the rapid propagation of the virus and the fragility of the economic system.

Since the pre-Covid-19 period, the Tunisian economy has been weakened reacting to the revolution of 2011, the political assassinations of 2013, and the terrorist attacks of 2014 and 2015. In addition, the rapid spread of the Covid-19 pandemic and the necessity to ensure drastic containment measures at the international and national levels has aggravated the economic situation in Tunisia. According to the national institute of statistics of Tunisia, economic growth plunged into a strong recession (-8.8%) in 2020, which is worse than that of 2011 (-1.9%). This recession has affected different elements of national demand. The inflation rate rose from 3% in 2016 to over 6.2% in March 2020, a level that it had not reached since 2000. Moreover, the current economic situation in Tunisia is characterized by an increase in the pressure on public finances. So, measures linked to the explosion of sanitary expenditure led to an important increase in the budgetary deficit and an excessive recourse to the public debt. According to the statistics published by the Tunisian ministry of finance, the budget deficit has widened to more than 11% of GDP in 2020, taking government debt to 88% of GDP.

The uncertainty linked to the Covid-19 crisis poses unprecedented challenges for monetary authorities. In fact, the economic impact of the pandemic depends on the effectiveness of measures that policymakers have put in place to support global demand and to finance health infrastructure. In this context, the Central Bank of Tunisia (CBT) decides to act

proactively by implementing a series of exceptional measures (CBT, 2019). Monetary authorities intended to face up to the ultimate consequences of the health crisis on economic activity and to support businesses as well as the most affected social categories. Thus, the CBT decided to lower its key rate by 100 basis points, bringing it down to 6.75% in March 2020 and then by 50 points in October 2020 in response to the economic repercussions that followed the second wave of the pandemic. Also, monetary policymakers have recourse to other measures, such as providing liquidity to the banking sector and applying prudential norms, notably the credit/deposit ratio. These measures aim to ensure the standard operations of banks and to support businesses by granting exceptional funding. The measures adopted by the Tunisian monetary authorities prioritize the rescue of human lives while making sure that economic stability is preserved. However, the high level of uncertainties and the limited monetary and budgetary room for maneuver didn't make the decision of the monetary authorities easy.

According to the literature, several proxies are proposed to measure the level of uncertainty (Altig et al., 2020). For example, forecast disagreement (Bachmann et al., 2013), stock market volatility (Leduc and Liu, 2016; Caggiano et al., 2020) and economic policy uncertainty (Sharif et al., 2020; Lyke, 2020), among others. Recently, many studies have used the World Uncertainty Index (WUI) developed by Ahir et al. (2019) as the main measure of aggregate uncertainty linked to different events such as financial crises, terrorist attacks and health outbreaks (Gozgor et al., 2019; Avom et al., 2020; Rjiba et al., 2020).

This article addresses new contributions to the literature related to the impact of Covid-19. First, this research sheds new light on the health pandemic in an emerging country such as Tunisia, alongside recent empirical studies (Jeribi and Snene Manzli, 2020; Kokas et al., 2020). In fact, this study offers new insights into the effect of uncertainty by using a new measure of WUI from Ahir et al. (2019). Second, we use a novel estimation technique called Bayesian vector auto-regression (BVAR) to examine the impulse responses of uncertainty and monetary shocks to a large number of macroeconomic variables.

This article is organized as follows: section 2 presents a description of the data and the empirical model. Sections 3 discuss the empirical results and section 4 concludes that we draw from this research.

2. Materials and methods

In this section, we present the empirical methodology and describe the variables of the model used to examine the macroeconomic effects of uncertainty and monetary policy shocks in Tunisia during the period of the Covid-19 crisis.

2.1. Methodology

We adopt a BVAR model referring to recent research about the economic impact of the Covid-19 pandemic (Djurovic et al., 2020; Evgenidis and Papadamou, 2020; Pinshi, 2020; Anton, 2022).

