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Financial Stress and Effect on Real Economy: Turkish Experience

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Abstract
The core of this paper is an econometric estimation of the relation between financial stress and a number of macroeconomic variables (consumption, real GDP, investment, unemployment). This estimation is done on Turkish quarterly data for the period 2002–2021 using threshold vector autoregression (*i.e.*, TVAR). The paper observes the non-linear trade-off between financial stress and macroeconomic indicators. The effect of financial stress appears to be adverse when the stress level is already at a higher level. During high stress episodes, any further increase in financial stress drags economic growth down and the effect appears to be prolonged in nature. Consumption and investment growth also moderate due to a higher stress level. Furthermore, the forecast error decomposition indicates sustained contribution of financial stress impeding growth prospects over the forecast horizon. The findings corroborate with the financial friction mechanism. As borrowing constraint tightens during a high stress regime, the effect of financial stress moderates economic activities. Lastly, the paper extends a local projection approach for estimating a threshold VAR model as a robustness check.

Keywords: Financial stress index, threshold VAR model, Markov switching model, local projection, forecast error variance decomposition

JEL Classification: C01, C32, G01

1. Introduction

The Global Financial Crisis (GFC) heralded a new era of banking supervision in recent times. It underlined the greater role of financial risk in real economy. The crisis started from the United States mortgage market and translated into a full-blown financial market collapse by September

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2008. With the collapse of Lehman Brothers, the stock market plummeted drastically and the US economy slipped into an economic depression. Unemployment levels reached a record level and US households suffered a drastic loss of their wealth as asset prices crashed. In short, the Global Financial Crisis underlined the rippling effect of financial stress on real economic activities. Following the collapse of the global financial market during the GFC, macro-financial linkage became a major area of analysis and understanding the role of financial stress on real economic activities captured the headlines of central bank research. Turkey's experience was no exception. In this paper, we analyse the impact of financial stress on real economic activities through the lens of the Turkish economy using a threshold vector auto regression model.

The primary contribution of the paper is its focus on empirical evaluation of the relationship between financial stress and real economy. We use a novel financial institution stress index (following Yildirim, 2021) to quantify historical stress levels in the financial sector. He created it by utilizing 16 banking sector variables capturing the funding costs, profitability, asset quality, capital adequacy and contagion risks via the portfolio theory, which is the most contemporary weighting method. The portfolio theory gives more weight to the financial stress that occurs on several sub-markets simultaneously simply by taking time-dependent cross-correlations between sub-indices into account when aggregating sub-indices.

The spillover analysis of financial stress is motivated by the financial friction literature. The paper analyses the economic impact of financial friction using various macroeconomic variables. The empirical framework uses a threshold vector autoregression model (TVAR), highlighting the role of non-linearity in financial shock spillover. For that, the existence of a threshold is established, and a threshold VAR model is used to model the impact of financial stress under low stress and high stress regimes. However, the coefficient estimates of threshold VAR models may lack stability due to lack of data availability and the coefficient estimates may be sensitive to the choice of the estimation period. Hence, we introduce local projection estimation methodology for checking the robustness of the coefficient estimates. The local projection estimation approach in the TVAR model is relatively new. We use the local projection approach of Jorda (2005) and extend it to the TVAR model. Local projection estimation derives the coefficient estimates using ordinary least squares for each choice of lag values (including a lag of 0). The impulse response function is estimated by plotting the estimated coefficients from each lag regression. The application of local projection to an estimation system of equations has come into prominence recently (Ramey, 2016; Angrist *et al*., 2018; Nakamura and Steinson, 2018; Stock and Watson, 2018). Montiel Olea and Møller (2021) observed that local projection estimates are more stable under different assumptions about the underlying data-generating process. However, there is no unique estimation methodology available for determining the threshold value. In this paper, the threshold estimate is carried out using a Markov switching (MSVAR) model on a financial stress index following Hamilton (1989). The paper observes an asymmetric effect of financial stress on overall growth and domestic demand. Financial stress is found to impart significant moderation of consumption and real GDP growth when the stress level is already high. The effect is found to be muted in a lower stress regime. This observation follows the financial friction models.

This paper contributes to broadly two strands of literature. The first strand of literature that the paper fits in is the empirical studies investigating the relation between financial stress and economic activities. This is the first paper highlighting the non-linear impact of financial stress on economic activity based on the financial stress regime. This paper also contributes to empirical studies examining the transmission mechanism of financial stress on the real sector using forecast error variance decomposition to disentangle the effect of credit growth, inflation and financial stress on real GDP, consumption, investment, and unemployment. Lastly, the empirical estimation of the threshold VAR using the local projection method also contributes to the growing literature on the local projection method in a VAR framework.

The rest of the paper is organized as follows. Section 2 provides a literature review. Section 3 outlines the possible transmission mechanism followed by a demonstration of the empirical framework and estimation methodology. Section 4 describes the data and stylized facts. Section 5 is the empirical findings. Section 6 presents the robustness check, and the paper concludes by summarizing the findings in Section 7.

2. Literature Review

In this section, we briefly review the economic literature on this topic, focusing on studies that allow for linear and non-linear relationships between financial stress and the real economy. Table 1 provides a summary of the works that have been carried out so far.

Table 1: Studies analysing the relationship between financial stress and real economy

Authors	Variables	Methodology	Country
Illing and Liu (2006)	Financial Stress Index and Economic Activity Index	–/+ 2 standard deviation	Canada
Claessens *et al.* (2008)	The linkages between macroeconomic and financial variables (credit growth, asset and equity prices)	Identification of recessions using Harding and Pagan	21 OECD countries
Hakkio and Keeton (2009)	Industrial production and financial stress	Comparing post-crisis correlation with the pre-crisis ones	USA
Davig and Hakkio (2010)	Financial stress and real economy	MSVAR	USA
Elekdag *et al.* (2010)	Financial stress and economic activity	VAR	Turkey
Afonso *et al.* (2011)	Financial stress, macro, fiscal and financial variables	TVAR	USA, UK, Germany and Italy
Hubrich and Tetlow (2012)	Financial stress index, real activity, inflation and monetary policy	MSVAR	USA
Holló *et al.* (2012)	Financial stress, output and consumption	TVAR	Eurozone countries
Cevik *et al.* (2013)	Financial stress and industrial production index	VAR	Turkey

Source: The collection of the literature gathered by the authors

3. Transmission Mechanism and Empirical Framework

The relation between the real and financial sectors can be drawn from real business cycle (RBC) models. As the macroeconomic condition deteriorates due to productivity shock, the household savings are affected adversely, resulting in low savings and low investments. Furthermore, as economic downturn sets in, households and firms default, leading to banks' asset-liability mismatch and bank run occurs. In RBC models, the linkage between the financial sector and the real sector is therefore one-directional. The implications of financial shocks on the real sector are drawn from the financial friction model. Following the friction literature, any financial shock can impact on real economic activities through three major channels: (i) the balance sheet effect of borrowers, (ii) the balance sheet effect of banks and other financial institutions, and (iii) the liquidity channel. The bank balance sheet effect can be triggered by two main sub-components: (i) the bank lending channel and (ii) the bank capital channel. Following Bernanke and Blinder (1988), the bank lending channel can be invoked as contractionary monetary policy affect banks' balance sheet on the asset and liability side. The bank balance sheet effect can also emerge in the case of a bank's capital loss (Holmstrom and Tirole, 1997). Any credit crunch therefore leads to lack of credit supply and as credit supply moderates, the aggregate demand also moderates.

Finally, the liquidity channel concentrates on the banks' liquidity condition in addressing credit demand. As discussed in the seminal works of Fisher (1933), Diamond and Dybvig (1983), and Diamond and Rajan (2005), banks opt for a fire sale of their assets in the case of any solvency shocks. The fire sale reduces the asset price, which further shrinks banks' assets, leading the banks to more asset sales. It leads to a liquidity channel impact in the event of a bank run.

The other endogenous variable is domestic inflation, which contains a direct impact of financial stress on domestic price movements and an indirect proxy of asset prices. Baker and Wurgler (2006), Bansal and Yaron (2004), He and Zong (2021) and Hakkio and Keeton (2009) observed that financial stress impacts on fundamentals of asset prices in a statistically significant manner. Assenza *et al*. (2009) also augments the Philips curve with asset price due to the monetary cost channel.

