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Full Length Article

What are the effects of financial stress on economic activity and government debt? An empirical examination in an emerging economy☆

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Abstract

Using a Bayesian Vector Autoregressive Model (BVAR) analysis, this paper explores the link between financial stress, economic activity, and government debt in Turkiye from January 1992 to December 2020. First, using the equally variance weighting approach, we calculate a financial stress index (FSI). Second, using the FSI, we estimate the BVAR model for the Turkish economy. The results of the BVAR model reveal that a positive financial stress shock is harmful for economic activity because it raises government debt. The findings also show that a positive government debt shock increases financial stress. Surprisingly, both government debt and financial stress diminish in response to a positive shock in economic activity. The conclusions of the study have substantial implications for future fiscal policy approaches.
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> Unless we understand what it is that leads to economic and financial instability, we cannot prescribe—make policy—to modify or eliminate it. Identifying a phenomenon is not enough; we need a theory that makes instability a normal result in our economy and gives us handles to control it.
>
> —Hyman Minsky[2]

1. Introduction

Economic shocks that force financial market players to alter their future return expectations are immediately incorporated in current asset values and then conveyed to the rest of the financial sector and the real economy (Kliesen et al., 2012). These shocks (like black swans) that begin in the financial markets are transmitted to the real economy and demonstrate the importance of following and monitoring the financial markets to policy makers.

According to Dufrénot et al. (2016), the perspective of the market must be considered while monitoring fiscal vulnerabilities because governments may face tighter financing limits, resulting in a future debt crisis. Furthermore, government debt management should be carried out differently in periods of financial instability than in normal times. This is because the increase in financial stress makes it difficult for the government to borrow in local currency—original sin (Eichengreen &

☆ **Note:** I just would like to emphasize that this article presented as an "abstract (not full paper)" at the Sixth International Conference on Economics (EconAnadolu 2022 https://econanadolu.com) to be held on 13–15 May 2022 in Eskisehir, Turkiye.

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[2] Minsky (2008), 111.

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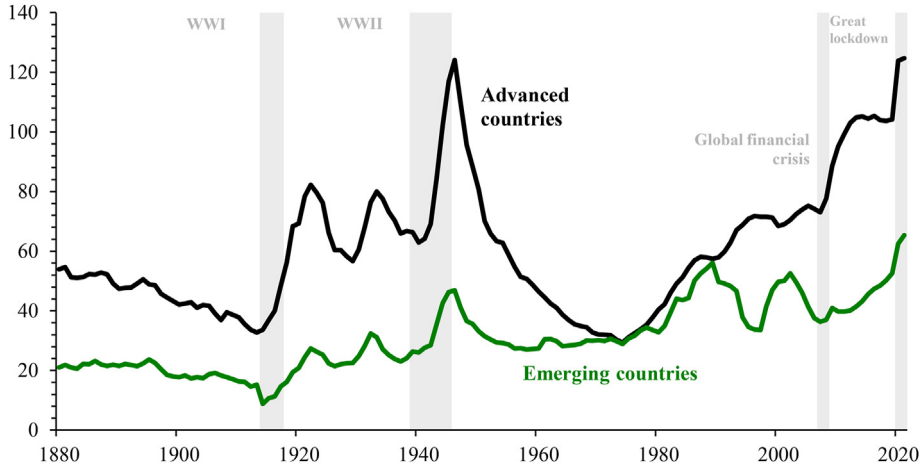

Fig. 1. The ratio of government debt to gross domestic product (GDP) in advanced and emerging countries
Note: The aggregate general government debt-to-GDP series for advanced and emerging market economies are based on a constant sample of 25 advanced and 27 emerging market countries.
Source: International Monetary Fund, Fiscal Monitor, October 2020.

Hausmann, 1999)—and the ratio of foreign currency debt in government debt increases during such periods. Therefore, policy makers need to monitor the transition mechanisms between financial markets and the real economy carefully in terms of government debt management. As Magkonis and Tsopanakis (2016, quoting Borio [2012: 62]) state: "Macroeconomics without the financial cycle is like Hamlet without a prince. In other words, macroeconomic policies will not be effective unless the financial cycle and its cyclical nature are taken into account by policymakers." This is why the measurements are being developed. One of these measurements is a financial stress index (FSI).

Financial stress is a financial market condition in which market participants suffer heightened uncertainty or adjust their expectations about future financial losses, fundamental asset value, and economic activity (Abdymomunov, 2013).[3] This definition reveals that financial stress has a multivariate nature and can have wide-ranging effects. Hence, investigating the relationship between financial stress, economic activity, and government debt is a critical issue that must not be overlooked.

During the COVID-19 pandemic, advanced and emerging countries implemented various fiscal measures, which caused debt to reach levels unseen since World War II (Fig. 1)—even higher than those during the global financial crisis. As shown in the figure, the fourth debt wave, which began after 2010 (Köse, Nagle, Ohnsorge, & Sugawara, 2020), reached an alarming level, and the COVID-19 pandemic exacerbated its severity. Uncertainty about the sustainability of government debt has increased.

Uncertainty about debt sustainability is a source of concern for financial markets. Concerns about the sustainability of government debt can weaken the creditworthiness of sovereign debt and increase financial stress (Afonso, Baxa, & Slavík, 2018). In particular, the increase in government debt–related financial market stress causes an increase in debt vulnerabilities and financial sector fragility. During times of financial stress, the rollover of debt can become increasingly difficult, potentially resulting in a crisis (Köse et al., 2020). For instance, the uncertainty about the end of unconventional monetary policies (quantitative tightening) and fiscal support during the COVID-19 pandemic raise the potential for a government debt–driven crisis as the appetite for risk in global markets decreases.

In times of crisis, high government debt can restrict the scope and effectiveness of fiscal stimulus, as well as harm long-term growth by crowding out productivity-enhancing private investment. Additionally, the rise in country spreads with the restoration of high inflation may lead to higher refinancing risks and an increase in the budget deficit. This limits the use of debt-financed expansionary fiscal policies that stimulate aggregate demand and output without crowding out private sector resources when firms face credit constraints (Ferraresi et al., 2015). More precisely, the increase in the share of interest expenditure in the budget can limit the fiscal space and economic growth–oriented government expenditure. Additionally, higher interest rates can make the financial system more vulnerable because they expand debt more quickly than the ability to service it (Eichengreen & Hausmann, 1999). Therefore, countries with high government debt have the most restrictions on fiscal policy.

We examine Turkiye, an emerging economy, to create an FSI and to guide fiscal policy makers in government debt management. This is because the recent surge in its central government debt has raised concern. Indeed, in 2020 its central government debt reached 38 percent of the gross domestic product (GDP), a 26 percent rise over the level 2019, before the pandemic (30 percent of GDP). Moreover, as of December 2020, its foreign currency debt reached an alarming level (57 percent of the central government's debt consists of foreign currency debt). Therefore, as mentioned above, empirical evidence of the stability of financial markets is a critical guide for fiscal policy makers. Identifying the sources of financial stress can assist them in

[3] For literature on the definition of financial stress, see Kliesen et al. (2012).

formulating policy solutions to prevent damage to the financial system (Altınkeski et al., 2022). Close monitoring of financial markets in terms of government debt management should not be overlooked by fiscal policy makers. Some studies have calculated an FSI for Turkiye, but none to date have examined the relationship between financial stress, economic activity, and government debt, hence the impact of the FSI on government debt is not yet clear.

This study makes two contributions to the literature. First, Turkiye's FSI is calculated for the period January 1992–December 2020. Second, using a BVAR method, we analyze the relationship between FSI, on the one hand, and economic activity and government debt, on the other. In the 1990s, Turkiye faced severe crises in terms of its economy and finances. After a crisis in 2001, Turkiye entered a new era, with economic policies supported by the International Monetary Fund (IMF), breathless growth, financial stability, and a stable ratio of government debt to GDP until the 2008 crisis. However, the 2008 global financial crisis caused weaker growth and disruption in financial stability. Subsequently, economic activity in Turkiye became more volatile, and government debt growth accelerated. The COVID-19 shock also contributed negatively to this process and increased financial instability in Turkiye, as well as all over the world.