The model is represented by the following equation:

$$Y_t = \alpha_0 + \sum_{i=1}^n A_i Y_{t-i} + \varepsilon_t$$

Where the vector A is a matrix of regression coefficients for the selection of all macroeconomic variables included in the Y vector, such as uncertainty, production, inflation, export, import, investment, exchange rate and interest rate.

$$A = \begin{bmatrix} a_0 \\ A_1 \\ \vdots \\ A_i \end{bmatrix}; Y = \begin{bmatrix} Y_{t-1} \\ \vdots \\ Y_{t-i} \end{bmatrix}$$

Also, a_0 is the intercept vector and $\varepsilon_t : N(0, \Sigma)$ is a vector of residuals.

In order to simplify the model, it can be written as follows:

$$Y = (L_n \otimes A)\theta + e$$

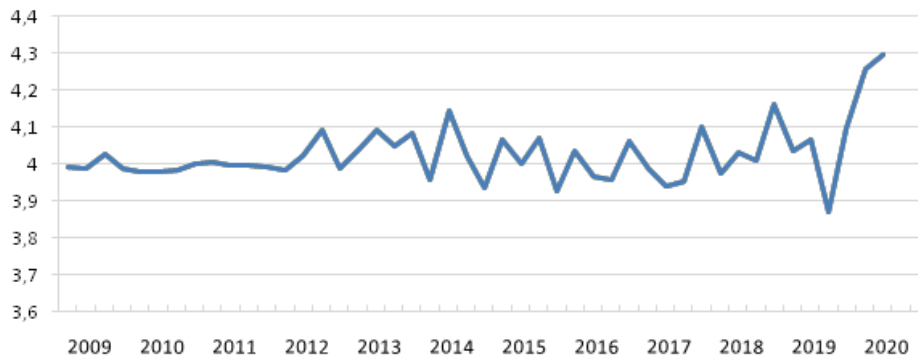
While, $A = (A_1, \dots, A_i)'$, L_n is the identity matrix of n dimension and $\theta = \text{Vec}(A)$

The advantage of estimating a BVAR model is that it leads to coping with the problem of over-parameterization by imposing prior beliefs on the parameters (Adjemian and Pelgrin, 2008). In setting the prior distribution, we use the Minnesota prior introduced by Litterman (1986) to reduce the problem related to the high dimension of a priori distribution.

2.1. Data and variable description

In the last decade, the degree of uncertainty has augmented significantly in Tunisia due to the revolution of 2011, the political assassinations of 2013 and the period of terrorist attacks in 2014 and 2015. In fact, this period of political transition has caused a fairly persistent uncertain environment. Besides, we notice in the Figure 1 below that the high level of uncertainty index arises during the global spread of Covid-19 disease and persists because the health crisis is not over yet.

Figure 1. Plot of logarithmic world uncertainty index for Tunisia



Source: By authors, worlduncertaintyindex.comdatabase

The WUI is formulated by counting the frequency of the word “uncertainty” (or its variants) in the Economist intelligence unit country reports and multiplying it by 1,000.

The other data for real gross domestic production (Real GDP), consumer price index (CPI), export (EXP), import (IMP), investment (INVEST), real effective exchange rate (REER) and monetary market interest rate (MMR) are extracted from the database of the national institute of statistics of Tunisia and the CBT. We use the MMR as a main instrument of the monetary policy of CBT for studying the effects of the monetary shock.

The sample covers data from 2009 m1 to 2020 m9 at a monthly frequency. Except for the policy interest rate, which is expressed as a percentage, the majority of the series are expressed in logarithms.

Table 1 presents the descriptive statistics of the main variables of our model mentioned above. The average WUI of the total sample is 3.6%. The Kurtosis test is a measure of the tailedness of a probability distribution. All of the variables are platykurtic with a Kurtosis less than 3. However, WUI is leptokurtic relative to the normal, with a Kurtosis of 3.082. Besides, the Jarque-Bera test determines whether a series follows a normal distribution. It is important to note that the Jarque-Bera statistic rejects the null hypothesis of normal distribution.