In view of the above mechanisms, we postulate a four-variable vector autoregression model with financial stress, credit supply, domestic inflation, and real economic activity to assess the impact of financial stress.

3.1 Threshold VAR model

Following the financial friction literature, the financial frictions amplify the economic downturn when the borrowing constraint binds. Higher financial stress is expected to amplify the asset price movements and thereby may result in a balance sheet impact. However, the same mechanism may not be true for regimes with low financial stress. In particular, low financial stress may not evoke the adverse asset price movements and, thereby, the financial friction mechanism is likely to be absent. With this background, we rule out the linearity assumption for assessing the impact of financial stress and introduce non-linearity in the VAR model. The simplistic VAR model with a non-linear trade-off can be achieved using a threshold VAR model. The threshold VAR model inhibits multiple different VAR models depending upon the regime. In a two-regime model, the regimes are defined in terms of a threshold variable. When the threshold variable crosses a particular threshold, then the data-generating process moves into a high regime and a VAR model from the high regime is used to explain the endogenous interactions among variables. The threshold variable can be endogenous or exogenous in nature. In this paper, we propose to use the level of financial institution stress to determine the regimes. This assumption helps make intuitive interpretation about the regimes.

Further to the threshold variable, the subjectivity lies with the choice of the optimal number of regimes. We follow the extension proposed by Lo and Zivot based on Hansen's (1996) approach to determine the optimal number of regimes from the data. We test for linearity under two regimes and linearity under three regimes with the optimal lag length of one quarter[1]. The optimal number of regimes is found to be two from our data. Following the choice of the number of regimes, the threshold VAR model for consumption, investment, real GDP, and unemployment growth can be written in the following way[2], where Δ stands for quarter-on-quarter growth. Here, ϕ_1^L and ϕ_1^H are coefficient matrices of the order (4 × 4) for the lower regime and the higher regime respectively, and ϕ_0^L and ϕ_0^H are constants (level shifter of the order 4 × 1) in the lower and the higher regime.

$$\begin{bmatrix} \Delta FISI_t \\ \Delta Credit_t \\ \pi_t \\ \Delta C_t \end{bmatrix} = \begin{cases} \phi_0^L + \phi_1^L \begin{bmatrix} \Delta FISI_{t-1} \\ \Delta Credit_{t-1} \\ \pi_{t-1} \\ \Delta C_{t-1} \end{bmatrix} + \epsilon_t^L & \text{if } FISI_{t-1} < \overline{FISI} \\ \phi_0^H + \phi_1^H \begin{bmatrix} \Delta FISI_{t-1} \\ \Delta Credit_{t-1} \\ \pi_{t-1} \\ \Delta C_{t-1} \end{bmatrix} + \epsilon_t^H & \text{if } FISI_{t-1} \geq \overline{FISI} \end{cases} \tag{1}$$

$$\begin{bmatrix} \Delta FISI_t \\ \Delta Credit_t \\ \pi_t \\ \Delta Y_t \end{bmatrix} = \begin{cases} \phi_0^L + \phi_1^L \begin{bmatrix} \Delta FISI_{t-1} \\ \Delta Credit_{t-1} \\ \pi_{t-1} \\ \Delta Y_{t-1} \end{bmatrix} + \epsilon_t^L & \text{if } FISI_{t-1} < \overline{FISI} \\ \phi_0^H + \phi_1^H \begin{bmatrix} \Delta FISI_{t-1} \\ \Delta Credit_{t-1} \\ \pi_{t-1} \\ \Delta Y_{t-1} \end{bmatrix} + \epsilon_t^H & \text{if } FISI_{t-1} \geq \overline{FISI} \end{cases} \tag{2}$$

1 We consider a lag length of one following the quarterly frequency of our data and to accommodate a higher number of regimes.

2 We do not include all the outcome variables in the threshold VAR due to limited data availability. As the number of variables increases, the parameter space explodes exponentially.

$$\begin{bmatrix} \Delta FISI_t \\ \Delta Credit_t \\ \pi_t \\ \Delta I_t \end{bmatrix} = \begin{cases} \phi_0^L + \phi_1^L \begin{bmatrix} \Delta FISI_{t-1} \\ \Delta Credit_{t-1} \\ \pi_{t-1} \\ \Delta I_{t-1} \end{bmatrix} + \epsilon_t^L & \text{if } FISI_{t-1} < \overline{FISI} \\ \phi_0^H + \phi_1^H \begin{bmatrix} \Delta FISI_{t-1} \\ \Delta Credit_{t-1} \\ \pi_{t-1} \\ \Delta I_{t-1} \end{bmatrix} + \epsilon_t^H & \text{if } FISI_{t-1} \geq \overline{FISI} \end{cases} \tag{3}$$

$$\begin{bmatrix} \Delta FISI_t \\ \Delta Credit_t \\ \pi_t \\ \Delta U_t \end{bmatrix} = \begin{cases} \phi_0^L + \phi_1^L \begin{bmatrix} \Delta FISI_{t-1} \\ \Delta Credit_{t-1} \\ \pi_{t-1} \\ \Delta U_{t-1} \end{bmatrix} + \epsilon_t^L & \text{if } FISI_{t-1} < \overline{FISI} \\ \phi_0^H + \phi_1^H \begin{bmatrix} \Delta FISI_{t-1} \\ \Delta Credit_{t-1} \\ \pi_{t-1} \\ \Delta U_{t-1} \end{bmatrix} + \epsilon_t^H & \text{if } FISI_{t-1} \geq \overline{FISI} \end{cases} \tag{4}$$

where $FISI_t$ is the financial stress index from Yildirim (2021); *Credit* represents total credit supply to the commercial sector; π_t is the domestic inflation proxy by GDP deflator; C_t is the consumption at the time t, I_t is the real investment at the time t, Y_t is the real GDP at the time t, and U_t is the unemployment at the time t. The threshold VAR model is estimated using the conditional least square approach.

As indicated previously, the impact of financial stress is examined using the impulse response function. The impulse response analysis in VAR models calculates the expected values of the variables defined in the system in the face of an external shock. In order to describe the effect of shocks, the system must be defined as a vector moving average (VMA) model.

$$Y_t = \mu + \varepsilon_t + \sum_{i=1}^{\infty} \emptyset_i (L) \epsilon_{t-i} \tag{5}$$

However, under the regime change, the VMA model cannot be modelled linearly in terms of shocks. Therefore, the impulse response analysis should be calculated with the magnitude and direction (whether they are positive or negative) of the shocks as well as the initial period information set. The impulse response function for the non-linear model is conditional on the entire history of the variables and the size and direction of the shock. To that end, we decide to use the method developed by Balke (2000) that calculates nonlinear generalized impulse response functions under alternative regimes using bootstrap simulations.

$$IRF_k = E\,[Y_{t+k} \mid \Omega_{t-1}, e_t] - E\,[Y_{t+k} \mid \Omega_{t-1}] \tag{6}$$

Here, $\boldsymbol{Y_{t+k}}$ is the vector of endogenous variables in the period k and Ω_{t-1} is the information set before the period when the t shock is applied. The formula indicates that the impulse response function depends on the initial conditions and there is no limit on the symmetry of shocks.

3.2 TVAR with local projection

One of the major disadvantages of the threshold VAR model is that the parameters to be estimated in each model increase exponentially as the number of regimes rises. Hence, it requires a longer history of variables to obtain robust estimates of the parameters, namely the unbiased standard errors of the coefficients under heteroscedasticity. In view of the lack of quarterly data for our analysis, we use a local projection approach to estimate the threshold VAR model at different horizons. The local projection method is adopted following Stock and Watson (2018) as well as Miranda and Agrippino (2021) using the threshold value from the Markov switching model.