The remainder of the paper proceeds as follows. In Section 2, we review the literature on the relationship between FSI and economic activity and fiscal policy. Section 3 presents the components of the FSI and how the FSI is calculated. In Section 4, the relationship between the FSI, economic activity, and government debt for Turkiye is analyzed. Then, the robustness analysis results are in Section 5, and Section 6 gives our conclusions and policy recommendations.

2. Literature review

Since the global financial crisis, many researchers have emphasized the impact of financial stress on economic activity. Many researchers have sought to determine the effects of financial stress on economic activity. Mittnik and Semmler (2013) analyze the relationship between the FSI and economic activity with a multiregime VAR (MVAR) approach for the US, the UK, and the four major eurozone countries. Their impulse response results reveal that the magnitude and size of the shocks are dependent on the current state of the economy. They conclude that shocks that raise financial stress have a greater impact on economic activity during times of high stress than during times of low stress. These results also show that huge negative shocks to financial stress have large positive effects on real activity in times of high financial stress, supporting the idea of "nontraditional" monetary policy measures in scenarios with extreme financial stress. Hueng et al. (2021) use an MVAR model to examine the asymmetric and nonlinear impacts of financial stress on China's real economy under high- and low-stress regimes. They find that China's real economy responds more strongly to a financial stress shock in high-stress regimes than in low-stress regimes. The asymmetric findings show that the response to a positive financial stress shock becomes disproportionately stronger as the magnitude of the shock increases, but a negative shock has no such amplification effect. The results suggest that a serious financial crisis intensifies the damage to China's real economy. Similarly, Elekdağ et al. (2010) and Çevik, Dibooğlu, and Kenc (2013) look at Turkiye, Çevik, Dibooğlu, and Kutan (2013) study transition economies, Çevik, Dibooğlu, and Kenç (2016) examine some emerging Asian economies, Hakkio and Keeton (2009) explore the and Cardarelli, Elekdağ, and Lall (2011) compare 17 advanced countries and find that financial stress has negative effects on economic activity.[4]

Recently, researchers have shown increased interest in analyzing the relationship between financial stress and fiscal policy, in particular, government debt. Studies such as Proaño et al. (2014), Ferraresi et al. (2015), Magkonis and Tsopanakis (2016), Afonso et al. (2018), Afonso and Jalles (2020) attempt to explain this relationship.[5]

Looking at 16 member countries of the Organization for Economic Cooperation and Development (OECD) from Q1 1981 to Q2 2013, Proaño et al. (2014) investigate whether the effect on economic growth of a change in the ratio of government debt to GDP depends on the level of debt and the level of financial market stress. They find that the ratio of government debt, regardless of debt level, has a detrimental effect on growth only at high levels of financial stress. Furthermore, they demonstrate that debt reduces growth during periods of high financial stress in the member countries of the European Monetary Union (EMU). They also show that the interaction of the debt level and the financial stress level is important in the debt-growth link. They conclude that rising debt levels, particularly in southern EMU countries, have a detrimental impact on growth at high levels of debt and financial stress.

Ferraresi et al. (2015) use 1984–2010 quarterly data for the US and analyze how the state of credit markets affects fiscal policy with a threshold VAR (TVAR) model. They conclude that the output response to fiscal policy shocks is stronger and more persistent in the presence of tight credit regimes. Moreover, they state that fiscal multipliers are quite different in tight and normal credit regimes. Ferraresi et al. (2015) find that the fiscal multiplier is higher than one, especially in the tight credit regime, when firms face increasing financing costs. More precisely, they argue that fiscal consolidation policies are extremely harmful when the economy is in a tight credit regime.

Magkonis and Tsopanakis (2016) analyze the financial and fiscal stress interconnectedness among five advanced countries. They demonstrate that during and after the global financial crisis, interaction between these two factors was remarkable. Their findings emphasize the need for coordinated

[4] Other studies have been conducted on different effects of financial stress. Çevik, Kırcı-Çevik, and Dibooğlu (2016) study the relationship between financial stress and global liquidity. Kırcı-Çevik et al. (2018) investigate the relationship between price stability and financial stability for major emerging countries. Dibooğlu et al. (2022) analyze the relationship between gold, silver, and the US dollar returns and financial stress in the US.

[5] For an examination of the relationship between monetary policy and financial stress, see also Baza et al. (2013) and Dibooğlu et al. (2020).

macroprudential measures in mitigating the detrimental impacts of excessive financial and fiscal stress.

Using a TVAR model, Afonso et al. (2018) examine the relationship between government debt, economic activity, and financial stress in different financial regimes, during the period April 1980–January 2014 in the US, the UK, Germany, and Italy. Their results show that production responds positively to an increase in the debt ratio in both the low and high financial stress regimes. However, the financial stress shock harms and worsens fiscal conditions. Additionally, they indicate that during the 2008 crisis the fiscal multipliers were larger than normal.

Afonso and Jalles (2020) examine the magnitude of the government reactions to debt in 123 advanced and emerging economies between 1980 and 2018, taking into consideration the changing characteristics of financial markets. They conclude that when stress in financial conditions is high, fiscal authorities use the primary balance more actively to reduce government debt. Furthermore, these findings indicate that strict financial conditions serve as a disciplinary tool. In summary, these results show that it is vital to investigate the relationship among the variables.

3. Measuring Turkiye's FSI

Much of the current literature on the FSI pays particular attention to how it is measured. The two critical issues in the literature are which variables should be selected and which method is used to create the FSI. The variables selected to reflect financial stress are used together for measuring the FSI. However, no consensus has been reached on which variables to use in measuring the FSI. Illing and Liu (2006), in which the FSI for Canada is developed, is a pioneering discussion about this issue. They created the FSI using variables for foreign exchange, stocks, debt, and banking sector beta using factor analysis, credit weight, and equal variance weight methods. They determine that the most appropriate index for Canada is an FSI created with the credit weight method. Hakkio and Keeton (2009) identify five basic determinants of financial stress: increased uncertainty about the fundamental value of financial assets, increased uncertainty about the behavior of other investors, increased information asymmetry, flight to quality, and flight to liquidity. Therefore, the FSI should take these determinants into account. They use variables with these characteristics in the creation of an FSI for the US.[6]

Hatzius et al. (2010) use 45 variables (bank credit, debt, asset-based securities, and consumer and household surveys) to construct a financial conditions index for the US through a principal components analysis (PCA). They conclude that the index demonstrates a tight link between financial conditions and future economic activities. Hatzius et al. (2010) state that, at the end of 2009, financial conditions were slightly worse than normal mostly because several quantitative credit indicators (particularly the issuance of asset-backed securities) remained exceptionally low for a recovering economy. Cardarelli et al. (2011) develop an FSI for six advanced countries (US, UK, Japan, Germany, France, and Canada) using the variables for banking, securities, and exchange rates with the equal variance weighting method. Their main conclusion is that financial stress often does not herald an economic slowdown or recession. However, they conclude that rapid credit expansion, rising housing prices, and large borrowing by firms and households contribute to stress on the financial system, which is more likely to lead to a serious economic downturn. They state that an increase in banking stress tends to have larger effects on economic activities.

Çevik, Dibooğlu, and Kenc (2013) collect monthly data to compile an FSI for Turkiye from January 1997 to March 2010. Banking sector risk, securities risk, currency risk, foreign debt, sovereign risk, financial account balances, credit stress, money market spreads, and stock market spread variables are employed as FSI components. By combining these variables with the PCA method, they generated an FSI. They also examine the impact of the FSI on economic activity, concluding that a positive FSI shock reduces economic activity.[7]

In this study, first, we select the variables for the creation of the FSI, based on with the characteristics specified by Hakkio and Keeton (2009). These variables are the short-term market interest rate (annual percentage change), exchange rate volatility, stock market volatility,[8] the volatility index (VIX),[9] and the Chicago Fed NFCI index.[10] Information on the variables is in Appendix Table 1. Table 1 lists the main characteristics of the variables.