Table 1. *Descriptive summary statistics*

Variables	Observations	Mean	Std. Dev.	Kurtosis	Jarque-Bera
WUI	141	0.365	0.299	3.129	0.000
MMR	141	5.062	1.281	2.935	0.000
Real GDP	141	3.747	0.029	1.962	0.028
CPI	141	2.091	0.074	1.868	0.014
EXP	141	3.386	0.108	2.421	0.216
IMP	141	3.537	0.116	2.651	0.617
REER	141	1.961	0.039	2.442	0.000
INVEST	141	1.764	0.284	2.840	0.001

3. Results and discussions

The aim of this section is to analyze the obtained results of impulse responses of uncertainty and monetary policy shocks to large macroeconomic variables such as output, inflation, export, import, exchange rate and investment. Firstly, we investigate the properties of the series by checking the stationary of each variable. Then, we made impulse response functions of macroeconomic variables to uncertainty and monetary shocks.

3.1. Unit root tests

The analysis of the unit root test is an important step for the application of the BVAR model (Silvia and Iqbal, 2012). Therefore, we apply the ADF test (Dickey and Fuller, 1981) to study the stationary of the series. This test covers the null hypothesis that validates the presence of the unit root meaning that the process is not stationary. The results reported in Table 2 show that the ADF test rejects the null hypothesis in the first difference of all the macroeconomics variables.

Table 2. Augmented Dickey-Fuller unit root test

Variables	Level		First difference	
	Intercept	Trend and intercept	Intercept	Trend and intercept
WUI	-1.910 (0.326)	-2.053 (0.566)	-4.963*** (0.000)	-4.999*** (0.000)
MMR	-0.947 (0.773)	-1.998 (0.596)	-4.008*** (0.001)	-4.008*** (0.008)
Real GDP	-1.906 (0.304)	-1.157 (0.914)	-8.023*** (0.000)	-8.131*** (0.000)
CPI	2.839 (1.000)	-1.488 (0.829)	-5.29*** (0.000)	-6.127*** (0.000)
EXP	-1.749 (0.403)	-2.984 (0.140)	-7.233*** (0.00)	-7.237*** (0.000)
IMP	-2.155 (0.226)	-2.054 (0.566)	-8.983*** (0.000)	-9.211*** (0.000)
REER	-1.478 (0.541)	-1.905 (0.646)	-4.400*** (0.000)	-4.427*** (0.002)
INVEST	-0.463 (0.893)	-2.595 (0.283)	-3.239** (0.019)	-4.141** (0.007)

Note: *, ** and *** indicate the significance level at the 10%, 5% and 1%, respectively. The number of lags was chosen based on the reporting criteria of Akaike and Schwartz.

Following the existence of the discontinuities and structural breaks in the time series, the one-regime unit root test becomes misidentified, and it is not informative enough of non-stationarity. In this regard, we examine the unit root properties of a series to determine the break-year in each variable. To do this, we use the procedure developed by Zivot et Andrews (1992) to test the null of unit root against the break-stationary alternative hypothesis. A structural break test is required to approve this proposal, and the results of this test are given in Table 3. The obtained results indicate that the series presented in the model are stationary by specifying the year of break for each variable.

Table 3. Unit root test of Zivot and Andrews

Variables	T-Statistic	Year of break
WUI	-7.689***	2020
MMR	-10.017***	2019
Real GDP	-29.674***	2020
CPI	-10.544***	2017
EXP	-10.850***	2020
IMP	-10.993***	2020
REER	-9.558***	2017
INVEST	-8.711***	2020

Note: *, ** and *** indicate the significance level at the 10%, 5% and 1%, respectively. Optimal lag length is determined according to the Schwarz information criteria (SIC). The breaks are in both intercept and trend.

3.2. Impulse response functions

We focus our study on the responses of macroeconomic variable to uncertainty and monetary shocks. In this regard, we use the BVAR model of Minnesota-Litterman prior based on the following values of hyper-parameters ($\lambda_1 = 0.1$; $\lambda_2 = 0.99$; $\lambda_3 = 1$) extracted from Pinshi (2020).

The figures below represent the impulse responses of these shocks. All graphs have an axis of abscissas that represents the monthly time horizon and a vertical axis that specifies the amplitude of the impulse response for each variable.