The local projection method estimates the coefficients of contemporary effects (*i.e.*, a lag value of 0) and lagged effects (*i.e.*, a lag value greater than 0) using ordinary least squares. Equation (7) illustrates the threshold VAR equation for each choice of lag k. For each choice of k, coefficient estimates are derived from Equation (7) using ordinary least squares separately. The impulse response is derived by plotting each coefficient estimates from $\phi_1^{L,k}$ against k for the lower regime and coefficient estimates from $\phi_1^{H,k}$ for the upper regime. The major difference between local projection and conventional estimation of the TVAR is reflected in the impulse response function. In conventional estimation of TVAR models, the impulse responses are generated as infinite mov-ing average representation, whereas the impulse response is generated from estimated coefficients from the estimation of Equation (7) at each lag value k. The standard error of the impulse response is generated using non-parametric bootstrap. The local projection estimation uses available data for estimation of the coefficients and, thus, coefficients for longer lag effects use fewer data points compared to shorter lag lengths. However, variation of estimation window length does not pose any imminent challenge to the coefficient estimates (Montiel Olea and Møller, 2021). Thus, we supplement local projection estimates for validating the robustness of our findings using the direction and significance of the effect of financial stress from the estimated impulse response function of the local projection estimates.

$$\begin{bmatrix} \Delta FISI_{t+k} \\ \Delta Credit_{t+k} \\ \pi_{t+k} \\ \Delta C_{t+k} \end{bmatrix} = \phi_0^{L,k} \mathbf{I}_{FISI<\overline{F}ISI} + \phi_1^{L,k} \begin{bmatrix} \Delta FISI_{t-1} \\ \Delta Credit_{t-1} \\ \pi_{t-1} \\ \Delta C_{t-1} \end{bmatrix} \mathbf{I}_{FISI<\overline{F}ISI} + \phi_0^{H,k} \mathbf{I}_{FISI\geq\overline{F}ISI} + \phi_1^{H,k} \begin{bmatrix} \Delta FISI_{t-1} \\ \Delta Credit_{t-1} \\ \pi_{t-1} \\ \Delta C_{t-1} \end{bmatrix} \mathbf{I}_{FISI\geq\overline{F}ISI} + \epsilon_t \forall k = 0,\ 1,\ 2,\ \ldots,\ H \quad (7)$$

Equation (7) is estimated for every horizon k (k = 0, 1, …, H). In view of the quarterly frequency of our data, we restrict H to eight quarters. Here, $\phi_1^{L,k}$ and $\phi_1^{H,k}$ are the coefficient matrix of the order 4 × 4 whereas $\phi_0^{L,k}$ and $\phi_0^{H,k}$ are constant terms of the order 4 × 1 for each choice of lag k.

4. Data and Stylized Facts

We take consumption, real GDP, investment, and unemployment as measures of economic activity. We also use the credit growth and domestic inflation rate to provide a plausible linkage between financial stress and economic activity. We obtained the data from the Turkish Statistical Institute (TUIK) for the period 2002:12–2021:12 with quarterly frequency.

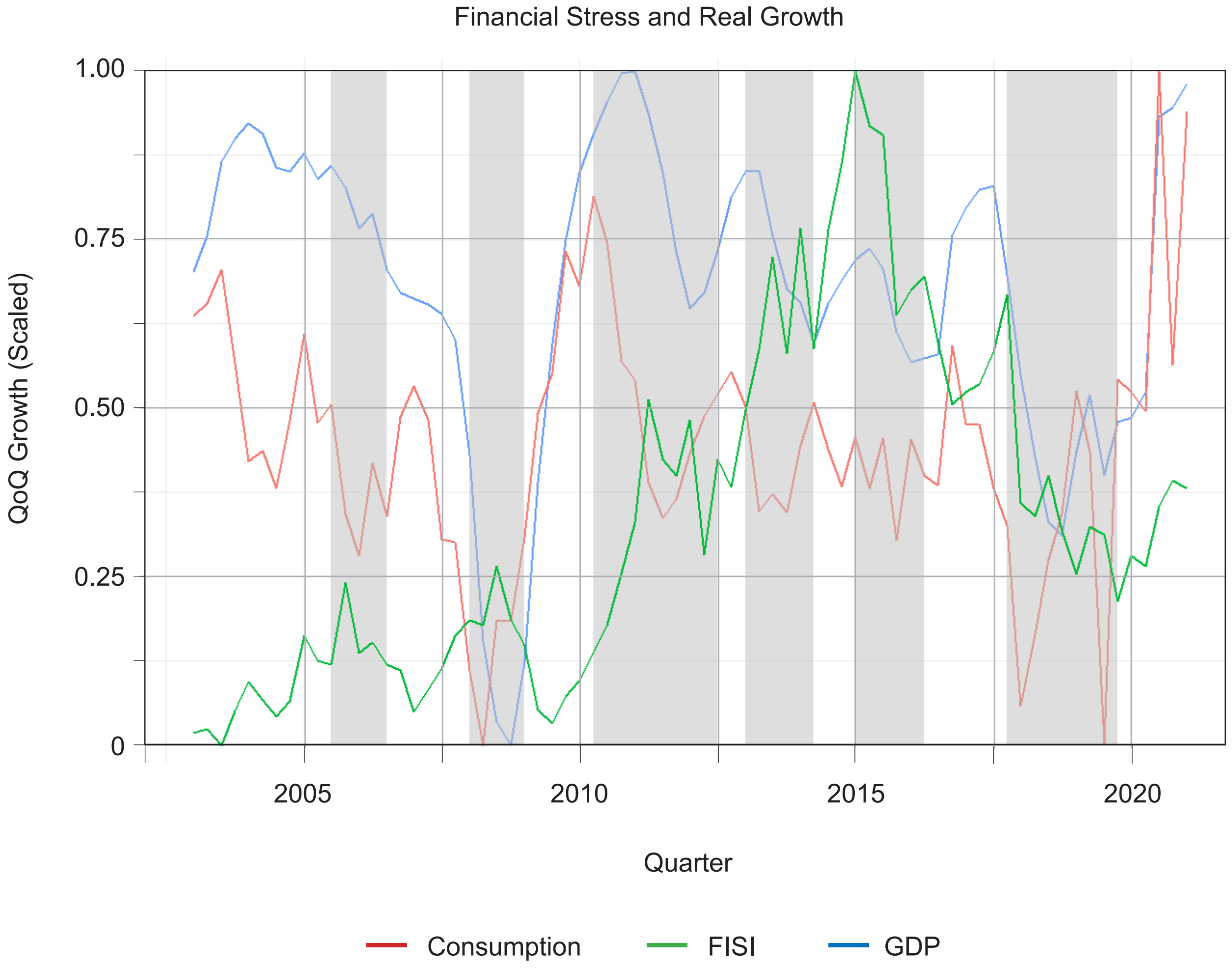
Table 2: Summary statistics of stationary variables

	Min	Q1	Median	Mean	Q3	Max
Real GDP	–7.07	3.51	5.85	5.37	8.43	11.20
Nominal GDP	0.36	12.98	15.30	16.33	19.00	41.88
FISI	–72.02	–24.35	8.79	20.76	48.70	190.08
Credit	–2.15	18.46	24.84	27.83	35.38	68.74
Consumption	–9.25	2.01	5.53	5.33	8.10	23.31
Inflation	3.91	7.32	8.18	10.40	12.27	27.97
Investment	–35.25	0.81	8.99	8.21	14.70	45.81
Unemployment rate	8.20	9.80	10.20	10.56	11.00	16.10

Source: Turkish Statistical Institute (TUIK)

The effect of financial stress is illustrated on the consumption growth and real GDP growth. Due to possible non-linearity in the trade-off between financial stress and real economy, we analyse the growth pattern in different phases of financial stress. The turnaround points of financial stress are identified using the Harding-Pagan approach for quarterly data. The growth patterns are then analysed for the phases when financial stress moves from peak to trough and from trough to peak. The shaded regions in Figure 1 represent the trough-to-peak transition of financial stress, *i.e.*, these episodes signify the period when financial stress moves from low stress to high stress regimes. As the stress moves from a lower to a higher level, both real GDP growth and consumption growth moderate visibly. This supports our hypothesis of possible non-linearity in the trade-off between financial stress and economic activities. In the next section, we try to establish the differential impact of financial stress on real GDP growth and consumption growth using econometric models.

Figure 1: Real GDP and consumption growth during financial stress cycle



Source: Turkish Statistical Institute (TUIK)

5. Findings

We use the threshold VAR model on the quarterly data to assess the impact of financial stress on real economy using quarterly data since 2003. For that, the optimal number of thresholds is determined using the Hansen test. The level of financial stress with a delay of one quarter is considered the threshold variable. We build three different models for financial stress impact on real GDP growth, consumption growth, investment growth, and unemployment growth. For that, we compare the linear model with two thresholds and three thresholds for VAR models with lags of one and two quarters. We restrict our model selection with a minimum lag length and a minimum number of regimes to ensure robustness in the estimates.

Following Table 3, we confine our model with two regimes and one quarter lag value.