Second, we determine that the method to use in the creation of the FSI is the equally variance weighting method. Each variable is standardized for this purpose by being subtracted from its mean and divided by its standard deviation. By using this approach, the fluctuations in the variables are at the same scale (Kliesen et al., 2012). Then, we combine the standardized values to obtain the FSI using the equal variance weighting method as follows:

[6] For more detailed information, see Hakkio and Keeton (2009), 13.

[7] Other studies measure the financial stress in different countries. Hanschel and Monnin (2005) measure the financial stress index for Switzerland, Morales and Estrada (2010) for Colombia, Louzis and Vouldis (2013) for Greece, and Corbet and Twomey (2014) for the UK.

[8] Exchange rate volatility and stock market volatility were obtained through the GARCH(1,1) method. The best model for exchange rate volatility is ARMA(1,2)-GARCH(1.1), whereas the best model for stock market volatility is ARMA(4,4)-GARCH(1,1). The conditional variance is obtained as a consequence of the model estimate to represent volatility. All results are available from the author upon request.

[9] The VIX (Volatility Index) is an indicator of expected volatility in the S&P 500 index, showing uncertainty about financial assets and other investors (Hakkio & Keeton, 2009) and is also used as an indicator for global financial conditions.

[10] The National Index of Financial Conditions (NFCI) of the Federal Reserve Bank of Chicago offers comprehensive information on US financial conditions in money markets, debt and stock markets, and traditional and shadow banking systems. Positive NFCI values imply that financial circumstances are tighter than usual, while negative values indicate that financial conditions are looser than usual. NFCI is not a negligible variable in assessing financial conditions. Indeed, Brave and Butters (2012) conclude that NFCI is robust to forecasting financial stress accurately for periods of up to one year.

Table 1
Variables in Turkiye's FSI.

Variable	Main characteristics	Mean	Standard deviation
Short-term market interest rate (i)	Flight to quality, flight to liquidity, increased asymmetry of information	3.364	51.881
Exchange rate volatility (FX)	Uncertainty about assets and other investors, flight to liquidity, flight to quality	0.002	0.006
Stock market volatility (STOCK)	Uncertainty about assets and other investors	0.013	0.01
Volatility index (VIX)	Flight to quality, flight to liquidity	19.39	7.951
FED National financial conditions index (NFCI)	Flight to quality, flight to liquidity	−0.422	0.498

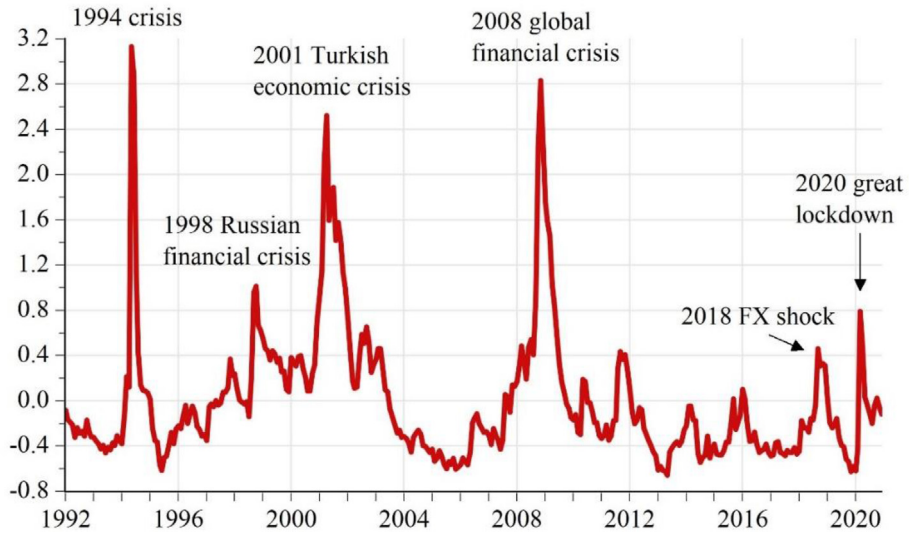

Fig. 2. The FSI for Turkiye.
Note: This figure illustrates the development of the FSI.

$$FSI = \frac{\frac{i_t-\mu_i}{\sigma_i} + \frac{FX_t-\mu_{FX}}{\sigma_{FX}} + \frac{STOCK_t-\mu_{STOCK}}{\sigma_{STOCK}} + \frac{VIX_t-\mu_{VIX}}{\sigma_{VIX}} + \frac{NFCI_t-\mu_{NFCI}}{\sigma_{NFCI}}}{5} \quad (1)$$

where μ represents the mean, and σ represents the variance. The FSI for the Turkish economy is shown in Fig. 2. A rise in the index implies an increase in financial stress, whereas a reduction shows a decrease in financial stress. In reality, excessive levels occur in times of panic/crash/crisis (Kliesen et al., 2012).

As seen in Fig. 2, the FSI reflects the financial, economic, and fiscal crises in Turkiye. The FSI reached its highest value during the 1994 Turkish economic crisis, the 1998 Russian financial crisis, the 2001 Turkish economic crisis, the 2008 global financial crisis,[11] and the COVID-19 pandemic (great lockdown; March 2020), respectively. The FSI also surged as a result of the tapering announcement by the US Federal Reserve in May 2013, political instability in the second half of 2015, and the foreign exchange shock in August 2018. Overall, the FSI can predict crises in Turkiye. The ability of the FSI to detect these crises is a crucial signal that it is a high-quality index. The FSI for Turkiye is also compared to other financial condition indexes. Fig. 3 depicts the FSI for Turkiye, the Kansas City FSI (KCFSI), and the St. Louis Fed FSI (STLFSI).

Fig. 3 indicates the existence of a strong relationship between the variables. This phenomenon is also buttressed by the correlation results. Indeed, the correlation coefficient between the KCFSI, the STLFSI, and Turkiye's FSI is 0.67 at the $p = 0.01$ level of significance. This coefficient indicates a positive relationship between the indexes that is fairly strong. This also shows the sensitivity of the FSI to global conditions. In addition, a threshold value (0.34) was determined with an HP (Hodrick-Prescott) filter for the FSI, as in Illing and Liu (2006), Cardarelli et al. (2011), and Çevik, Dibooğlu, and Kenc (2013). Periods exceeding this level indicate increased financial stress.

4. VAR evidence

4.1. Model

In analyzing the effect of financial stress on economic activity and government debt, we use the model by Afonso (2018) but, instead, estimate the model with a BVAR. The levels specification in the model is BVAR(3).[12] BVAR models

[11] Indeed, the increased uncertainty in the global financial markets and banking system in 2008 contributed to a rise in financial stress (Çevik, Dibooğlu, & Kenc, 2013).

[12] AIC (Akaike Information Criterion) and FPE (Final Prediction Error) criteria were used in the selection of the lag length. Although the Schwarz information criterion indicates a lag length of 2, the results are very similar and available upon request.