First of all, Figure 2 presents impulse responses to an uncertainty shock in Tunisia during the last 12 months. We observe a significant drop in production activity, which stabilized at the end of the period. This severe recession is accounted for by the cessation of economic activity following the containment measures. Therefore, the Tunisian economy has plunged into a phase of depression in the long term. Also, the inflation rate increased until the 4th month. Then, it got down slightly in the short time period of 2 to 3 months. After that, inflation started to grow again from the 6th month until it reached a high level. This augmentation is due to the decision of the monetary authorities to reduce the interest rate.

According to the literature, Krol (2014) shows that uncertainty makes the exchange rate volatile. We remark in the graphic that the exchange rate is volatile since the 4th month because of the uncertainty linked to the Covid-19 crisis. This situation generates difficulty in making decisions on international trade and investment for economic agents. So, the level of exports started to drop in the 3rd month following the interruption of exporting businesses' activity during the containment period. Then, exports increased again, with a slow recovery expected in line with the impact of the health situation on tourism and related activities.

According to the responses of investments, they have plunged significantly because of the increase in uncertainty and the fall in economic agents' income. Overall, we suggest that an uncertainty shock has a negative impact on the different macroeconomic variables. Thus, the uncertainty and the suspension of some economic activities and businesses affect the economic situation in Tunisia.

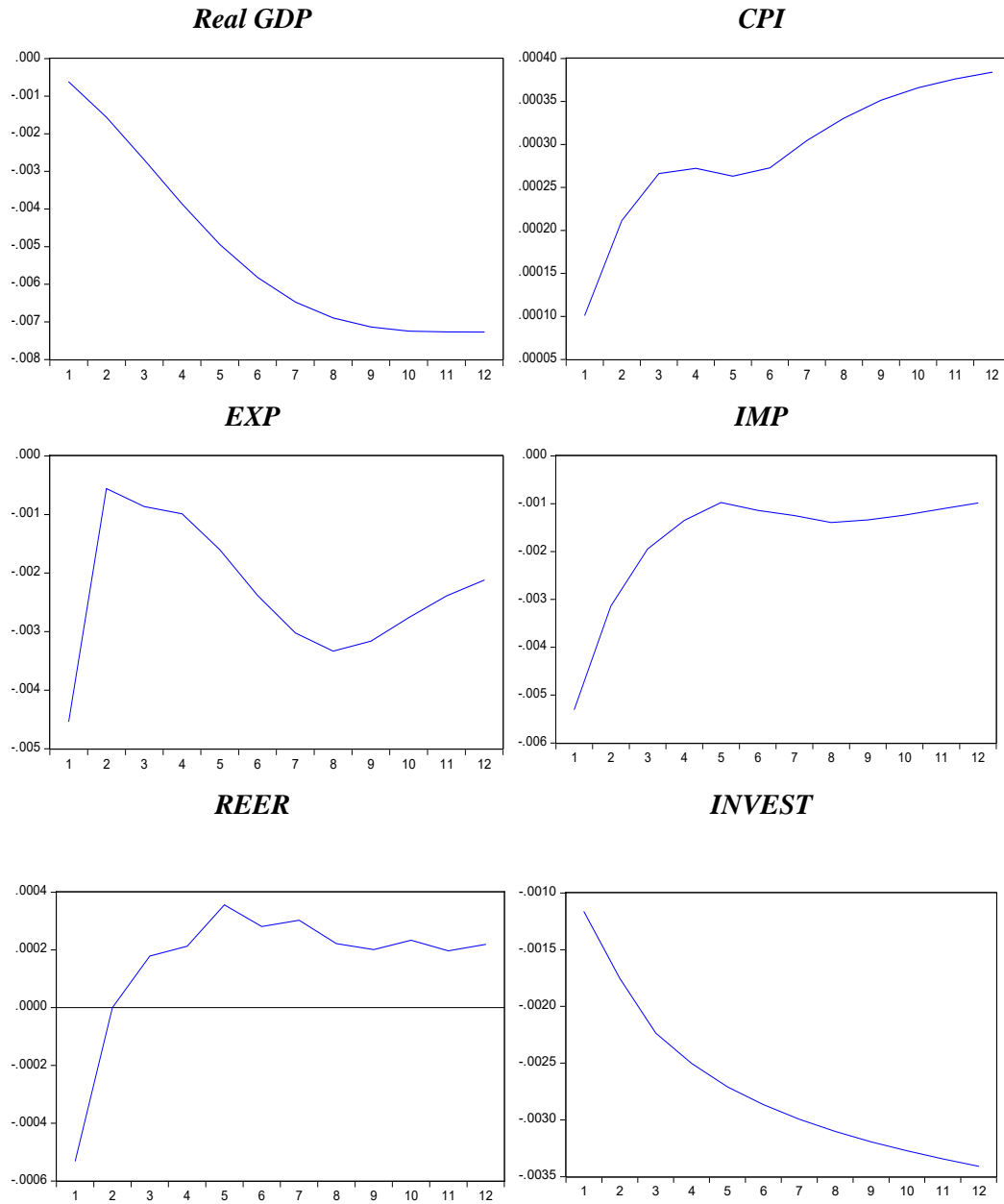
Furthermore, Figure 3 plots impulse responses to monetary policy shocks in Tunisia during the last 12 months. From these graphics, we examine the impact of the reduction in the interest rate. Firstly, we note that the production activity has started to decrease gradually from the third month. Then, it has continued to deteriorate significantly. Secondly, we observe that the inflation rate increased until it reached a high level. This augmentation is due to the reduction in the interest rate. In fact, controlling the level of inflation has long been considered a challenge for the CBT, especially in times of crisis.