Table 3: Threshold determination using LR test

	linear vs two regimes	linear vs three regimes
Lag length of one quarter		
Test statistic	71.24*	4,215.77***
***p*-value**	(0.08)	(0.00)
Lag length of two quarters		
Test statistic	108.28***	4,178.01***
***p*-value**	(0.00)	(0.00)

Source: Turkish Statistical Institute (TUIK)

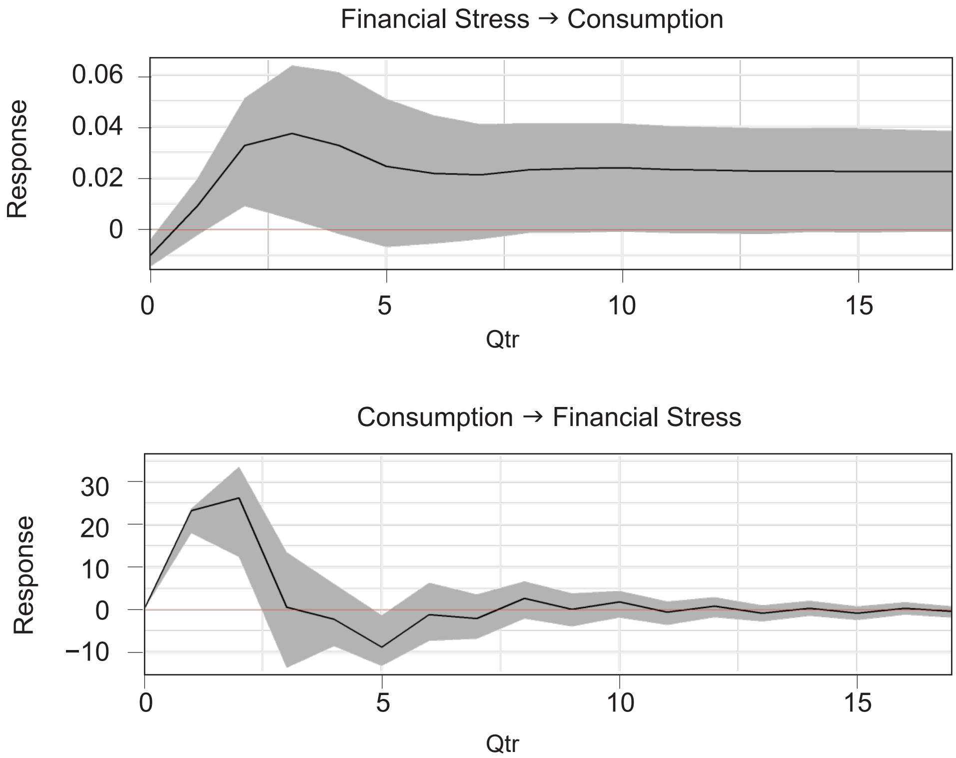
With the model selection, the parameters of endogenous variables were estimated for the two regimes (we call these two regimes the high and the low regime). The threshold value of financial stress level was found to be 0.03[3].

We start with the consumption and investment impact first since the friction channel of financial stress impacts on the real economy through consumption and investment growth. To understand the impact of financial stress, we analyse the impulse responses by giving one standard deviation shock on the change of financial stress and measuring the impact on consumption and investment growth in the high stress and low stress regimes. Towards the end of the findings, we also focus on the overall impact of financial stress on real GDP growth.

Figure 2 illustrates the response of consumption growth and financial stress on each other in a low stress regime. This response function provides us with insight into the possible feedback mechanism occurring between financial stress and consumption growth. When the overall stress level is low, the consumption growth appears to decline immediately as financial stress increases, and the effect is found to be statistically significant at 95% confidence. However, in the longer horizon, the impact turns to positive and lasts for about five quarters. The response of consumption growth to one standard deviation shock in the change of financial stress reaches its maximum level, which is 1%. On the other hand, an increase in consumption growth appears to be reducing the stress level. This phenomenon follows a typical business cycle model, where higher financial stress does not impede real economic activities as the overall stress level remains low. The financial friction mechanism remains absent in this process as the borrowing constraint does not bind.

3 The threshold of financial stress index corresponds to a scaled value of the financial stress index. The scaling of the financial stress index is done using the Z-score of the FISI index value over time.

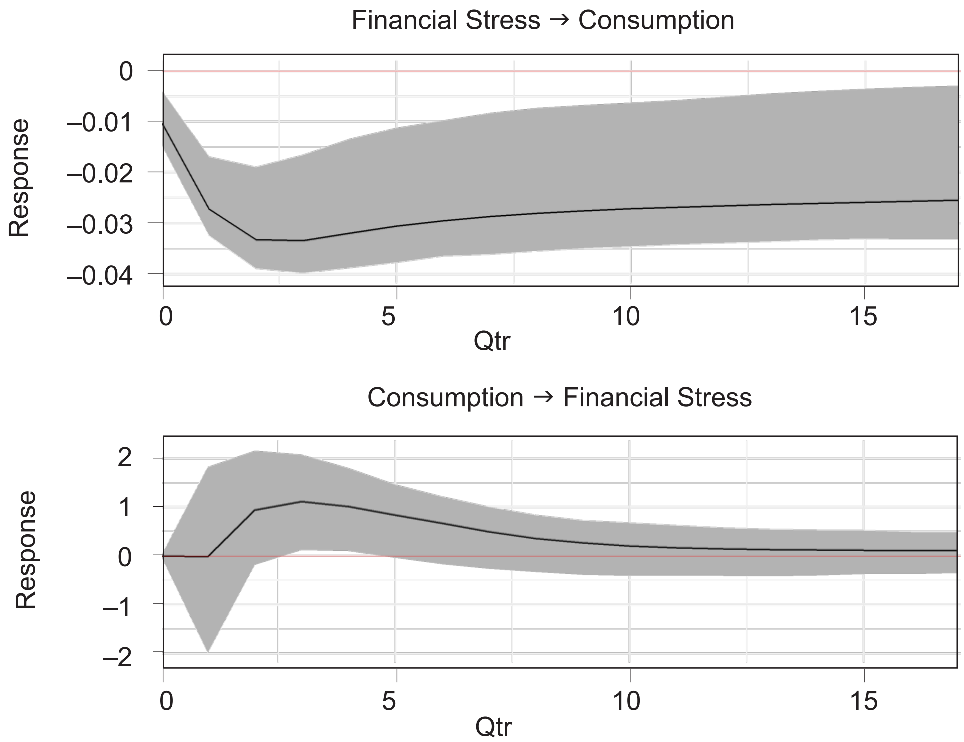
Figure 2: Impulse response from TVAR for lower regime



Source: Turkish Statistical Institute (TUIK)

Contrary to the low stress regime, the impact of financial stress on the higher regime imparts a contractionary effect on consumption growth and the effect stays for five quarters (Figure 3). The response of consumption growth to one standard deviation shock in the change of financial stress hits its maximum level, which is almost 1%. When the consumption shock is applied during the high stress regime, the financial stress increases further, and the effect is statistically significant over a longer period of time (Figure 3). The contraction in consumption due to high financial stress is justified through the lens of financial friction models when the stress level is already high. Higher financial stress induces financial institutions to apply a strict borrowing constraint. As the borrowing constraint binds, the financial friction kicks in, moderating the consumption growth.