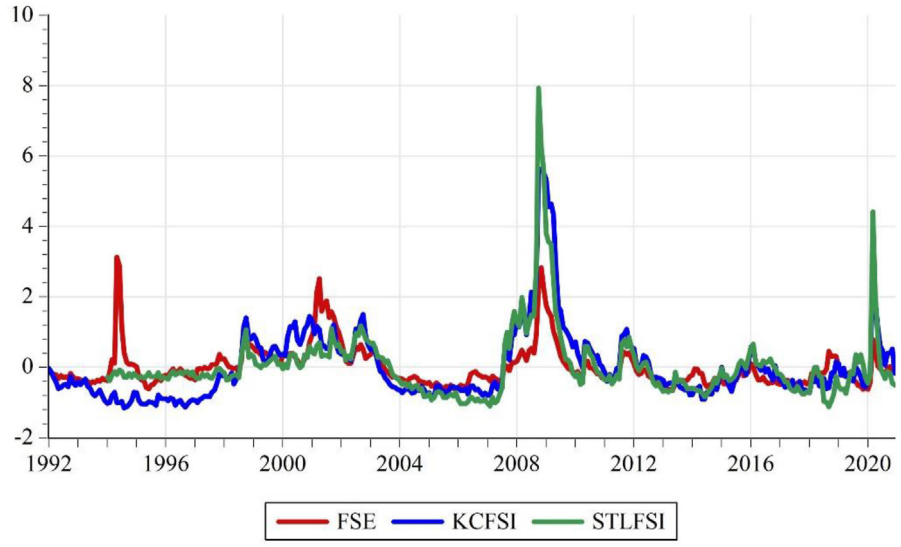

Fig. 3. A comparison of FSIs.
Source: KCFSI and STLFSI variables were obtained from the Federal Reserve Economic Data (FRED) database.

are relatively simple and have two distinct advantages over commonly used macroeconometric models. The first is that it does not require judgmental adjustment. Therefore, it can be examined without the need for a forecaster to run the model. Second, it generates a comprehensive, multivariate probability distribution for future economic events, which seems more realistic than that yielded by other methods (Litterman, 1986). First, we consider a standard VAR model as follows (Ciccarelli & Rebucci, 2003):

$$Y_t = B_1 Y_{t-1} + B_2 Y_{t-2} + \ldots + B_p Y_{t-p} + u_t \tag{2}$$

The variable vector in the model, Y_t, represents the endogenous variable vector $n \times 1$, the logarithm of the annual change in the industrial production index (PRO), the logarithm of the annual change in the inflation rate (INF), the logarithm of the annual change in the total stock of central government debt (D), and the level value of the FSI. The industrial production index is used as a variable for economic activity. The inflation variable is included in the model because high inflation has a considerable impact on the Turkish economy. The model also includes the government debt ratio as a variable for fiscal policy.[13] u_t represents the $n\ x\ 1$ vector of error terms i.i.d (independent and identically distributed random variables) process with a variance covariance matrix, Σ. Equation (2) can be abbreviated as:

$$Y_t = X_t\beta + \varepsilon_t \tag{3}$$

where $X_t = (I_n \Theta W_{t-1})$ is $n\ x\ nk$, $W_{t-1} = (Y'_{t-1}, \ldots, Y'_{t-p}, z'_t)$ is $k\ x\ 1$, and $\beta = vec(\beta_1, \beta_2, \ldots, \beta_p)$ is $nk\ x\ 1$. The unknown parameters in the model are β and Σ. The probability function using Eq. (3) is as follows (Canova, 2007; Ciccarelli & Rebucci, 2003; Lütkepohl, 2005):

$$L(Y \mid \beta, \Sigma) \propto \left|\Sigma\right|^{-0.5T} exp\left\{-0.5\sum_t (Y_t - X_t\beta)' \Sigma^{-1} (Y_t - X_t\beta)\right\} \tag{4}$$

Additionally, a joint prior distribution of the parameters, $p(\beta, \Sigma)$, and a joint posterior distribution of the parameters, $p(\beta, \Sigma \mid Y)$, are estimated with the Bayesian rule. The analytical solution of $p(\beta, \Sigma \mid Y)$ can be solved with the Monte Carlo simulation method (MCMC). By randomly picking values from the distribution, it is possible to describe a distribution without knowing all its mathematical features (Ravenzwaaij et al., 2018). An important problem encountered in the estimation of Eq. (3) is the selection of a priori distribution for the parameters of the model (Ciccarelli & Rebucci, 2003). Indeed, the prior distribution is required for Bayesian estimation. According to Larson (1982), the a priori distribution of a parameter is a probability function or probability density function that represents our belief about the value of the parameter prior to observing a sample of random variables whose distribution function depends on the parameter. According to Koop and Korobilis (2010), it is difficult to obtain precise estimates of the coefficients without prior knowledge, and therefore aspects such as impulse responses and predictions tend to be imprecisely estimated. As a result, in the estimation of the BVAR model, a priori distribution should be used. In the present study, a normal inverse-Whishart prior is used for the prior distribution.[14] According to Uhlig (2005), the flat prior is appealing because reordering the variables and

[13] As in Ferraresi et al. (2015), the model is rerun using the logarithm of the annual change in the level of government spending as a fiscal policy variable. The results are similar and presented in the robustness section.

[14] For different priori types, see Canova (2007), Koop and Korobilis (2010), and Giannone et al. (2015).

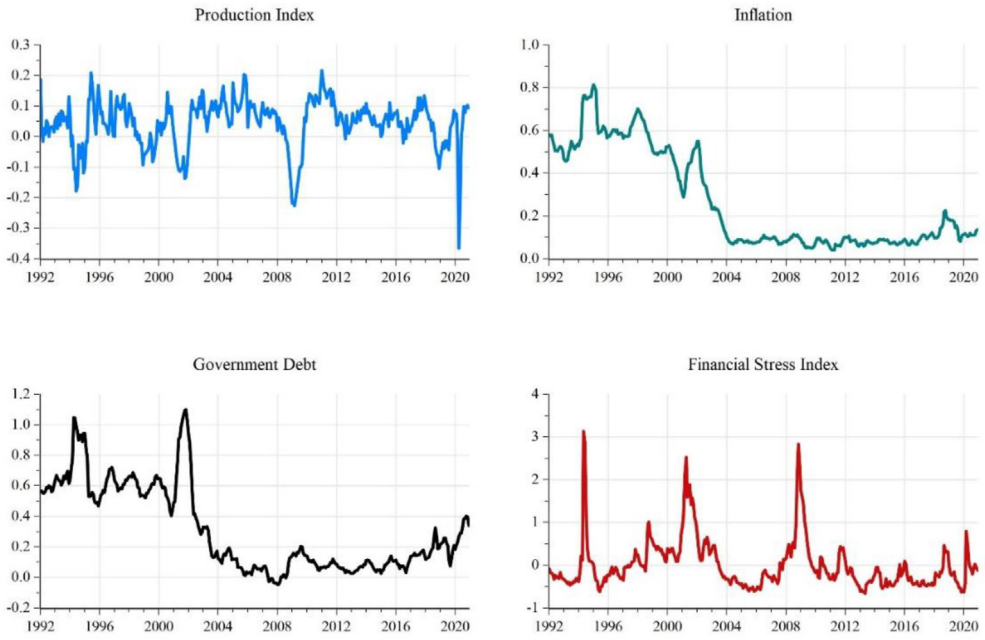

Fig. 4. Graphs of the variables.
Note: This figure presents the evolution of the research sample over time.

using a different Cholesky decomposition to parameterize impulse vectors will not generate different results.

The dynamic effects of shocks to the variables are examined using impulse-response functions after the BVAR(3) model is estimated in Eq. (2). The shocks are determined using Cholesky decomposition, and the variables are ordered from the most exogenous to the most endogenous, following Afonso et al. (2018). This ordering assumes that the FSI responds to all variables in the system simultaneously. The fiscal variable is ordered after the production variable to account for the necessity of determining the effects of automatic stabilizers on the economy. Moreover, because of decision and implementation lags in fiscal policy (Blanchard & Perotti, 2002), all fiscal policy measures are assumed to be purely automatic.

4.2. Data

A 1992–2020 monthly data set is used to estimate the BVAR(3) model. The key reason for selecting this period is the availability of data. Among the variables, the industrial output index and inflation data were obtained from the FRED database, and the central government debt stock data come from the Ministry of Treasury and Finance of Turkiye's website. The details on the variables are in the Appendix. Fig. 4 illustrates some of the main characteristics of the variables.

As shown in Fig. 4, industrial production experiences sudden downward changes in periods when the FSI rises, but inflation and government debt demonstrate sudden upward changes. In Fig. 4, industrial production falls during periods of high financial stress. The figure shows that government debt increases in periods of high financial stress. Financial stress is low when industrial production rises. Furthermore, the data show that Turkiye experienced significant structural changes before and after 2000. The correlation coefficients are presented in Fig. 5 to examine the relationship between the variables.