Moreover, we note a strong decline in international trade in response to the monetary shock. Thus, we remark a significant drop in the level of exports until the 4th month. Then, it continued to decrease slowly in the long term. As to the response of the exchange rate, it has accentuated since the 4th month in the long term. Finally, we observe a tragic drop in investment in response to the reduction in interest rates.

In conclusion, we note that a monetary policy shock has negative repercussions on the principal macroeconomic variables in Tunisia, during the Covid-19 period. Indeed, the reduction in the interest rate has increased the severity and persistence of inflationary pressures without necessarily stimulating Tunisian economic activity.

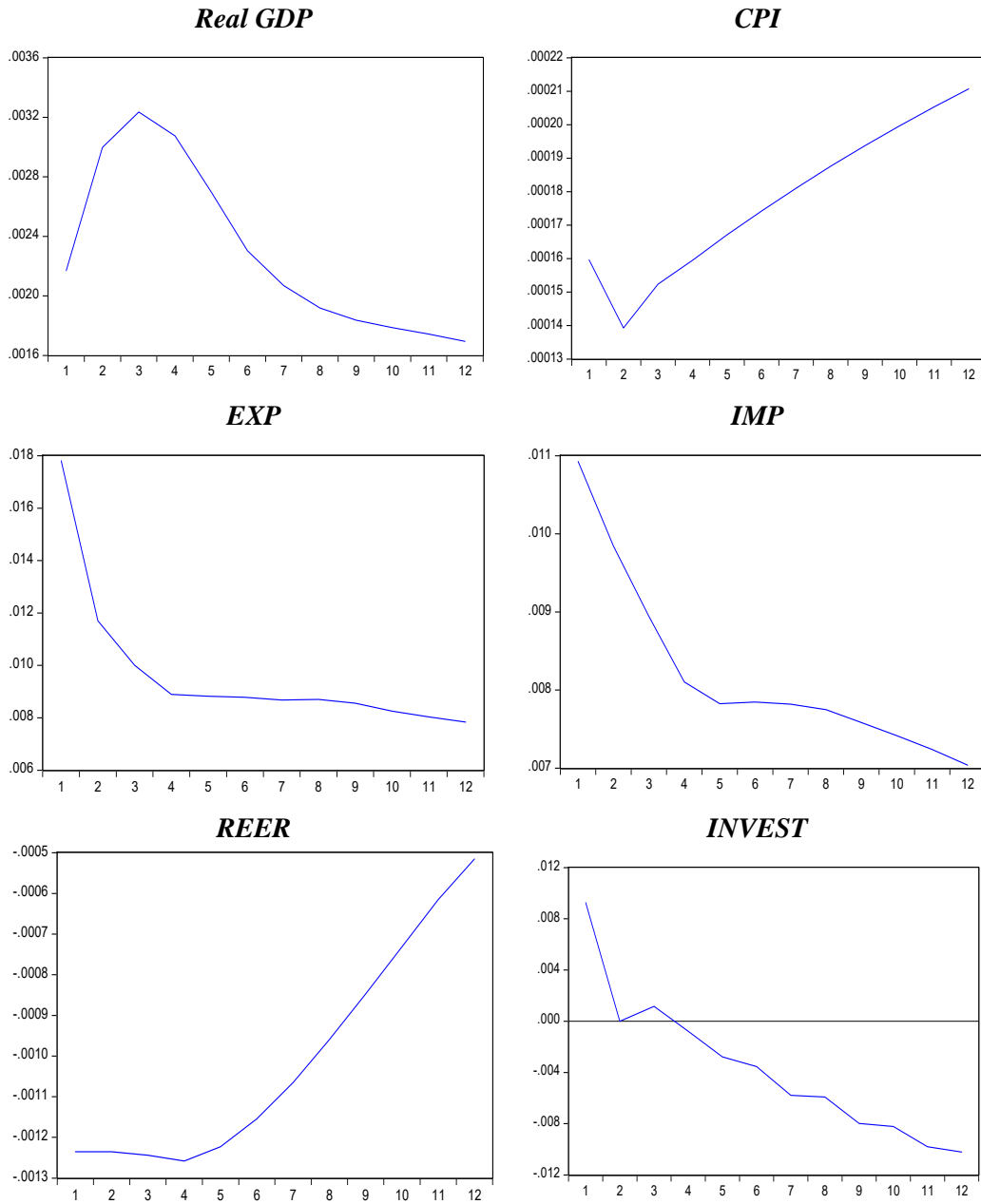
The finding results suggest that the conventional measures adopted by the monetary authorities are insufficient to overcome the economic repercussions of the Covid-19 crisis. Therefore, the CBT should reexamine its monetary policy strategy and replace it with the unconventional operational framework.