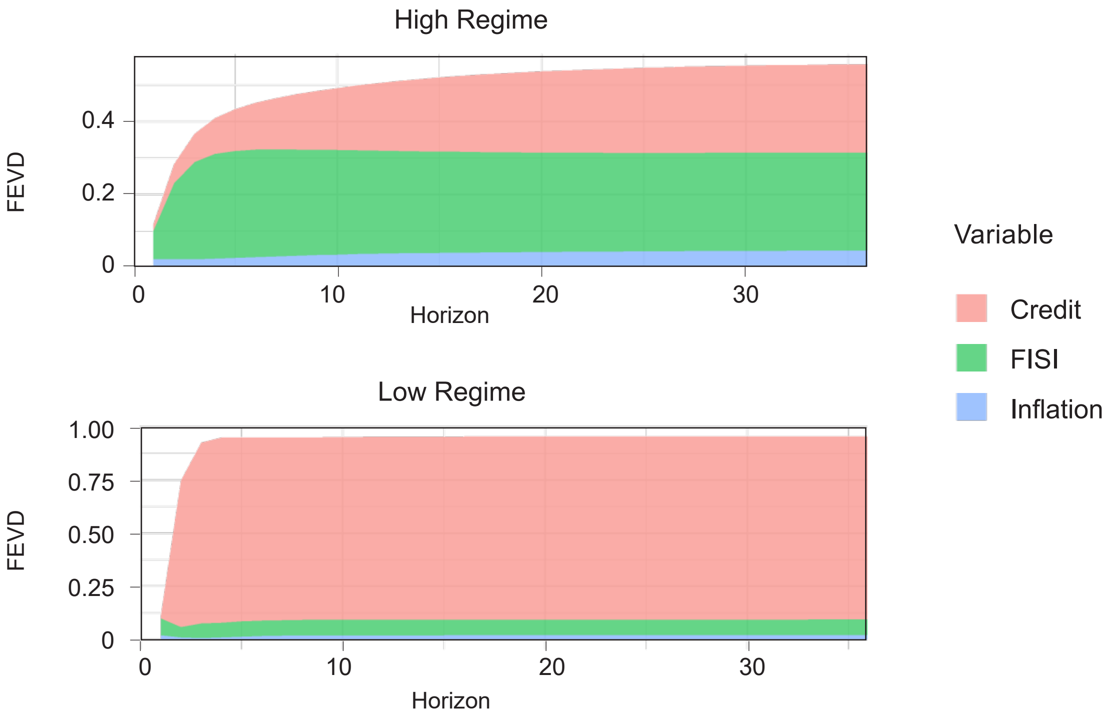
Figure 3: Impulse response from TVAR for upper regime



Source: Turkish Statistical Institute (TUIK)

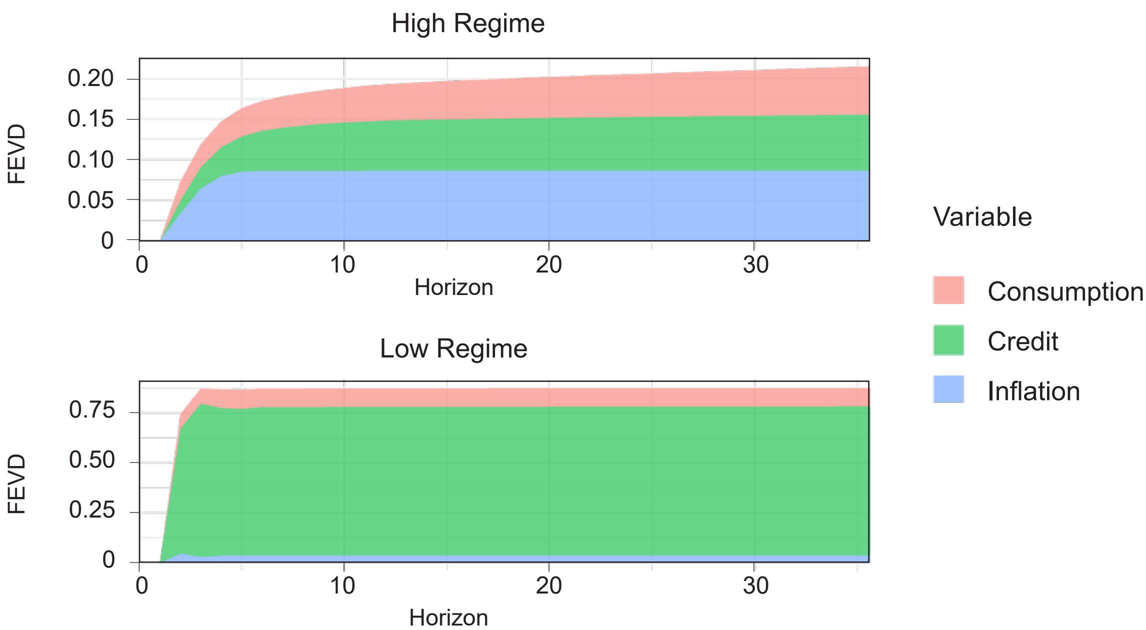
We move to the forecast error variance decomposition in the high stress and low stress regimes for consumption growth and financial stress. The forecast error of consumption growth is contributed to by the significant extent of financial stress over different forecast horizons when the stress level is already high. In fact, the contribution of financial stress outpaces the contribution of credit growth and domestic inflation, implying the dominant effect of binding constraint during the high stress regime (Figure 4). The dominance of financial stress on consumption growth continues when the financial stress level is relatively lower. Shifting to forecast error variance of financial stress, the effect of consumption growth and credit growth is noticeable when the stress level is higher. While consumption growth is the dominant factor in the high stress regime, credit growth is the one in the low stress regime (Figure 5). These findings corroborate with the credit channel effect of financial friction models. The lingering effect of financial stress on consumption growth implies that the binding nature of the borrowing constraint remains effective as higher stress forces financial institutions to maintain a strict borrowing constraint.

Figure 4: Forecast error variance decomposition of consumption growth



Source: Turkish Statistical Institute (TUIK)

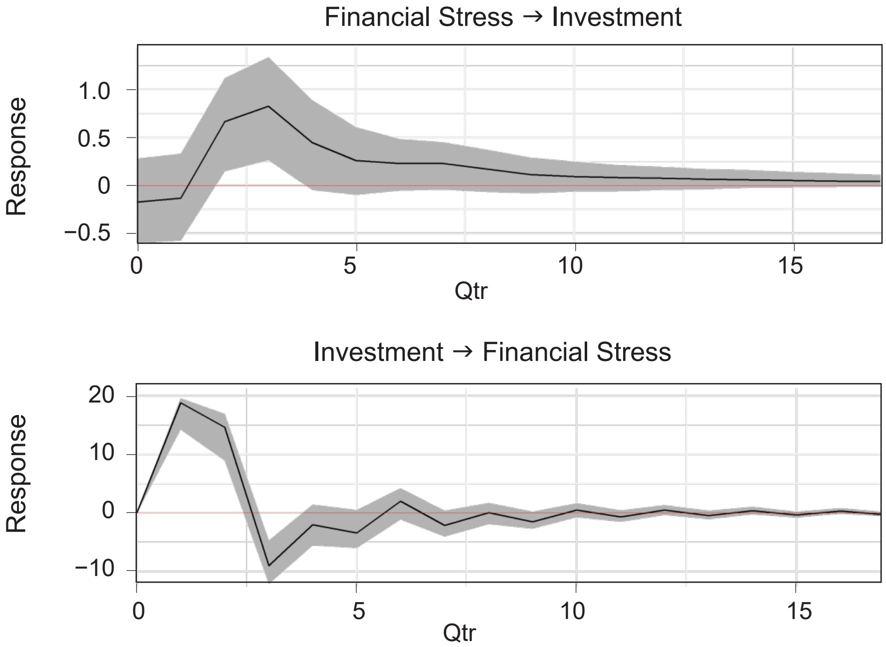
Figure 5: Forecast error variance decomposition of financial stress



Source: Turkish Statistical Institute (TUIK)

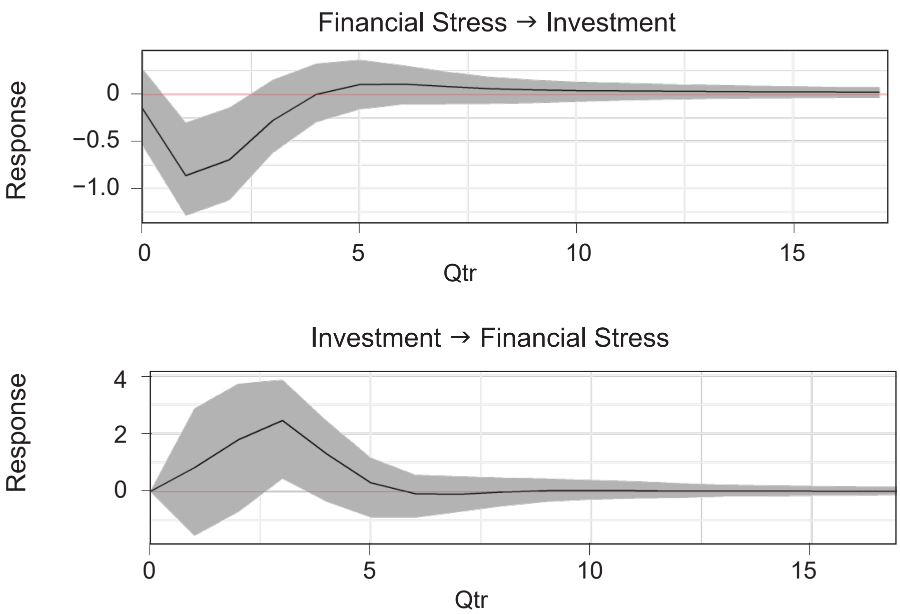
The effect of financial stress on investment growth is similar to the case of consumption (Figures 6 and 7). During the high stress regime, the impact of financial stress on investment growth changes its direction since the fifth quarter. On the other hand, higher investment growth increases financial stress by almost ten quarters. The forecast error variance decomposition of investment growth also displays a pattern similar to that of consumption growth (Figures 8 and 9).