The results from the correlational analysis are presented in Fig. 5, showing that the FSI is negatively correlated to PRO (−0.6). The PRO is negatively correlated to INF (−0.2), and D (−0.3). The FSI is positively correlated to INF and D (0.25 and 0.40, respectively) at the $p = 0.01$ significance level. The highest correlation coefficient is between INF and D (0.90). These results help explain the relationship between the variables. Next, we turn to the econometric evidence on the dynamic effects of shocks to the variables.

4.3. VAR results

The impulse responses from a one-standard-deviation increase in the FSI are shown in Fig. 6.[15] In Fig. 6, the solid red line represents the mean response for 60 periods with 1000 draws, and the blue lines represent the confidence interval for the impulse response coefficients. The FSI has a statistically significant and long-lasting effect on production and government debt. When the FSI increases, production decreases, and government debt increases. The decrease in production is sudden and deep, and the effect of the shock continues until the end of the twentieth period. The increase in government debt reaches its peak (~1.5%) at the end of approximately one year. After almost three years, the impact of the shock on the government debt wears off. These impulse responses show that the increase in financial stress has nonnegligible effects on output and government debt. The results of the impulse response are

[15] The impulses responses in this paper are obtained using R Studio 4.1.2. The author thanks Christian Danne for sharing open-source R codes.

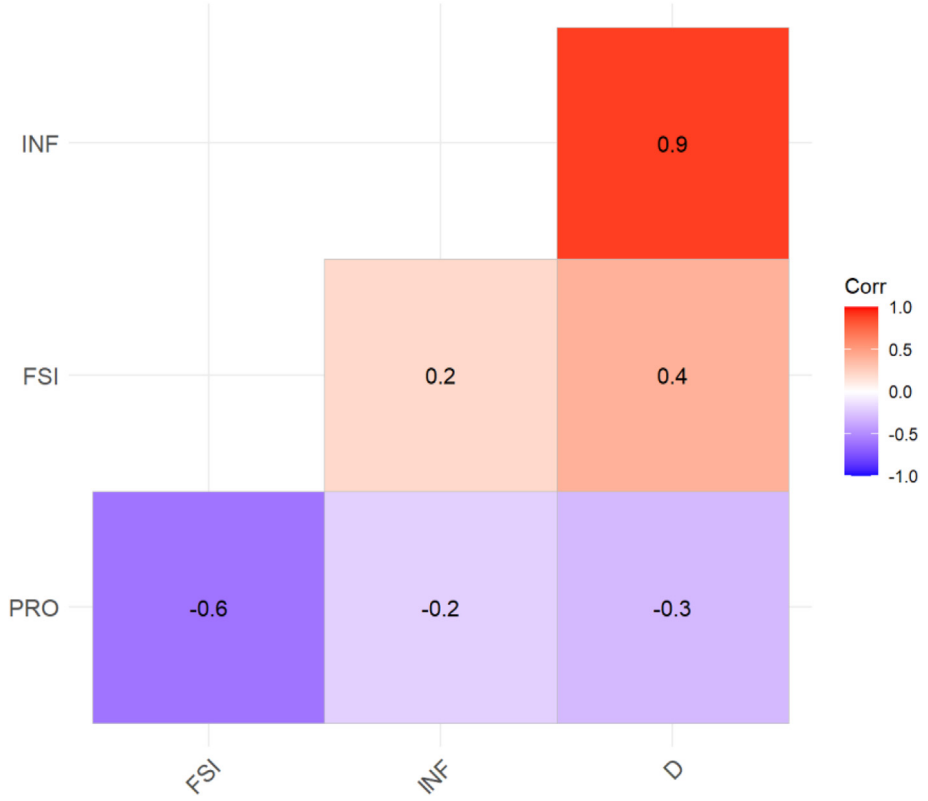

Fig. 5. Correlation between the variables.

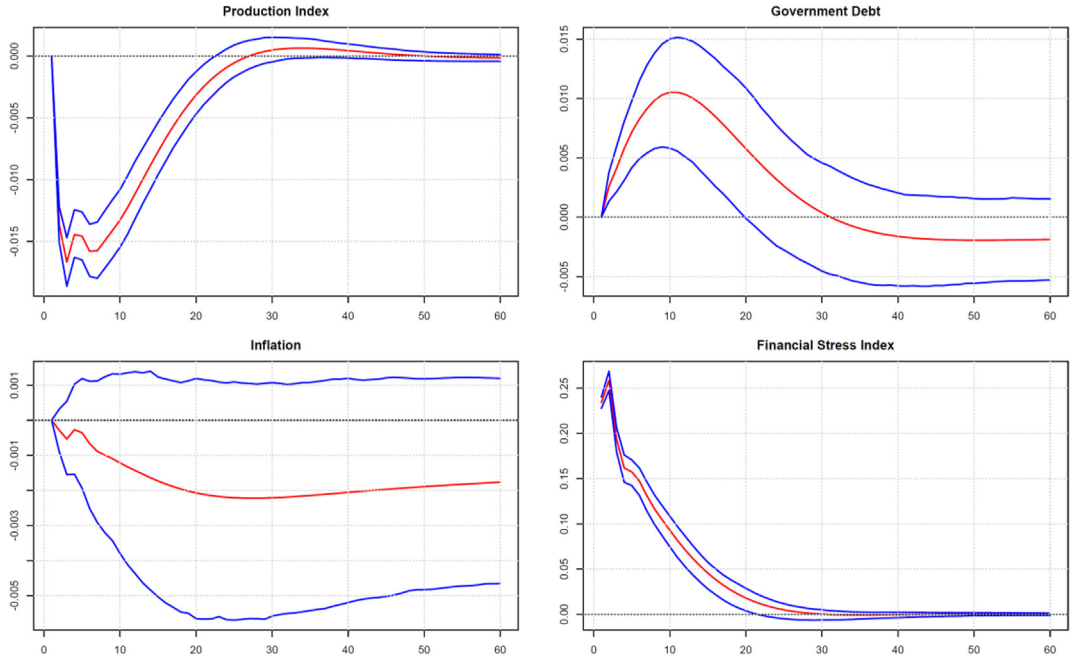

Fig. 6. Impulse responses of the production index and government debt to a positive FSI shock
Note: Impulse responses to a one-standard-deviation positive shock in the FSI. The red line represents the mean response, and the blue lines represent the 25%–75% confidence intervals.

within the framework of expectations. This finding is consistent with that of Elekdağ et al. (2010) and Çevik, Dibooğlu, and Kenc (2013), which has similar results for Turkiye.

Fig. 7 shows the impulse responses to a positive shock in government debt on output and financial stress: a shock to government debt of one standard deviation sharply increases