Figure 2. Impulse response to uncertainty shock



Note: Impulse response to an uncertainty shock in Tunisia obtained from a BVAR model of Minnesota-Litterman prior. The value of hyper-parameters ($\lambda_1 = 0.1$; $\lambda_2 = 0.99$; $\lambda_3 = 1$).

Figure 3. Impulse response to monetary shock



Note: Impulse response to a monetary shock in Tunisia obtained from a BVAR model of Minnesota-Litterman prior. The value of hyper-parameters ($\lambda_1 = 0.1$; $\lambda_2 = 0.99$; $\lambda_3 = 1$).

4. Conclusion

In this article, we analyze the effects of an uncertainty shock on the Tunisian economy during the period of the Covid-19 pandemic and examine the effectiveness of the monetary policy responses to overcome the economic consequences of this crisis. In this regard, we simulate both uncertainty and monetary shocks on a large range of macroeconomic variables, including economic activity, inflation, the exchange rate, export, import, and investment. Also, we consider the WUI as a proxy to measure the degree of uncertainty and the interest rate as the main instrument of monetary policy. By contributing to better understanding of the impacts of an uncertainty shock, we use the BVAR approach.

Specifically, better identification of economic characteristic during the period of the health pandemic found that an environment of uncertainty would generate persistent macroeconomic instability in Tunisia. We suggest that a shock of uncertainty has a negative impact on the different macroeconomic variables. Thus, the uncertainty related to the duration and severity of Covid-19 as well as the suspension of some economic activities and businesses affects the Tunisian economic situation.

During the period of uncertainty due to the Covid-19 crisis, the response of monetary policy by reducing interest rates appears ineffective. So, the CBT failed to control inflation and regulate national economic activity. This result suggests that conventional measures of monetary policy are insufficient to overcome the economic repercussions of uncertainty linked to the health crisis.

In summary, given the finding, our research highlights the policy implications. Tunisian authorities should reexamine their monetary policy strategy to overcome the effects of the Covid-19 pandemic on the national economy. They should extend its action to unconventional measures adopted in advanced economies since the global financial crisis.

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