Figure 6: Impulse response from TVAR for lower regime



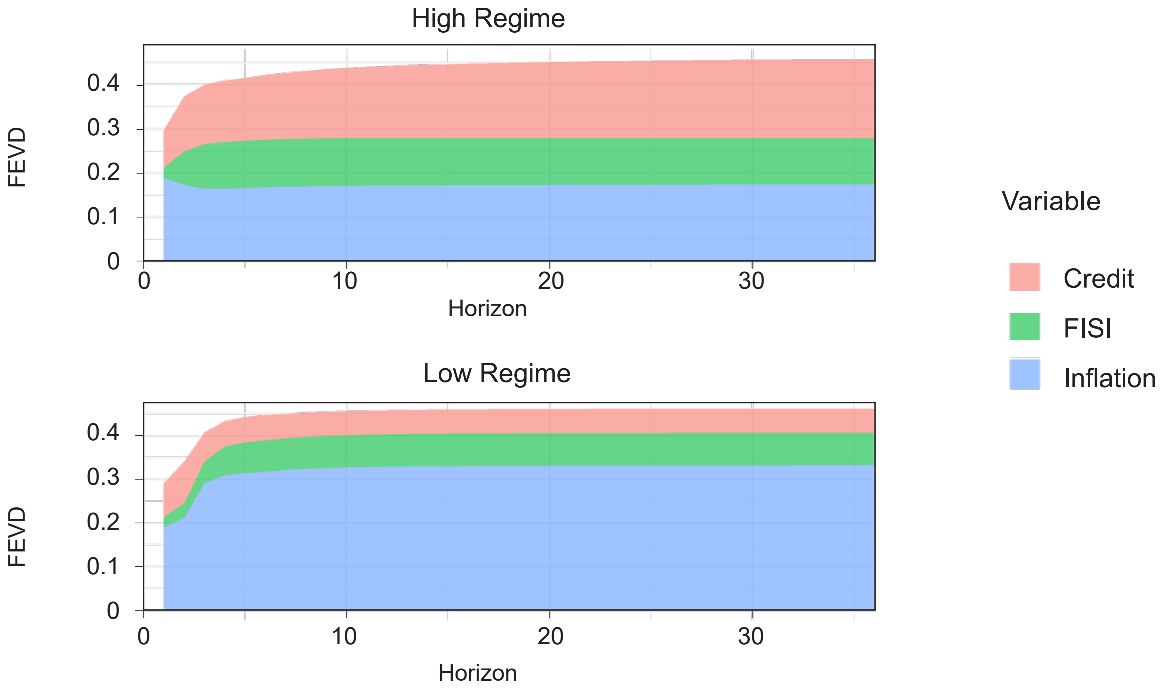
Source: Turkish Statistical Institute (TUIK)

Figure 7: Impulse response from TVAR for upper regime



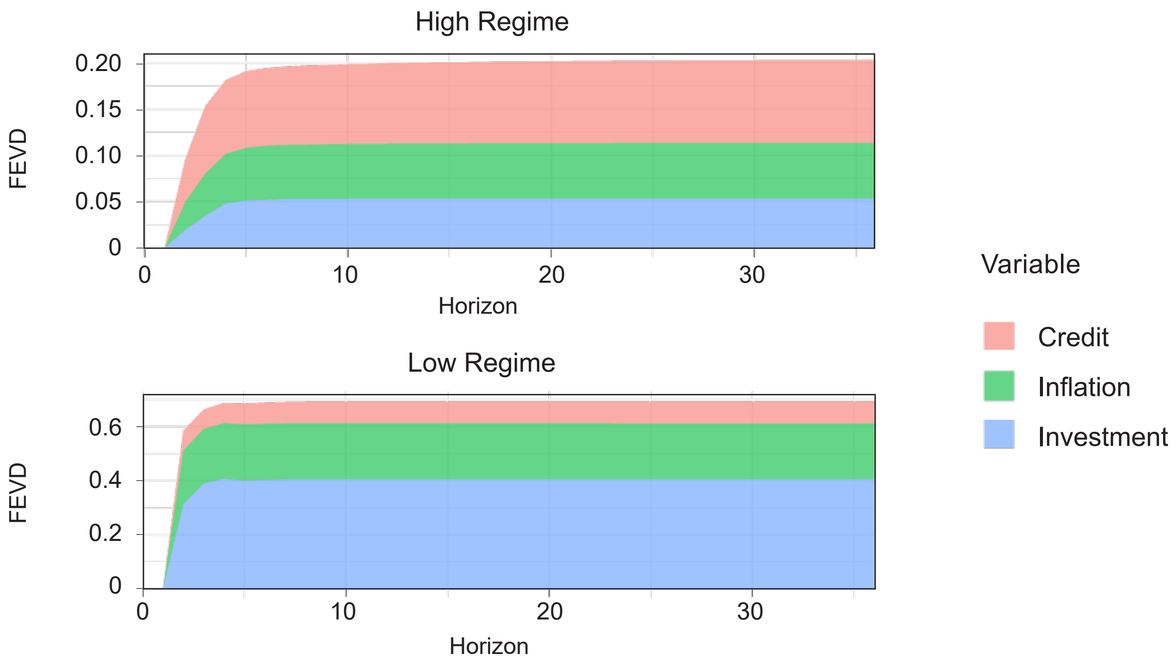
Source: Turkish Statistical Institute (TUIK)

Figure 8: Forecast error variance decomposition of investment growth



Source: Turkish Statistical Institute (TUIK)

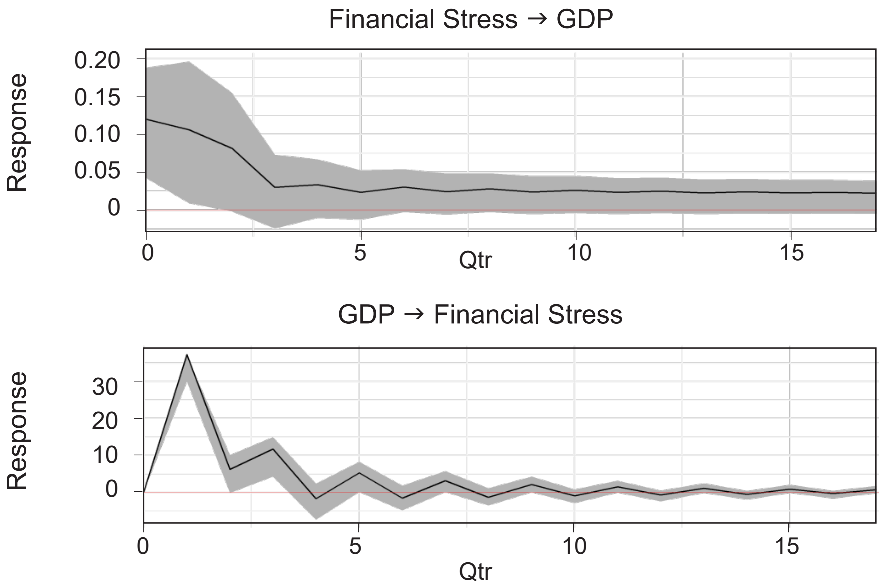
Figure 9: Forecast error variance decomposition of financial stress



Source: Turkish Statistical Institute (TUIK)