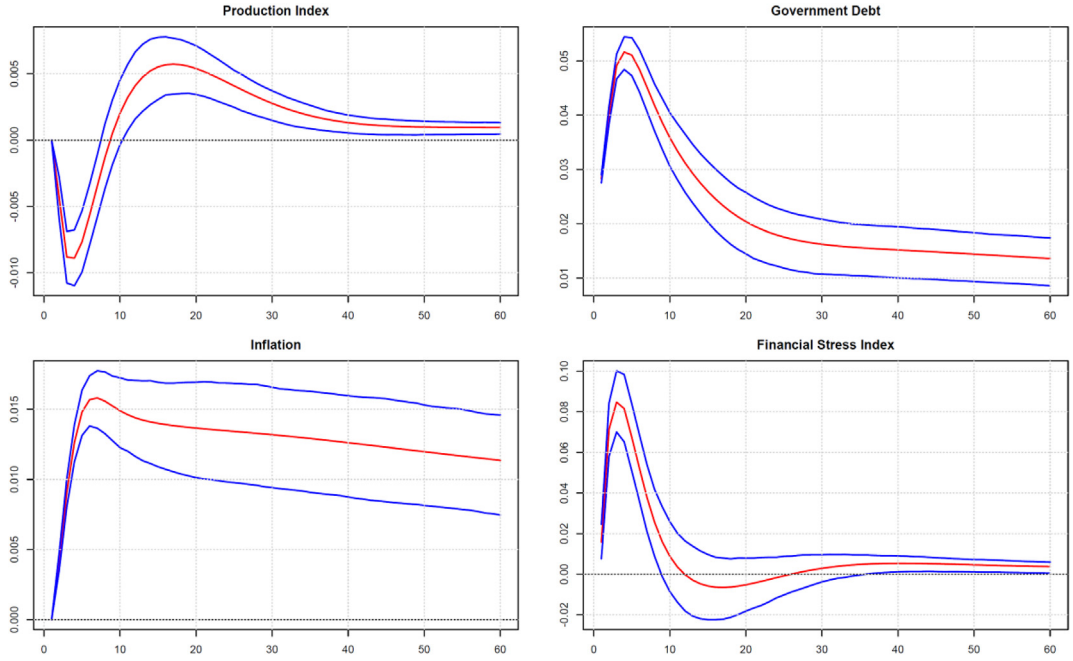

Fig. 7. Impulse responses of the production index and the FSI to a positive government debt shock
Note: Impulse responses to a one-standard-deviation positive shock to government debt. The red line represents the mean response, and the blue lines represent the 25%–75% confidence intervals.

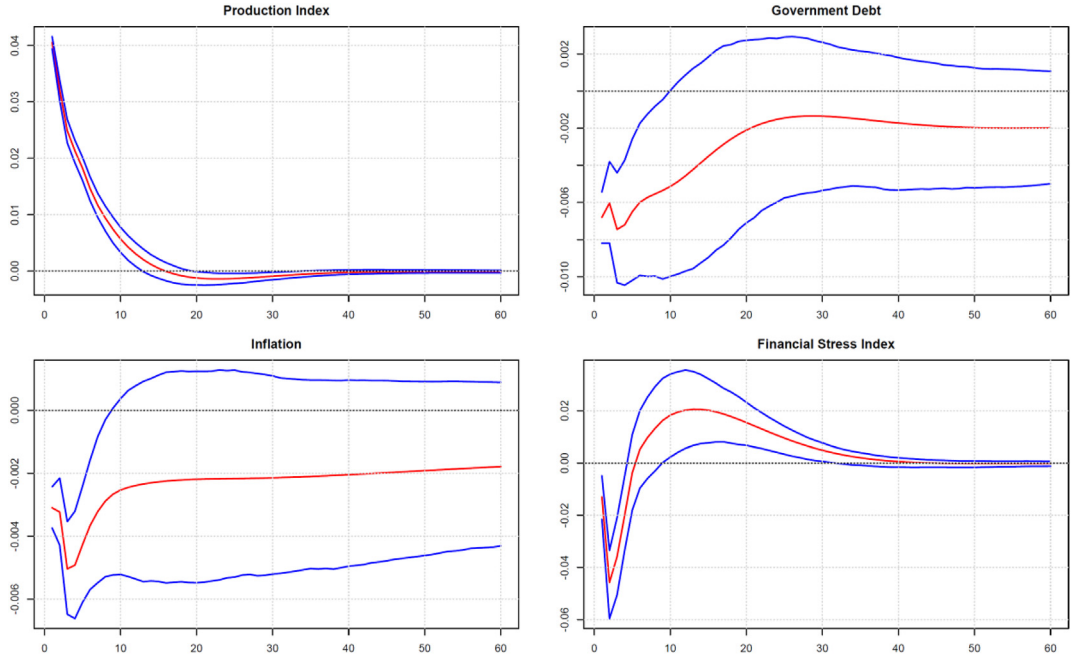

Fig. 8. Impulse responses of government debt and the FSI to a positive production index shock
Note: Impulse responses to a one-standard-deviation positive shock in economic activity. The red line represents the mean response, and the blue lines represent the 25%–75% confidence intervals.

financial stress. Indeed, the effect of the shock to financial stress approaches 10 percent at the end of the fourth month. The half-life of the FSI response is about one year. The effect of government debt on production is negative. A one-standard-deviation increase in government debt reduces output by a little over 1 percent by the end of the fourth month. The effect of the shock disappears at the end of one year. Therefore, the impact of increases in government debt on economic activity and financial stress is crucial for government debt management.

Fig. 8 shows the effects of government debt and financial stress on a positive one-standard-deviation shock in the industrial production index. The impulse responses show that the



Fig. 9. A schematic representation of the results.

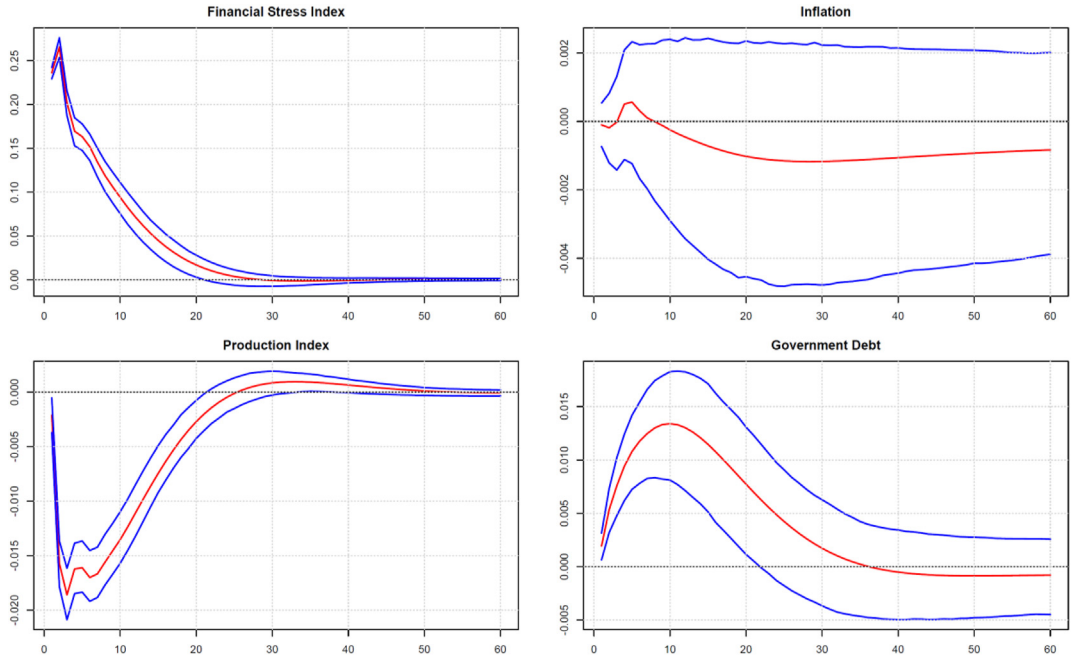

Fig. 10. Impulse responses to a positive FSI shock for alternative identification.
Note: Impulse responses to a one-standard-deviation positive shock in the FSI. The red line represents the mean response, and the blue lines represent the 25%–75% confidence intervals.

increase in industrial production reduces government debt and financial stress. A basic explanation can be given for this result. As a result of high production, budget revenues increase, and the financing burden of government decreases. Additional financing needs and rollover costs are reduced. Therefore, government pressure on financial markets disappears, and the FSI declines.

The results are represented schematically in Fig. 9, which illustrates that high financial stress reveals low economic activity and high government debt.

These results have critical implications for fiscal policy. In particular, the effect of government debt as a fiscal policy tool on production and financial markets should be taken into account. Production-oriented fiscal policies of the government can have positive effects on both government debt and financial stress. In particular, the increase in budget revenues due to economic growth can reduce the financing needs of the government, so the fiscal space might increase and limit the burden on financial markets. Therefore, effective government debt management is important for ensuring that the government does not create a crowding-out effect. Additionally, policy makers need to monitor market-based indicators and make decisions about their fiscal vulnerabilities (Dufrénot et al., 2016).