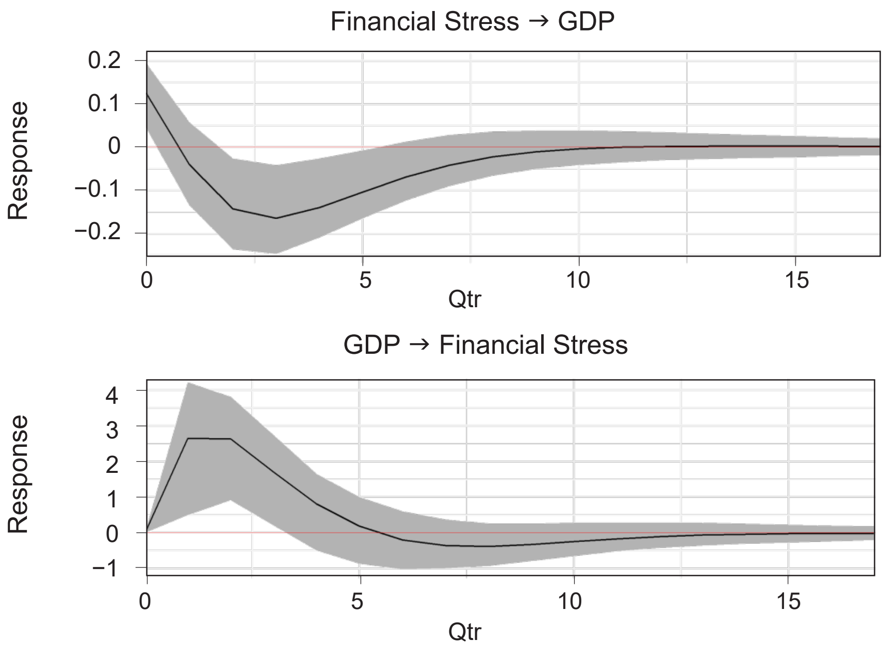
Then, we analyse the effect of financial stress on real GDP growth. In the case of the low stress regime, the impact is statistically insignificant for all the horizons (Figure 10). During the high stress regime, real GDP growth contracts in response to higher financial stress until the tenth quarter (Figure 11). Unlike consumption and investment growth, the domestic inflation is the highest contributing factor on real GDP growth during the higher stress regime (Figure 12). On the other hand, real GDP growth dominates the movement of financial stress during the low stress regime (Figure 13).

Figure 10: Impulse response from TVAR for lower regime



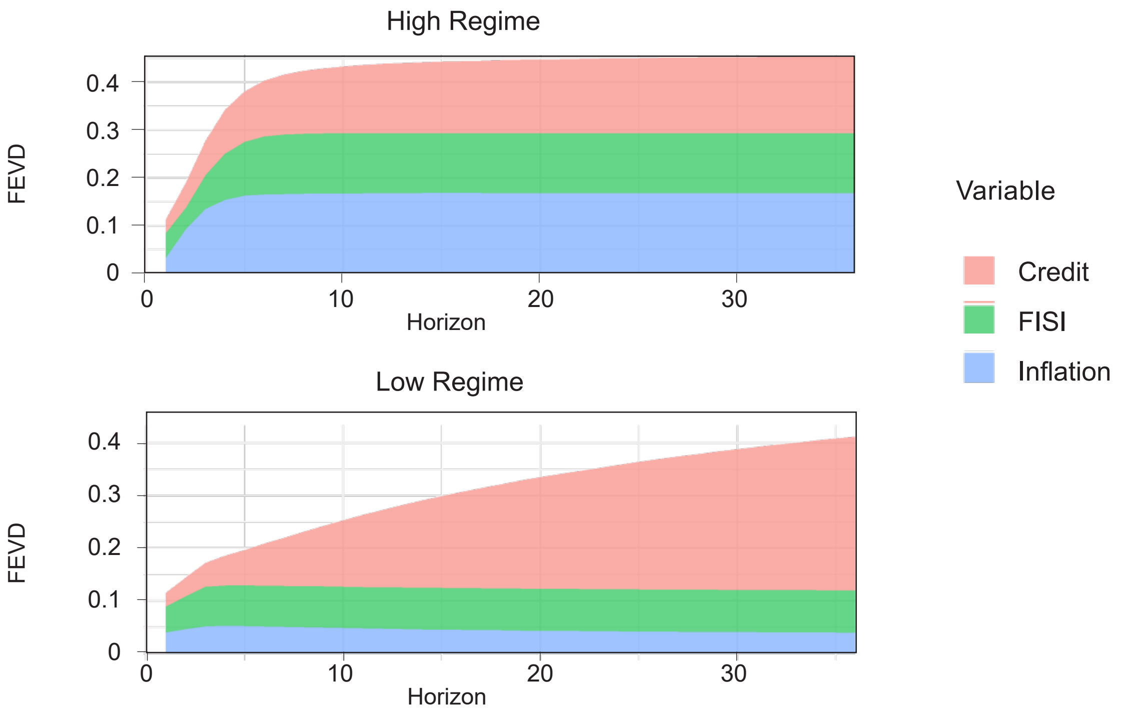
Source: Turkish Statistical Institute (TUIK)

Figure 11: Impulse response from TVAR for upper regime



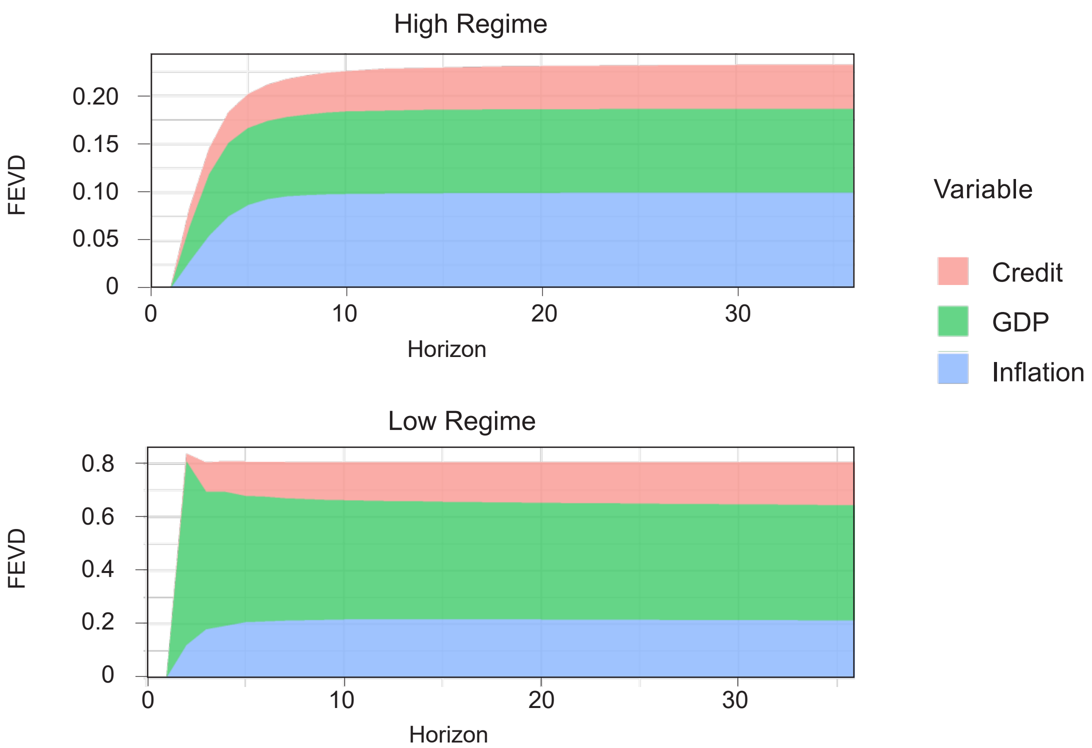
Source: Turkish Statistical Institute (TUIK)

Figure 12: Forecast error variance decomposition of real GDP growth



Source: Turkish Statistical Institute (TUIK)

Figure 13: Forecast error variance decomposition of financial stress



Source: Turkish Statistical Institute (TUIK)

Lastly, we analyse the impact of financial stress on the unemployment rate. Unlike real GDP growth or its components, the effect of financial stress on the unemployment rate remains less prominent. During the low stress regime, although financial stress initially leads to a rise in unemployment, it loses its significance after a while. However, we observe quite the opposite situation for the effect of unemployment on financial stress (Figure 14). While the economy is in the high stress regime, the effect is statistically insignificant for all the horizons (Figure 15).

Figure 14: Impulse response from TVAR for lower regime

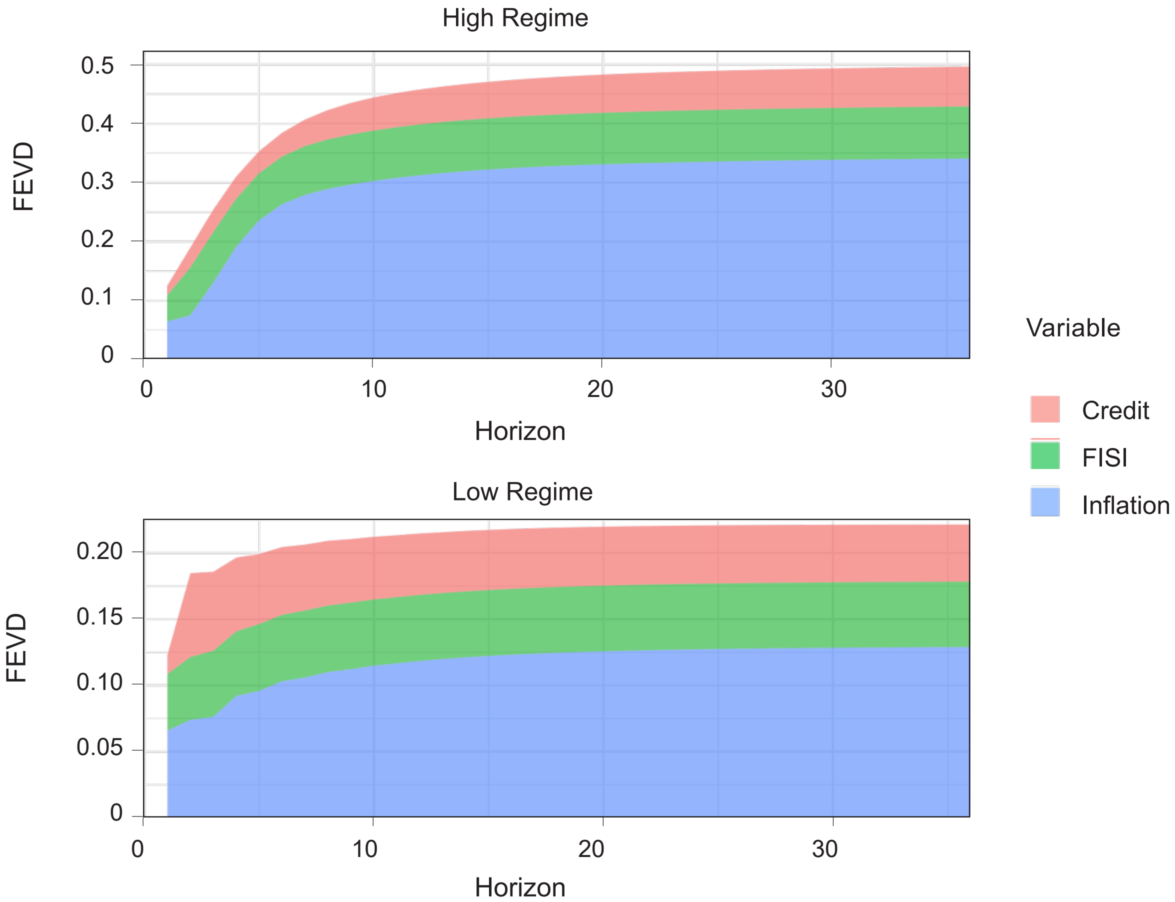
Source: Turkish Statistical Institute (TUIK)

Figure 15: Impulse response from TVAR for upper regime

Source: Turkish Statistical Institute (TUIK)

The forecast error variance decomposition of the unemployment rate indicates a range-bound contribution of financial stress in both regimes, which implies a persistent direct effect from financial stress. On the other hand, the indirect effect resulting from domestic inflation contributes significantly to the unemployment rate over a longer forecast horizon (Figure 16).

Figure 16: Forecast error variance decomposition of unemployment growth



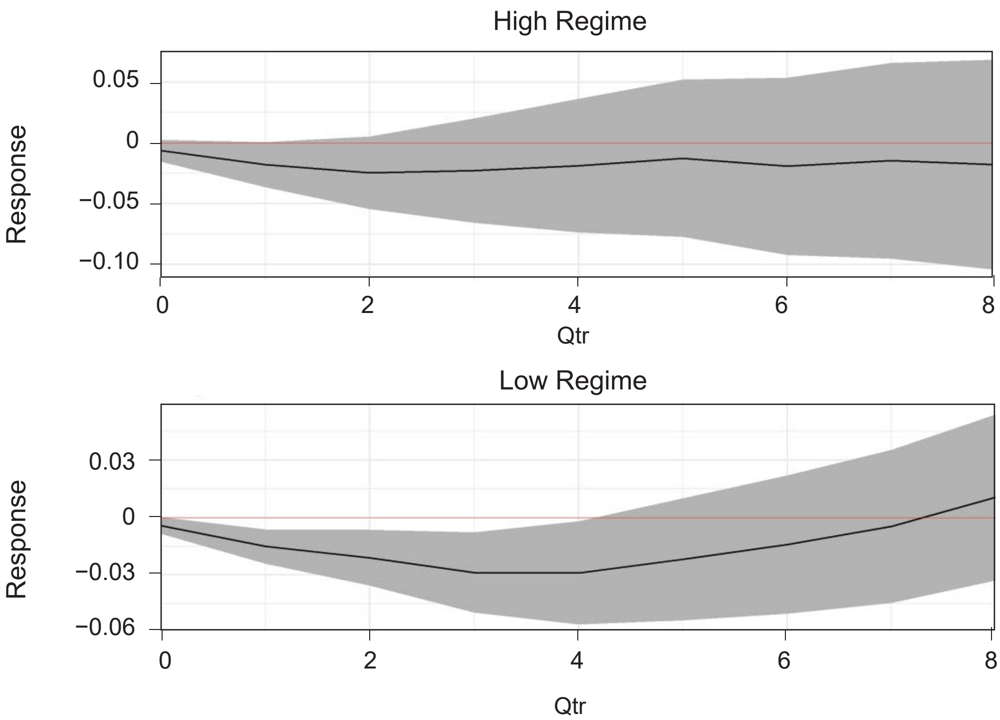
Source: Turkish Statistical Institute (TUIK)

6. Robustness

In this section, we present the findings of the threshold VAR estimates using the local projection method. We estimate the threshold level using the Markov switching model on financial stress and apply the local projection method on threshold estimates. The estimation code of the threshold VAR using the local projection (LP) method broadly follows Stock and Watson (2018) as well as Miranda-Agrippino and Ricco (2021) using the threshold value from the Markov switching model. The basic idea behind local projections, as proposed by Jorda (2005), is to estimate the impulse responses separately at each horizon by a direct regression of the future outcome on current covariates opposite to the standard VAR models which estimates the impulse responses with respect to a recursive orthogonalization of the reduced-form forecast errors. The benefit of using the LP method is that it does not make any structural assumption among the endogenous variables. However, one of the major disadvantages of the LP approach is that different parameter estimates for different horizons are based on different numbers of data points. The impulse responses are derived from LP estimates for values above and below a threshold. Here we present the parametric impulse responses for both regimes in the case of consumption and real GDP[6].

The impulse response of LP estimates corroborates with the conventional estimation. These impulse responses correspond to one unit of positive shock on financial stress (compared to one standard deviation shock in previous analysis). Following Figure 17 for real GDP effect, we observe that the GDP growth moderates significantly when the financial stress is already high, whereas the effect is not significant in the case of low financial stress.

Figure 17: Impulse response from TVAR for real GDP



Source: Turkish Statistical Institute (TUIK)

7. Concluding Remarks

The Global Financial Crisis, which emerged in the economies of developed countries in 2008 and spread to developing countries, underlined the severity of the impact of the financial sector on real economy. Using quarterly data since 2002 onward, we analysed the effect of financial stress on several macroeconomic variables.

The empirical framework used the likelihood ratio test to test for possible non-linearity in the trade-off between financial stress and economic activities. Following the acceptance of non-linear feedback, we used the threshold VAR model with two regimes to differentiate the effect of financial stress on macro economy. The regimes were identified using the financial stress level with a delay of one quarter. Lastly, we employed the local projection mechanism to estimate the threshold VAR model for validating the robustness of the findings.

Using the two-regime threshold VAR model, we observed that the financial stress impedes real economic activities when the stress level is already high. The effect appears to be less pronounced in the lower stress regime. This is an indication of the non-linear nature of the trade-off between financial stress and economic slowdown.

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