Afonso et al. (2018) write that when production growth and the output gap are uncertain, indicators of negative sentiment on financial markets can reduce the danger of false signals and provide information about the state of the economy. Lastly, policy makers should not forget that, in times of financial stress, private debt can quickly turn into government debt, as stated by Köse et al. (2020).[16] However, it is beyond the scope of this study to examine the relationship between private debt and the FSI.

5. Robustness

We test whether the results are robust to potential problems. More precisely, we analyze whether the results change with the use of alternative identifications, subsample analysis, and alternative fiscal policy tools.

5.1. Alternative identification

Alternative ordering assumptions can be made in the BVAR (3) model. We follow Çevik, Dibooğlu, and Kenc (2013) and order the FSI first in BVAR(3) model. The FSI is assumed to affect all other variables simultaneously, but the FSI is affected by a lag. Fig. 10 shows the responses of the variables to a

[16] Reinhart and Rogoff (2011) demonstrate that private debt becomes public as a crisis unfolds. In other words, private debt is included as hidden debt.

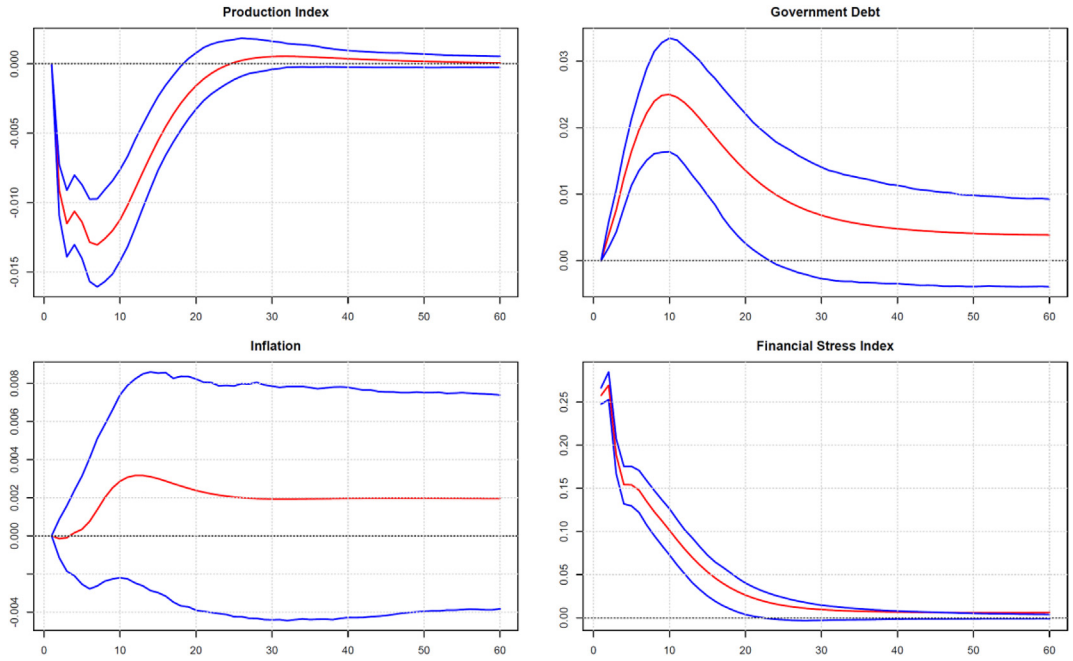

Fig. 11. Impulse responses to a positive FSI shock for the period January 1992–December 2007
Note: Impulse responses to a one-standard-deviation positive shock in the FSI. The red line represents the mean response, and the blue lines represent the 25%–75% confidence intervals.

positive one-standard-deviation shock in financial stress, based on the alternative ordering assumption.

As depicted in Fig. 10, the results are robust to the alternative ordering. These results show that the FSI is still important in driving production and government debt in Turkiye.

5.2. Subsample analysis: different period

Next, we examine whether the results are robust to the use of a different sample. To this end, we re-estimate the BVAR(3) model for the period January 1992–December 2007, before the global financial crisis following the collapse of Lehman Brothers. Fig. 11 demonstrates the impulse responses in the FSI after a positive one-standard-deviation shock.

Fig. 11 shows that the results of an increase in the FSI on production and government debt are similar to those of the baseline model. However, the estimated impulse response for this period reveals a larger increase in government debt because during this period Turkiye was heavily in debt, and two major crises occurred (in 1994 and 2001). Then, we rerun the BVAR(3) model for the period January 2010–December 2020, after global financial crisis. The results obtained were similar. Taken together, these findings all indicate that government debt is highly sensitive to increases in financial stress.

5.3. Alternative fiscal policy tools

Then, we re-estimated the BVAR (3) model with government spending, instead of government debt, as an alternative fiscal policy tool. The government expenditure data were obtained from the Central Bank of the Republic of Turkiye–Electronic Data Delivery System (CBRT-EDDS). The government spending is measured as the logarithmic change from a year earlier. The results are summarized in Fig. 12.

As shown in Fig. 12, the impulse-response results confirm the baseline results even though the model was estimated with a different fiscal policy tool. Despite the increase in the FSI, government spending declined at first but eventually surged significantly. The potential explanation of this result is that it is characteristic of countercyclical fiscal policy.[17] Indeed, fiscal policy makers respond to declining output by boosting government spending in high-stress periods.

5.4. Alternative extended FSI

We extended our financial stress index with idiosyncratic components of Turkiye. We excluded the VIX and NFCI variables from the FSI as they cannot be controlled by Turkish policy makers. We added external debt to our alternative extended FSI. As pointed by Çevik, Dibooğlu, and Kenc (2013), Çevik, Dibooğlu, and Kutan (2013) and Çevik, Dibooğlu, and Kenç (2016), external debt is vital for economic growth in emerging countries, and the rise in external debt raises concerns about debt sustainability. Therefore, we include the annual change in Turkiye's total external debt stock in our index.[18] We use the financial account balance in the balance of payments as a proxy for trade finance. Çevik, Dibooğlu, and Kenç (2016) and Kırcı-Çevik et al. (2018)

[17] As Kaminsky et al. (2004) state, fiscal policy is countercyclical in the sense that it tends to stabilize the business cycle (i.e., fiscal policy is contractionary in good times and expansionary in bad times).
[18] We used the cubic spline method to create the monthly external debt series because in Turkiye the total external debt stock data is measured quarterly.

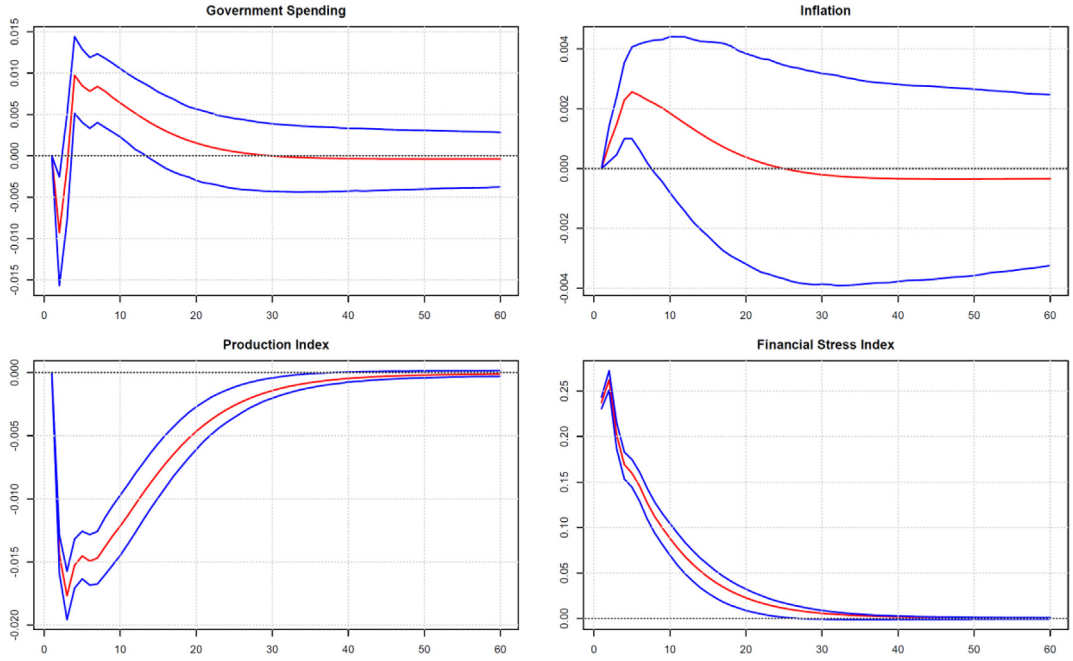

Fig. 12. Impulse responses to a positive FSI shock for an alternative fiscal policy tool
Note: Impulse responses to a one-standard-deviation positive shock in the FSI. The red line represents the mean response, and the blue lines represent the 25%–75% confidence intervals.

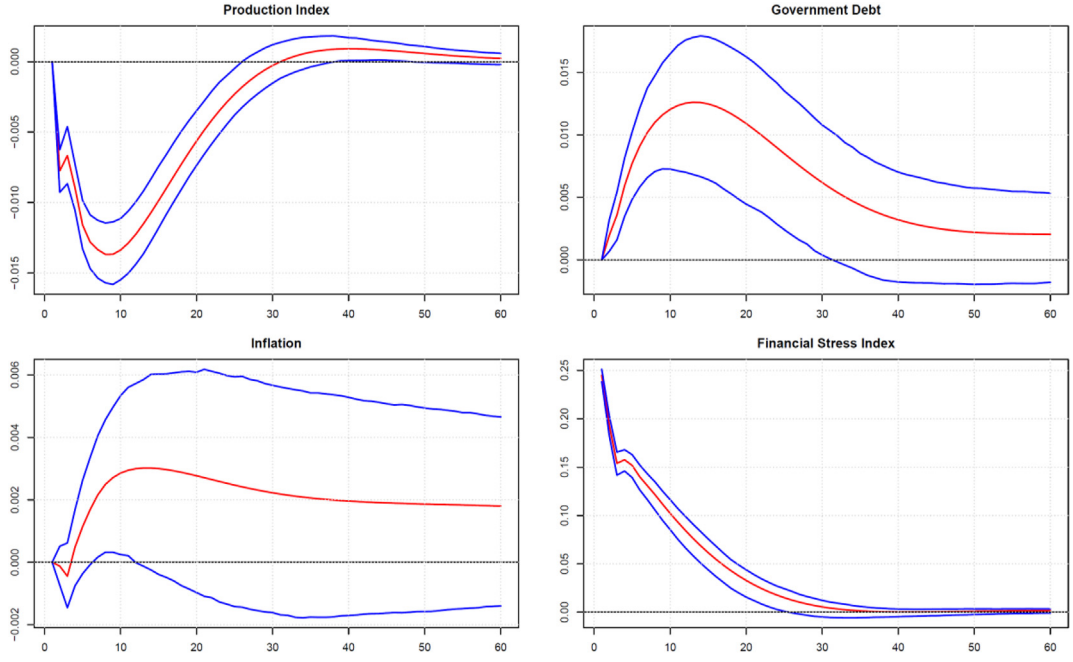

Fig. 13. Impulse responses of production index and government debt to a positive alternative extended FSI shock.
Note: Impulse responses to a one-standard-deviation positive shock in the FSI. The red line represents the mean response, and the blue lines represent the 25%–75% confidence intervals.

emphasize the need for a strong financial sector in terms of the real economy. Moreover, trade finance is a substantial component of financial stress in emerging countries. Additionally, we include the BIST Financial Sector Index volatility,[19] which represents the risk of the banking system[20] in the alternative extended FSI. The correlation coefficient between the alternative extended FSI and the FSI is 0.70.[21] Lastly, we re-estimate the BVAR(3) model with the alternative extended FSI. The results are presented in Fig. 13.

As seen in Fig. 13, the effects of a one-standard-deviation alternative extended FSI shock on the variables are similar to those in the baseline model. Taken together, the results are robust.

6. Conclusions and policy recommendations

This study analyzes the effect of financial stress on economic activity and government debt in Turkiye with a BVAR model based on a large sample from 1992 to 2020 on a monthly basis. The results of the study are clear. Financial stress is nonnegligible major factor. The results show that the effect of a positive shock in financial stress on economic activity and government debt is noteworthy. Specifically, financial stress dampens economic activity and increases government debt.

The sensitivity of economic activity and government debt to financial stress gives policy makers a vital roadmap. First, financial conditions must be monitored by policy makers because the state of financial markets provides important information in terms of the effectiveness of fiscal policy. Second, for the sake of overall financial stability, government debt must be stabilized because higher government debt can lead to greater vulnerability and fragility when financial stress is high. Otherwise, a permanent increase in government debt can cause difficulties in debt rollovers and contribute to an increase in financial stress. The responses of financial stress and economic activity to a positive government debt shock confirm these results. Third, lower government debt and ample fiscal space can provide more room for expansionary fiscal policy when economic activity declines. In short, ample fiscal space plays a critical role in reducing the impact of high financial stress, as the increase in economic activity also reduces government debt and financial stress. Indeed, the impulse responses indicate that an increase in economic activity reduces government debt and financial stress. Therefore, in Turkiye production-oriented fiscal policies are important in terms for reducing government debt and reducing sensitivity to financial stress.

[19] Due to insufficient BIST Banking Sector Index data, we used the BIST Financial Sector Index in the alternative extended FSI. The BIST Financial Sector Index includes banks and companies closely related to banks. Therefore, the BIST Financial Sector Index is a key element in determining the soundness of the financial sector.

[20] As Çalışkan et al. (2021) conclude, the top ten systemically important financial institutions account for more than 90% of total risk in Turkiye, where systemic risk comes primarily from large commercial banks. Therefore, we include the BIST Financial Sector Index in the alternative extended FSI.

[21] Our alternative extended FSI is available from the author upon request.

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Conflict of interest

The author declares that he has no conflict of interest.

APPENDIX.

Table 1
Variable descriptions and data sources.

Variables	Definition	Source
Production Index (PRO)	Production of total industry in Turkiye, Index 2015 = 100, logarithmic change from a year earlier	FRED-TURPROINDMISMEI
Inflation (INF)	Consumer price index: All items for Turkiye, Index 2015 = 100, logarithmic change from a year earlier	FRED-TURCPIALLMINMEI
Government Debt (D)	Central government gross debt, logarithmic change from a year earlier	Republic of Turkiye Ministry of Treasury and Finance
Government Spending (SPEND)	Central government spending, logarithmic change from a year earlier	EDDS
Interest Rate (INT)	Short-term market interest rate, logarithmic percentage change from a year earlier	FRED-TURLOCOSTORSTM
Exchange Rate (FX)	US dollar to Turkish lira, logarithmic change	CBRT-EDDS-TP.DK.USD.A.YTL
Borsa Istanbul (BIST)	Stock exchange, index, logarithmic change	CBRT-EDDS-TP.MK.F.BILESIK
Riskiness of Banking Sector (BS)	BIST Financial Sector, index, logarithmic change	CBRT-EDDS-TP.MK.F.MALI
External Debt (ED)	Gross external debt of Turkiye, logarithmic change from a year earlier	CBRT-EDDS-TP.DB.B01
Trade Finance (TF)	Financial account balance in the balance of payments, level, million USD	CBRT-EDDS-TP.ODANA6.Q13
Volatility Index (VIX)	Chicago Board Options Exchange market volatility index	FRED-VIXCLS
National Financial Conditions Index (NFCI)	Chicago FED national financial conditions index	FRED-NFCI

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